SECOND IN A SERIES

A Technical Development Strategy for Creating Interoperability between Navy Applications to Support Technical Product Data Management

A Report by
The S1000D-SCORM Bridge Project Team

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NAVAL ENTERPRISE
THE BRIDGE PROJECT
LITTORAL COMBAT SHIP

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1 Executive Summary

This report is one deliverable from an Office of the Secretary of Defense (OSD) Reduction in Total Ownership Costs (RTOC) project. OSD awarded funding to the Littoral Combat Ship (LCS) Mission Module Program. Known as "The Bridge Project", the project is implementing ways to improve technical and learning content integration processes from a Naval enterprise perspective. OSD's Advanced Distributed Learning Initiative is managing The Bridge Project and is expected to conclude in April 2011.

The scope of this report extends The Bridge Project's objectives by developing a set of high level use cases and recommended follow-on tasks focused on improving the interoperability among Navy systems used to develop, manage, and distribute technical product data (TPD). TPD is defined as all logistics data needed to support the operation and maintenance of a system or equipment. For the purposes of this report, TPD includes: Engineering Operational Sequencing System (EOSS) Manuals, Planned Maintenance System (PMS) Data, Technical Manuals (TM), Training Material, Configuration Data, and Engineering Drawings. The Bridge Project focuses interoperability between learning content development tools and common source databases.

The objective of this report is to support the improvement of the Navy change management practices by identifying processes and data exchanges that facilitate the identification of all impacted TPD during design of a planned equipment or system modification. This will support automated data updates across all TPD when applicable, and will reduce the lag time for TPD development and updates. Overall benefits to the Navy include:

- Seamless integration of Naval enterprise applications that support TPD.
- Accurate and consistent data across all products.
- Uniform process for identifying data affected by design changes.
- Reduced cycle time for delivery of all TPD, supporting increased readiness.
- Less deficiency reporting from the user based on outdated shore or shipboard TPD.

Naval Enterprise Vision for Product-Relevant Digital Assets

The Navy operates a streamlined enterprise product data environment, guaranteeing accurate maintenance, operational and learning content to support human readiness.

See Section 4.1

Naval Enterprise Strategy for Product-Relevant Digital Assets

Enable automated technical product data exchange between applications used to develop, manage and distribute product data for the DoD enterprise.

See Section 4.2

Tactical Problem Statements

Based on the vision and strategy statements, the team developed a set of Tactical Problem Statements. Each Tactical Problem Statement represents one issue or set of related issues that can inhibit the realization of the vision.

See Section 4.3

Use Cases

After initial review of the technical product processes, the team defined a generic 5-stage lifecycle model that describes a set of common services for each type of TPD. Because of the broad scope of this strategy, multiple Navy systems exist that provide the services identified in the lifecycle model.

See Section 5

Findings and Next Steps

The team performed a gap analysis between the Naval Enterprise Vision and the data exchange use cases stated in the report. The result is a list of follow-on tasks prioritized in a logical order that best enables opportunities for improved product data interoperability between Navy systems.

See Section 8.1

- Inclusion of training data in product life cycle management.

The report objectives were accomplished by evaluating and documenting the lifecycle processes for various TPD and identifying areas where process efficiencies could be introduced to improve the quality and timeliness of product delivery to the ship and potentially reduce cost. The TPD lifecycle processes are supported by a number of different processes, technologies, and systems based on a multitude of variables such as ship class, technical product type, program and/or command.

In order to understand some of the complexity of this problem, a generalized process framework for TPD was constructed. This framework provides a baseline from which the effectiveness of any one TPD development and delivery process can be evaluated.

The initial findings identified many opportunities for improvement. Additionally, it is clear that all TPD lifecycle process permutations could not be represented in this report to the extent required to propose a detailed solution. Therefore, the report findings are supported by a list of recommended activities that can be performed to elaborate on the details of this report.

The following conclusions were derived from this effort:

- Many systems, some new, some legacy, are currently being used to support the TPD lifecycle processes.
- Some systems (CDMD-OA, TDMIS, Contenta - the Navy content management system, etc.) are well established and could potentially be more effectively utilized.
- Some systems, such as TDKM, provide an essential set of services that could be extended to additional TPD types.
- The same fundamental services are being provided by similar systems (TDMIS, PMS MIS, EOSS Accountability, NAFL) for different TPD types or different commands, and the opportunity to consolidate should be considered.
- The data exchange between systems is in many cases manual and in some cases non-existent.
- The coordination and synchronization across TPD for a specific change is not easily managed or audited.
- Navy enterprise services and systems can include training as TPD.

2 Project Scope, Motivation, and Objectives

2.1 Project Scope

This report was initiated to support the Littoral Combat Ship (LCS) Mission Module Program to explore ways to improve technical and learning content integration. The scope is to develop a set of high-level use cases and recommended follow-on tasks focused on improving the interoperability among Navy systems used to develop, manage, and distribute TPD. TPD is defined as all logistics data needed to support the operation and maintenance of a system or equipment. For the purpose of this report, TPD includes Engineering Operational Sequencing System (EOSS) Manuals, Planned Maintenance System (PMS) Data, Technical Manuals (TM), Training Material, Configuration Data, and Engineering Drawings.

The scope of this report becomes very complex when the many different systems involved in the development, management, distribution, and use of TPD throughout the Navy are considered. This is amplified by the fact that there are multiple systems utilized within a certain functional area, and different systems may be used for similar functions based on command (e.g., NAVSEA, NAVAIR), type of ship (e.g., carriers, surface ships, or submarines), or even ship class. In order to address this complexity, this report outlines a generalized process or approach to tackling the TPD interoperability problem and uses representative systems to illustrate the issues and identify areas that require further investigation. The intent is to document an approach and framework that can be used to define additional detailed use cases based on specific systems and functional areas and highlight areas of commonality. The use cases will be a guide that can be used to make decisions on potential consolidation of system functionality or development of system enhancements to expand the scope of particular systems to other functional areas.

2.2 Project Motivation

To train and support sailors to operate and maintain the fleet in rapidly changing technical environments requires TPD of many types to be efficiently exchanged among enterprise applications then quickly updated and distributed to the right people at the right time in the right format. A large portion of TPD is in varied formats and managed in disparate databases.

TPD is often divided into subsets. EOSS, PMS, and TMs are defined as Technical Data that is managed in separate databases by the technical authorities (e.g., In-service Engineering Agents (ISEAs)) for the equipment or system. The data for training and configuration management are also managed in separate databases by experts in these data areas. The development of TPD relies on the receipt of accurate engineering data that is usually developed and managed by a different group—the design group in a Computer-Aided Design (CAD) system.

Current processes and systems used in the development and management of TPD do not maintain a consistent, established relationship between engineering data and related technical data, or between technical data and related training material to facilitate change management. Typically, this data is updated by logistics groups after receipt of revised engineering or technical data identifying an equipment or system change. The change notification process is informally managed through the distribution of completed technical data updates that are typically distributed to users as CD-ROMs or printed material. Updates are dependent upon updated engineering and technical data getting to the correct personnel to make changes. Frequently, updates are driven by Fleet feedback identifying gaps or deficiencies.

The challenge is to develop a set of systems and system data exchanges that will facilitate the development, management (including change management), distribution, and use of TPD while reducing inconsistent or inaccurate data, rework, manual data entry, and update cycle time.

2.3 Project Objectives

The objective of this report is to support the improvement of the Navy change management process by identifying processes and data exchanges that facilitate the identification of all impacted TPD during design or modification. This requires relating the TPD to the appropriate equipment through key data elements during product development then maintaining these relationships in the Navy programs of record when the TPD is delivered to the Navy and throughout the lifecycle of the product. A logical view

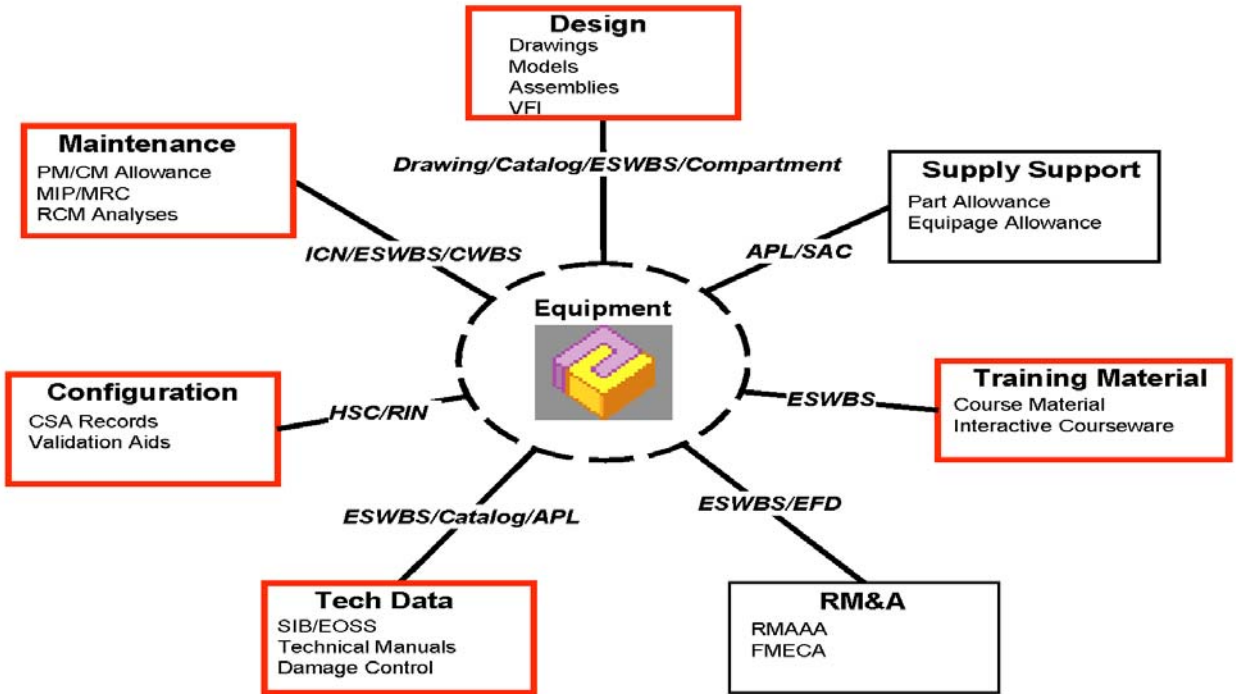


Figure 1. Relating Technical Product Data to Equipment

of these key relationships is shown in **Figure 1**. The TPD discussed in this report is a subset of the overall logistics data maintained over the lifecycle as depicted in Figure 1. This report focuses on the highlighted areas of Design, Training Material, Tech Data, Configuration, and Maintenance. Supply Support and RM&A products, although not directly addressed, are used as critical input to areas such as maintenance and the development of the configuration baseline.

Maintaining these relationships throughout the equipment lifecycle will require enhancing the stored metadata and data exchange capabilities between technical data, training material, configuration data, and engineering applications to foster consistency of related data. This synchronization of data will facilitate automated updates across applicable TPD and reduce lag time between TPD development and updates. Overall benefits to the Navy include:

- Seamless integration of Naval enterprise applications that support TPD.
- Accurate and consistent data across all products.
- Uniform process for identifying data affected by design changes.
- Reduced delivery time for TPD, supporting increased readiness.
- Less deficiency reporting from the user based on outdated shore or shipboard TPD.
- Much need configuration of technical training content.

The report goals were:

1. Document problem statements that encompass the issues associated with the inability to identify, for the purpose of automated update, all TPD associated with a specific system or equipment. Section 4 provides a description of the Strategic Vision and Tactical Problems Statements.
2. Develop a set of use cases for the development and implementation of a specification that will:
   - Provide a high level overview of the processes and systems that are used to create, update, review and approve, and distribute all TPD to the ship.
   - Identify candidate integration points among Navy systems.

- Identify metadata fields in the applicable Navy systems that will facilitate change identification and configuration management.
- Normalize data element names across Navy systems.

Section 6 includes a summary of a representative set of the use cases that generalize the current processes. Section 7 provides the details of these use cases.

3. Recommend follow-on tasks including changes to existing Navy applications and /or processes, to be used as input for future projects. Section 8 contains the recommendations.

3 Project Planning

The project is a government-industry collaboration and is reflected in the organizational structure:

Main Project Lead
Wayne Gafford
Advanced Distributed Learning, OSD
Lead Writer
Michael Olson
Northrop Grumman Technical Services

3.1 Project Team

Working in other projects and community user groups, participants have recognized the need for data interoperability between content management systems and product data environments that factor in training requirements. Sponsorship for data exchange implementations diagrammed in the use case section will be sought. It is anticipated this team will evolve into a group with strategic competencies in the areas of:

- Relevant international specifications and standards (S1000D, SCORM, Product Life Cycle Support (PLCS)).
- Systems acquisition.
- Database management.
- User requirements gathering.
- Business rules.

3.2 Meetings

The project team met twice during the planning project:

- Advanced Distributed Learning, Alexandria, Virginia; June 3-4, 2009.
- Advanced Distributed Learning, Alexandria, Virginia; July 22-24, 2009.

Teleconferences were arranged in August, October and December to report on progress.

3.3 Participating Organizations

Representatives from the following organizations were part of the report team.

Advanced Distributed Learning
Wayne Gafford
Jason Haag

Intelligent Decision Systems, Inc.
Glenn Handrahan

Intergraph
Ted Briggs

Naval Surface Warfare Center, Port Hueneme
Adam Holland

Naval Surface Warfare Center, Carderock Division-Ships Systems Engineering Station
Bernie Coval
Nang Tran

NAVAIR
Robert Sharrer

Northrop Grumman Shipbuilding–AMSEC
Mike Turcotte
Phil Deuell
Dana McKnight
Joe Garner

Northrop Grumman Technical Services
Michael Olson

4 Naval Data Enterprise Vision, Strategy, and Tactical Problem Statements

At the initial project planning meeting in Alexandria, Virginia, the team composed a strategic vision and a set of tactical problem statements describing issues that currently impede the strategic vision. The vision and problem statements are the foundation for developing use cases and functional requirements that define both process and capability solutions for the stated problems and advance the overall vision.

The Strategic Vision provides a broad view across the Department of Defense (DoD) enterprise where TPD is integrated throughout all phases of development and support. The Tactical Problem Statements describe issues with the current state of TPD integration that inhibit achievement of the Strategic Vision.

4.1 Naval Enterprise Vision for Product-Relevant Digital Assets

The Navy operates a streamlined enterprise product data environment, guaranteeing accurate maintenance, operational and learning content to support human readiness.

4.2 Naval Enterprise Strategy for Product-Relevant Digital Assets

Enable automated technical product data exchange between applications used to develop, manage and distribute product data for the DoD enterprise.

This strategy includes several key points. First, it involves *automated* technical data *exchange*.

- *Automated* emphasizes eliminating redundant manual input to save time and improve data quality.
- *Exchange* implies capitalizing on standard data exchange formats to improve data quality, reduce costs with standardized schemas and automated validation/exchange mechanisms, and increase data reuse among systems.

Automated exchange of integrated technical data will facilitate communication and data sharing among disciplines (e.g., between design and logistics, between design and manufacturing) as well as among Navy organizations (e.g., Program Executive Officers, NAVSEA, ISEAs, shipyards, training commands, etc.), commercial shipyards, integrators, and suppliers.

Second, emphasis is placed on *technical product data* being exchanged *throughout the lifecycle* of the product.

- *Technical product data* denotes all the technical data, including metadata, required to develop and maintain a specific product throughout its lifecycle.
- *Throughout the lifecycle* emphasizes improving data exchange and interoperability, not only during development of the TPD, but also through the management and distribution of the data to the Fleet and through changes and updates in the lifecycle of the product.

Automated TPD exchange will enable a change management process based on automated identification of change impacts to support cost/benefit analyses, design trade studies, and impact analysis on design and/or logistics changes, thus enabling an overall reduction in the cost to evaluate and implement changes and the ability to develop higher quality end products.

Lastly, the strategy can be expanded across the broader *DoD enterprise* as opposed to being limited to the Navy or even a ship class-specific solution. A wider view of the problem and potential solutions encourages the Navy to leverage work accomplished by other services as well as the commercial and international communities to solve current Navy challenges (e.g., leveraging the commercial and international work being performed with the S1000D and STEP AP239 Product Life Cycle Support (PLCS) international standards).

4.3 Tactical Problem Statements

Based on the vision and strategy statements, the team developed a set of Tactical Problem Statements. Each Tactical Problem Statement represents one issue or set of related issues that can inhibit the realization of the vision. These tactical problems serve as a focal point for deriving a set of use cases and functional capabilities that, when implemented, will promote the realization of the vision.

These problem statements are not intended to be an exhaustive list of problems but are foundation issues and should be reconciled first in order to move forward. There may be many more issues, both organizational and system related that could be addressed in future projects.

4.3.1 Tactical Problem Statement 1

The ability to identify and discover sharable and reusable product data does not exist.

To facilitate reuse, a standard repository or set of repositories is required that allows the data and products to be discoverable by internal and external applications and users. Effective reuse requires that the data is in small enough "pieces" so that it can be reused and that standard processes and metadata exist for storing, searching, retrieving, and updating the content.

4.3.2 Tactical Problem Statement 2

Existing product data has insufficient metadata to support data discovery, reuse and sharing.

In order to discover, reuse, and/or share data across applications and organizations, the data must be tagged with sufficient metadata to facilitate effective search and retrieval. This metadata must be understood across different organizations, domains, and applications.

4.3.3 Tactical Problem Statement 3

Data element names and schemas across applications are inconsistent.

Using common schemas facilitates the search and discovery process and enforces a common use of metadata that can be used to discover, reuse, and share data. Common schemas facilitate the exchange of data across applications by eliminating multiple point-to-point interfaces and reducing the need to map attributes and relationships between multiple applications.

4.3.4 Tactical Problem Statement 4

There is no unified process in place that identifies all information products impacted by a design change.

Identification of change impacts is a labor intensive, error-prone process. It usually requires extensive manual investigation to identify all the dependencies and related products affected by a specific change. A further complication is that several organizations and domain areas may be responsible for products impacted by a change. Employing a common approach to change impact identification using standard data exchange and product data linking mechanisms can reduce this cost of change and facilitate more accurate change implementation.

4.3.5 Tactical Problem Statement 5

Ship programs use different methods to transfer product data to the DoD enterprise.

Across ship programs there is a common need to deliver product data for the as-designed and as-built ship to the Navy for use in the design, manufacture, operation, and maintenance of the ship. Due to the diverse set of applications used to design and build the ship, this data is produced in various formats and then translated to other formats for delivery to the Navy. This involves many point-to-point interfaces developed specifically for each ship class. Many times, the data is dispersed to several different Navy systems and relationships among the data that may have existed in the design and build environments are lost when the data is transferred to the Navy. Once in the Navy enterprise, this loss of data relationships can lead to inaccurate information over time because of inadequate mechanisms to identify change impacts to the data.

5 Use Case Development Framework

This section presents the framework that provides the context for all use cases documented in sections 6 and 7. After initial review of the technical product processes, the team defined a generic 5-stage lifecycle model that describes a set of common services for each type of TPD.

Because of the broad scope of this strategy, multiple Navy systems exist that provide the services identified in the lifecycle model. In order to present the use cases in practical terms, representative Navy system were identified for each technical product deliverable. Data flow diagrams for each technical product lifecycle identify the points of integration be-

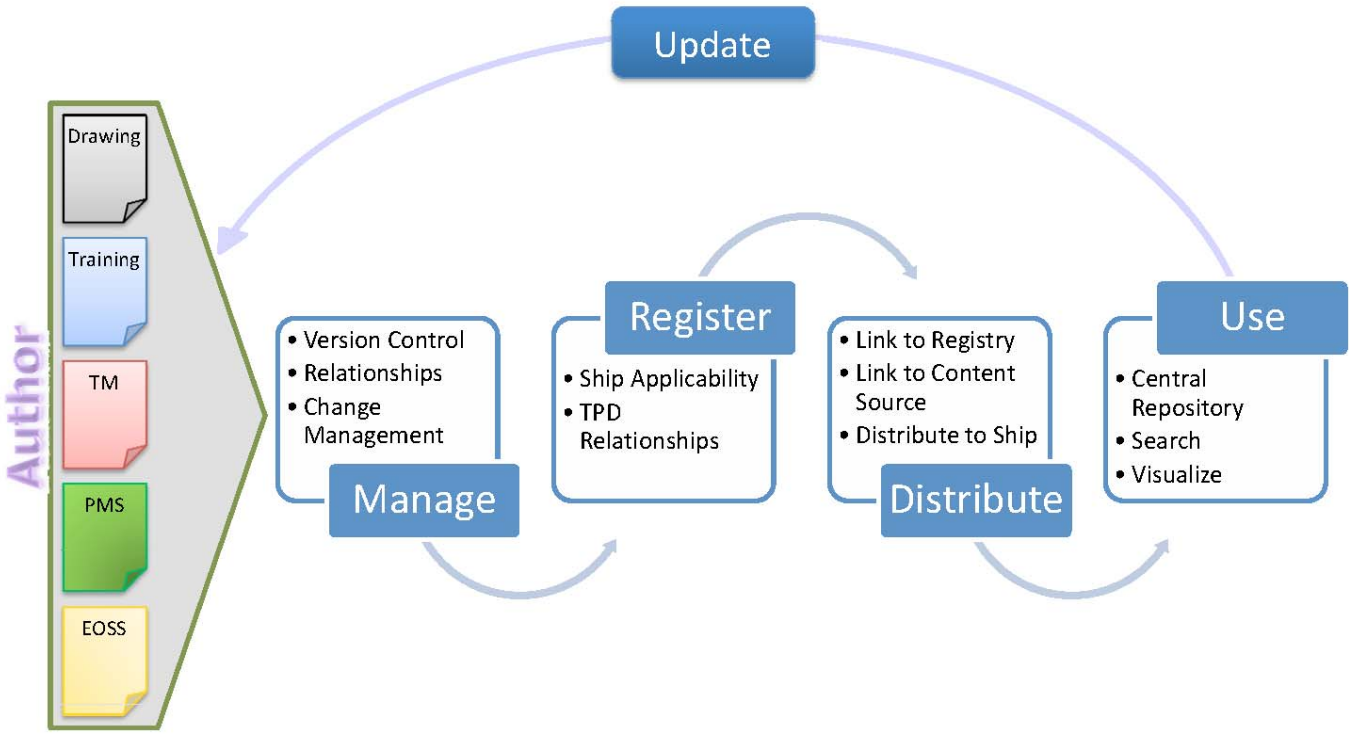


Figure 2. Technical Product Data Lifecycle

tween systems where automated data exchange is or should be supported.

5.1 Technical Product Data Lifecycle

All TPD must traverse through a number of systems that eventually deliver the content to the applicable ships. Each type of TPD illustrated in **Figure 2** is authored in a specialized application. Once completed, each TPD type can be thought to travel through the generalized process.

Although the services provided by the each of the lifecycle systems are available in existing Navy programs of record, not every TPD deliverable makes use of all available services. In addition, similar (if not identical) lifecycle services are provided by different systems, depending on the program or other factors.

The following describes the services provided by each of the identified systems.

- **Author**—each TPD deliverable is created in an authoring application that is designed to construct the document in the format appropriate for delivery.
- **Manage**—deliverables are often managed in a content management system (CMS), which is a centralized repository that provides version control and maintains relationships to other deliverables. The CMS plays an important role in ensuring the integrity of the TPD deliverables as they undergo change and serves as a repository for the data so that it can be distributed to downstream systems.
- **Register**—some TPD (e.g., TMs) are referenced in registries that identify which deliverables are applicable to each ship.
- **Distribute**—most TPD deliverables are delivered to the ship on CD but some are delivered using other resources, examples of which are listed below.
- **Use**—once the data has been distributed to the ship, a shipboard application or repository is updated to include the data so that it is available for use by the sailor.

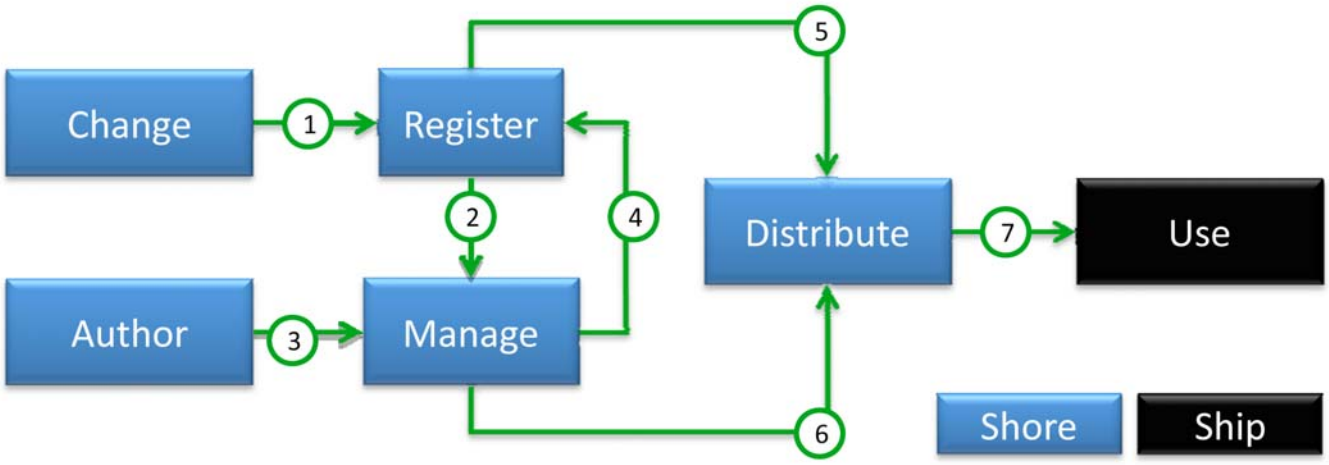
Table 1. Examples of Technical Product Data Lifecycle Support Systems

Deliverable	System				
	Author	**Manage**	**Register**	**Distribute**	**Use**
Technical Manual	Arbortext	Contenta	TDMIS	TDKM	TDKM
Training Material	AIM	NeL CSDB	NAFL	Geo Replicator	NeL
EOSS	Arbortext	Contenta	EOSS Accountability	CD	ATIS
PMS	Navy PMS Editor	Contenta	PMS MIS	CD	PMS SKED
Configuration Data	CDMD-OA	CDMD-OA	CDMD-OA	RADWeb	OMMS-NG
Drawing	CAD	NSEDR	SDI	CD	ATIS

5.2 Technical Product Data Lifecycle Support Systems

Table 1 provides examples of the systems used to support the creation of the essential TPD deliverables through delivery to the ship and use by shipboard personnel.

This table is a representative example of the various TPD types and the many systems used to support them. Variations of this matrix can be created to reflect a specific program or ship class within the Navy.



#	Producer	Consumer	Transferred Data
1	Change	Register	Change request data, Hull number
2	Register	Manage	Affected Items, related TPD numbers, Hull number
3	Author	Manage	Updated TPD documents, Hull number
4	Manage	Register	Updated TPD numbers, Hull number
5	Register	Distribute	Affected Items, updated TPD numbers, hull number
6	Manage	Distribute	Updated TPD documents
7	Distribute	Use	Affected Items, Hull number, updated TPD documents and TPD numbers

Figure 3. Example of Points of Data Transfer in Generalized Data Flow

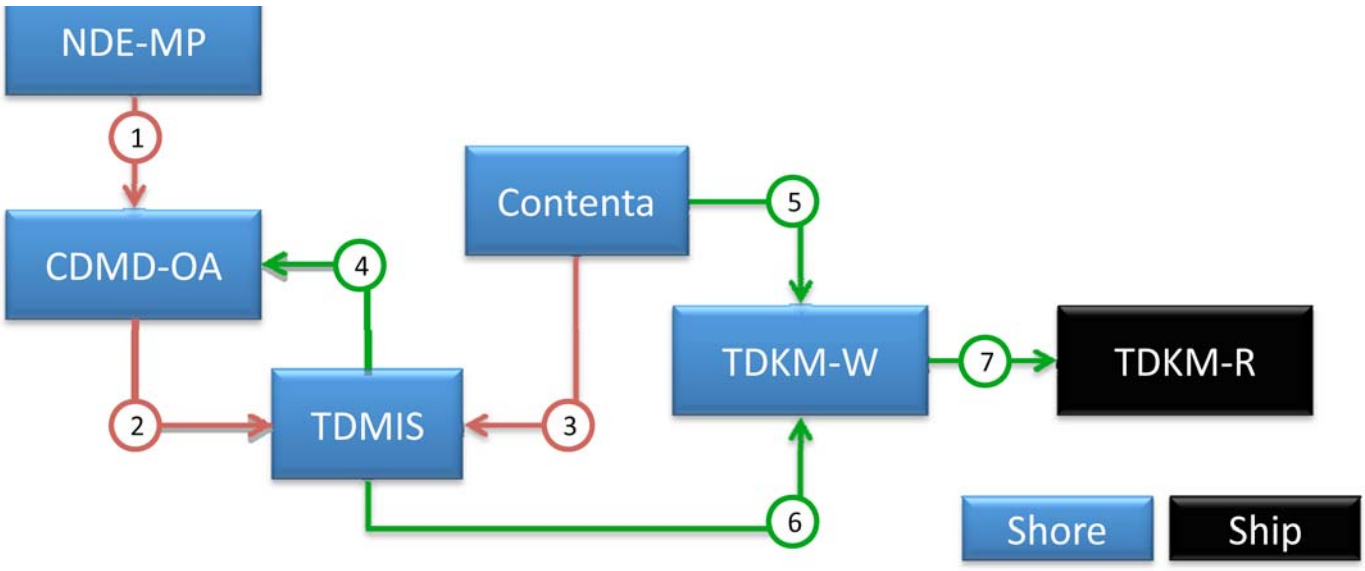
5.3 Technical Product Change Data Flow

Understanding data relationships and dependencies between systems is essential to comprehending the objectives of this report. **Figure 3** illustrates a generalized data flow between an idealized set of systems to support the overall TPD lifecycle.

The data flow diagrams shown in Figures 4 through 8 identify specific systems involved in TPD lifecycles and include connectors between each system to indicate where data exchange is required. The Navy Data Environment–Modernization Plan (NDE-MP) and Configuration Data Managers Database–Open Architecture (CDMD-OA) systems are currently in place to support the change request portion of the data flows for all TPD deliverables (interface line 1 in Figures 4 through 8), although a direct interface or exchange between these two systems is not implemented at this time. An initial change request, represented by a Ship Change Document (SCD) that describes the proposed change to be made to a specific hull, is processed through NDE-MP. That information is then passed to CDMD-OA, which provides a view into all the TPD that is related to the equipment onboard each ship.

CDMD-OA is responsible for maintaining the configuration of all TPD that supports the Logistics change process. As shown in the diagrams, CDMD-OA is the source for distributing the current data to the change process and is the recipient of the updated data after the approval process.

As with the TPD lifecycle support systems shown in Table 1, the data flow diagrams are only representative. All possible TPD types are not shown. All applications used across the Navy in lifecycle support



#	Producer	Consumer	Transferred Data
1	NDE-MP	CDMD-OA	Ship Change Document data, Hull number
2	CDMD-OA	TDMIS	Affected Items, related TM numbers, Hull number
3	Contenta	TDMIS	Updated TM numbers, Hull number
4	TDMIS	CDMD-OA	Updated TM numbers, Hull number
5	Contenta	TDKM-W	Updated TMs
6	TDMIS	TDKM-W	Affected Items, updated TM numbers, Hull number
7	TDKM-W	TDKM-R	Affected Items, Hull number, updated TMs and TM numbers

Figure 4. Technical Manual Change Data Flow

of TPD are not shown. The set represented in these diagrams is comprehensive enough to support the objectives of this report.

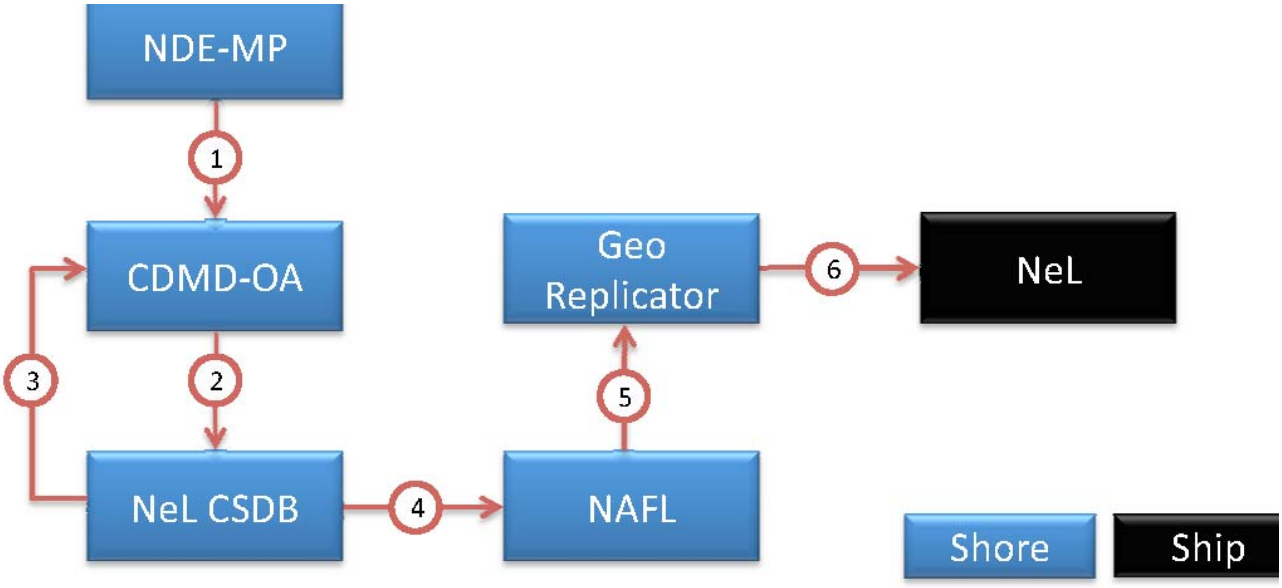
5.3.1 Technical Manual Change

Figure 4 illustrates the flow of TPD as it is initiated from an SCD through the TM change process. As shown, there are systems in place to support TMs for all services identified in Table 1. (This is not true for all TPD deliverables.)

Green indicates interfaces that currently exist. Red indicates interfaces that are manual or do not exist. The black boxes indicate the destination of the TPD.

This example of a TM change references three specific systems that provide the essential services for managing, registering, distributing and using TMs.

Contenta provides a centralized repository for storing versions of the TM as it moves through the modification, review and approval processes. The output is the approved version of the updated or new TM along with the configuration data that identifies each TM individually as well as its relationships to the equipment it references and the hulls for which it is applicable. The configuration data is passed to the TDMIS registry and the documents are submitted to TDKM for distribution.



#	Producer	Consumer	Transferred Data
1	NDE-MP	CDMD-OA	Ship Change Document data, Hull number
2	CDMD-OA	NeL CSDB	Affected Items, related Training Product numbers, Hull number
3	NeL CSDB	CDMD-OA	Updated Training Product numbers, Hull number
4	NeL CSDB	NAFL	Updated Training Product numbers, Hull number
5	NAFL	Geo Replicator	Updated Training Product numbers, Ship Class
6	Geo Replicator	NeL	Updated Training Products

Figure 5. Training Product Change Data Flow

TDMIS is a registry that is the authoritative source for the ship/hull applicability of all TMs. It is responsible for delivering the TM configuration data to CDMD-OA.

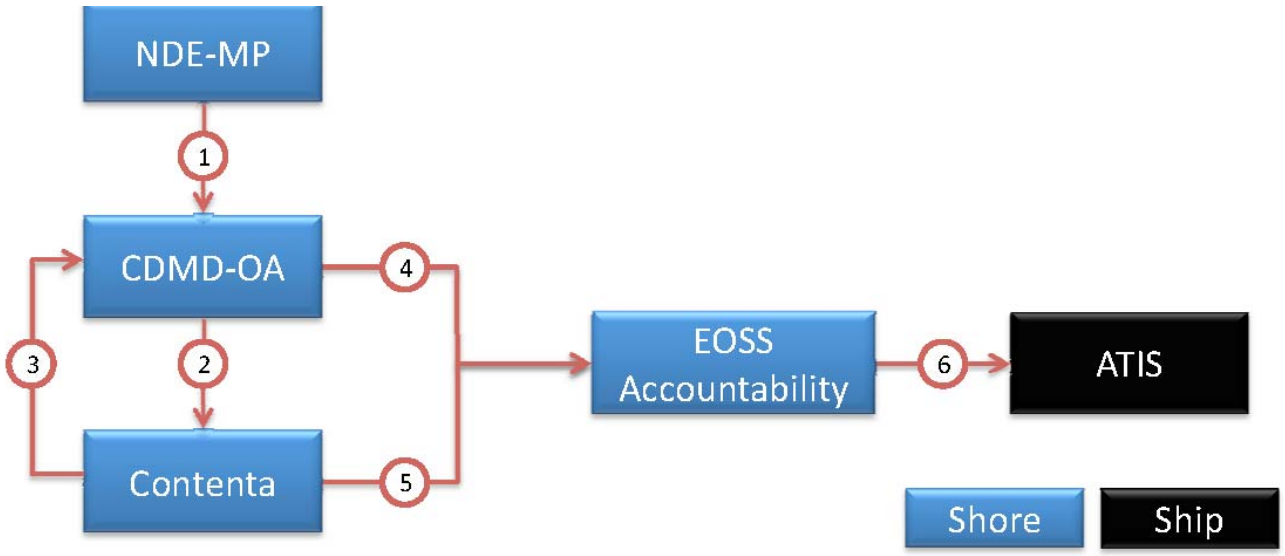
TDKM is comprised of a number of modules, two of which are germane to this discussion. The TDKM Wholesaler (TDKM-W) is the centralized repository for all TMs that are approved for distribution to the ship. TDKM-W services requests from the ship for the most current version of the TMs that are applicable to that hull.

The TDKM Retailer (TDKM-R) resides on the ship and is the repository for all TMs that have been electronically transferred from TDKM-W. Onboard, TDKM-R services all requests to view TMs.

5.3.2 Training Product Change

Figure 5 illustrates the flow of TPD as it is initiated from an SCD through the Training Product change process.

The tools used to create, manage, and distribute training content are continually evolving as the Navy transitions to support an S1000D modular approach for learning content. The diagram above represents a suite of systems that are currently used to support the lifecycle of training content. The representative examples used here for training consider Computer-Based Training (CBT) intended for delivery to the ship. Different systems are used for instructor-led training products intended for shore-based learning centers.Although each of these systems pro-



#	Producer	Consumer	Transferred Data
1	NDE-MP	CDMD-OA	Ship Change Document data, Hull number
2	CDMD-OA	Contenta	Affected Items, related EOSS numbers, Hull number
3	Contenta	CDMD-OA	Updated EOSS numbers, Hull number
4	CDMD-OA	EOSS Accountability	Affected Items, updated EOSS numbers, Hull number
5	Contenta	EOSS Accountability	Updated EOSS documents
6	EOSS Accountability	ATIS	Updated EOSS documents

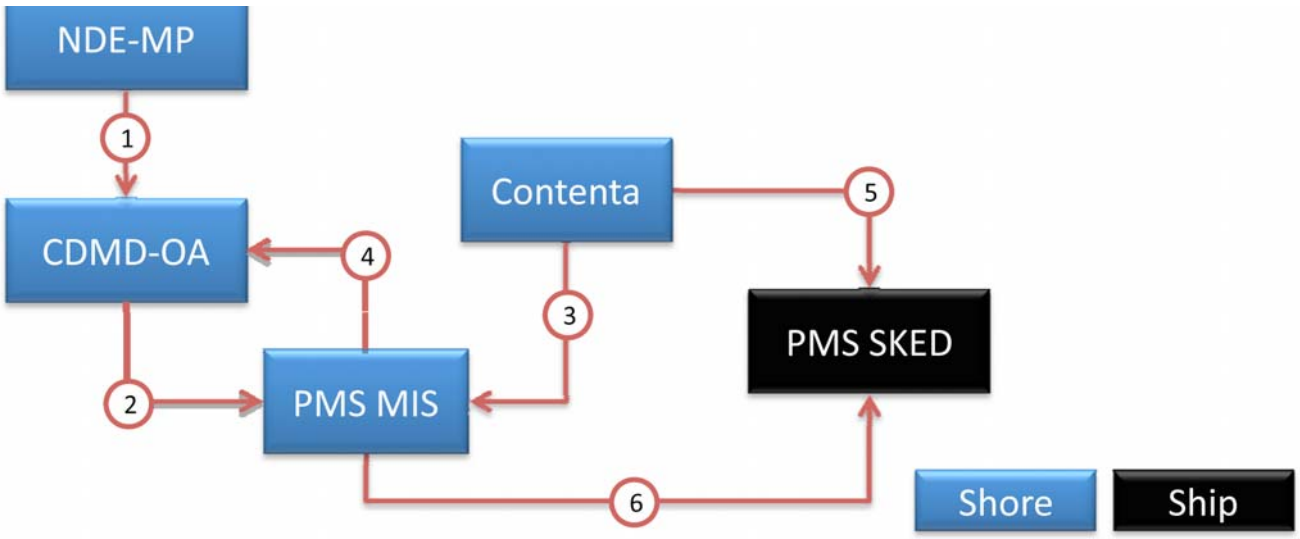
Figure 6. EOSS Manual Change Data Flow

vides some level of automation for their designated service, the data exchange between the systems is essentially manual.

Training content is stored and managed in a centralized Navy eLearning (NeL) Common Source Database (CSDB). The applicability of the training content for each specific hull is stored in NTMPS Afloat (NAFL) and available for reporting purposes. Geo Replicator is the system that publishes and manages the distribution of training content to the ship. The published training content is managed by class of ship, not for each specific hull.

5.3.3 EOSS Manual Change

Figure 6 illustrates the flow of TPD as it is initiated from an SCD through to the EOSS change process. As with TMs, EOSS manuals are managed in Contenta. The applicability of each EOSS manual as it relates to a specific hull is managed in the EOSS Accountability database.



#	Producer	Consumer	Transferred Data
1	NDE-MP	CDMD-OA	Ship Change Document data, Hull number
2	CDMD-OA	PMS MIS	Affected Items, related MRC & MIP numbers, Hull number
3	Contenta	PMS MIS	Updated MRC & MIP numbers, Hull number
4	PMS MIS	CDMD-OA	Affected Items, updated MRC & MIP numbers, Hull number
5	Contenta	PMS SKED	Updated MRC and MIP documents (via CD)
6	PMS MIS	PMS SKED	Updated MRC and MIP records (via CD)

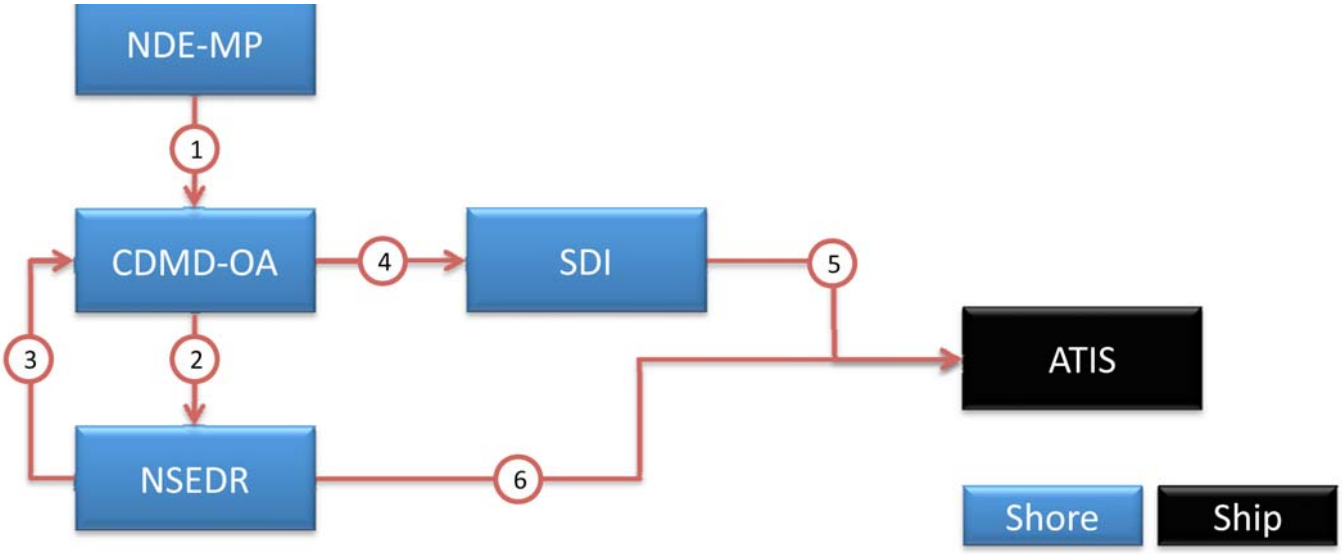
Figure 7. PMS Product Change Data Flow

5.3.4 PMS Product Change

Figure 7 illustrates the flow of TPD as it is initiated from an SCD through to the Preventive Maintenance change process. The content management and registration for ship applicability are managed by Contenta and PMS MIS, respectively. The PMS Editor is responsible for updating the MRC and MIP documents to support the identified change. When the changes are complete, the PMS Editor updates the records in PMS MIS to identify the applicability by hull and configuration item.

The updated documents are saved to a shared folder where they are reviewed by QA. Once approved, they are submitted to Contenta for secure storage.

On a quarterly basis, all PMS changes are collected. Information from Contenta and PMS MIS is merged and written to CD. The CD is delivered to the ship so the PMS SKED can be updated.



#	Producer	Consumer	Transferred Data
1	NDE-MP	CDMD-OA	Ship Change Document data, Hull number
2	CDMD-OA	NSEDR	Affected Items, related Drawing numbers, Hull number
3	NSEDR	CDMD-OA	Updated Drawing numbers, Hull number
4	CDMD-OA	SDI	Updated Drawing numbers, Hull number
5	SDI	ATIS	Affected Items, updated Drawing numbers, Hull number
6	NSEDR	ATIS	Updated Drawings

Figure 8. Drawing Change Data Flow

5.3.5 Engineering Drawing Change

Figure 8 illustrates the flow of TPD as it is initiated from an SCD through to the Engineering Drawing change process. Engineering Drawings utilize the Ship's Drawing Index (SDI) as a registry. The SDI is a simple listing of all the Engineering Drawings that are applicable to a specific hull. Although not as substantial or automated as TDMIS is for TMs, the SDI performs a vital role in ensuring the right drawings are delivered to the right ships.

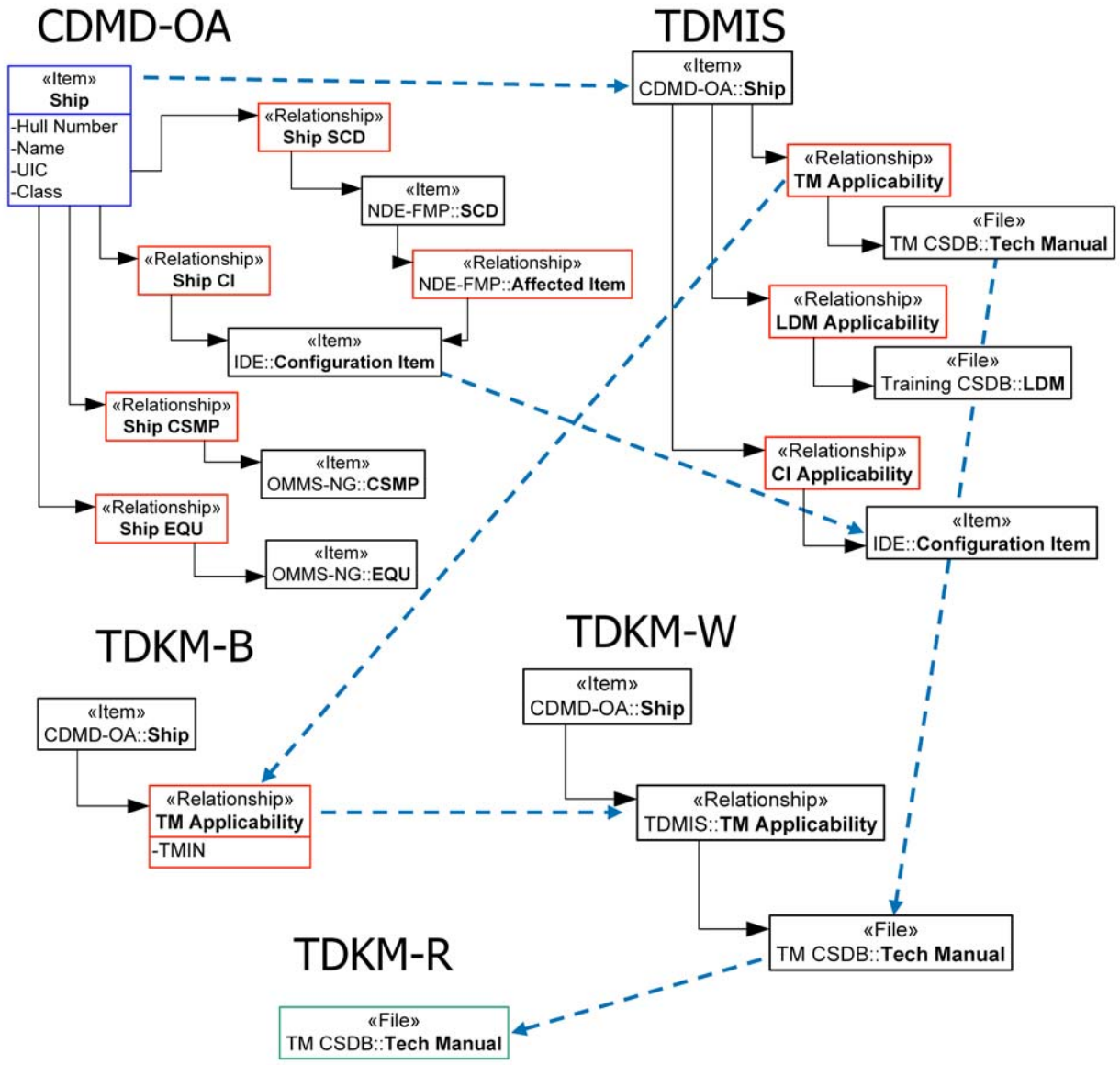


Figure 9. Technical Manual Data Flow

5.4 Data Model and Data Mapping

To understand the impact of change on related TDP, the TDP metadata and how it is interrelated as it flows through multiple systems must be described.

Figure 9 illustrates the TM data model from multiple systems, each of which is responsible for representing its data in the lifecycle process for delivery to the ship. This is a representative sample of the type of analysis that is required for all TDP types to understand the impact of change and interfaces required to maintain a consistent set of data across all systems.

Although the role of each system in the process is somewhat unique, the data that is created, managed, registered, distributed or used by each system has many common underpinnings. Many of the shortcomings of the current collection of logistics support systems can be attributed to the fact that a standard, comprehensive and global data model has not been established. Each system may operate effi-

ciently within its own application space, but may not share and communicate its data effectively with other systems. Documenting a standard data model and defining the data exchange requirements between systems involved in the lifecycle support of that data is essential to building a more effective and efficient system. The use cases that follow begin to define the scenarios that must be supported in order to meet the logistics support requirements. For TPD, with all of its interrelationships, to be accurately and completely delivered to the ship in a timely manner, many system requirements must be met:

- The flow of common data between systems must be understood
- The authoritative source of all data must be defined
- The exchange of data between systems must be automated wherever possible
- Relationships between TPD must be modeled to support impact analysis of change
- Notification of change must be communicated to the owners of all impacted deliverables

6 Use Case Overview

6.1 Use Case Global Preconditions

Each use case description states certain preconditions specific to that use case that will impact its success. Examination of potential use cases revealed several preconditions that fundamentally impacted all use case success and ultimately that of the Technical Development Strategy itself. These global preconditions include:

- Reconciliation of database field names
- Uniform digital metadata
- Common digital data format for product data
- Access to DoD enterprise applications
- Support and participation by Navy eLearning (NeL)

6.1.1 Reconciliation of Database Field Names

The establishment of common definitions and names for enterprise data elements across all applications has long been associated with database interoperability paradise and has been, in one form or another, a focus of many DoD Enterprise efforts for many years. This history underscores both the desirability of satisfying this particular precondition, and the difficulties associated with its elusive solution. Use case implementations, therefore, must address this issue in ways that offer hope for the use case without getting bogged down in solving all problems associated with the precondition. Thorough and careful definition of all relevant element and field names associated with use case applications and databases is paramount to successful reconciliation. Recognizing that owners of the applications are not apt or able to change field names, this reconciliation will likely be achieved through mappings, filters or transforms.

6.1.2 Uniform Digital Metadata

Metadata, the data about data, serves important purposes that may vary greatly among applications and databases. Metadata can identify many things about the data and can be used for many purposes. The implementation of uniform metadata standards and practices within an enterprise can greatly facilitate control of access and distribution of data as well as search and discovery of data. Achieving uniform metadata faces many of the same obstacles as reconciling database field names. Existing metadata among system applications is not likely to be uniform and consistent in definition or use. Consequently, use case developers need to carefully identify and understand the definitions and uses of all metadata among interfacing systems.

6.1.3 Common Digital Data Format for Product Data

Product data includes a wide range of data and data types associated with the design, build, development, and life cycle support of products. The DoD acquisition, development, and lifecycle support of weapons and weapon systems generates a plethora of product data. Contractors and developers have many systems and methodologies for developing this data and often use their own digital formats to create and maintain the data. The DoD has worked for years to standardize the digital formats in which the product data is delivered. The Services have various policies directing the use of these standards (e.g., DON Policy on Digital Product/Technical Data, 2004). The purpose for these standards is to guarantee interoperability of the data among organizations and activities that must use the data. The reality is that the Services receive and accept product data in a range of different formats for a variety of reasons: requirement missing from the con-

tract, inconsistent policies, or simply the evolution of information technology outpaces policy statements and standardization efforts.

Compounding this issue is the fact that the Services manage a considerable amount of data that is associated with legacy equipment and systems and predates standardization efforts and exists in many different digital formats. An assumption, therefore, of the existence of a common digital data format for product data as a use case precondition is accompanied by potentially significant boundaries and limitations. The use cases discussed in this document may be less impacted by the format variations of the product data itself, than the possible difficulty in accessing and interpreting the configuration and identification data (or metadata) associated with the product data. This is the data that links the product data to management information systems such as CDMD-OA and TDMIS.

6.1.4 Access to DoD Enterprise Applications

Use case planning will identify the DoD application interfaces necessary for use case success. Access to these applications is usually restricted to approved users. Use case developers will have to account for the needed permissions for the access required.

6.1.5 Support and Participation by Navy eLearning (NeL)

The Navy eLearning program manages more than 8000 on-line courses for shore-based personnel and more than 4000 on-line courses for personnel afloat. The courses are accessible by more than a million personnel (active duty, civilian, employees, retirees and family members). Much of the technical content of the eLearning associated with ship and weapon system operations and maintenance is based on related TPD (especially TMs) and may require changes whenever related TPD changes. There is currently no easy way to assure that training product developers are notified of changes in technical data that has been used in training products. One of the objectives of the The Bridge Project is to close the gap between technical and training data management and production processes to achieve effective sharing of data and assure congruence of training data configuration with that of the technical data.

Technical data changes are initiated by engineering changes and TM deficiency reports and are well tracked by existing information systems. How the training community uses technical data, what technical data is being used, and in what learning products it exists has been managed and tracked less rigorously. Maintaining an equally comprehensive configuration control of the technical data that has been re-used or modified by the training development community will require support from the Navy eLearning community. Use case success will likely depend on the training community actively participating in managing additional interfaces and data relationships with the authoritative sources of the technical data that they use.

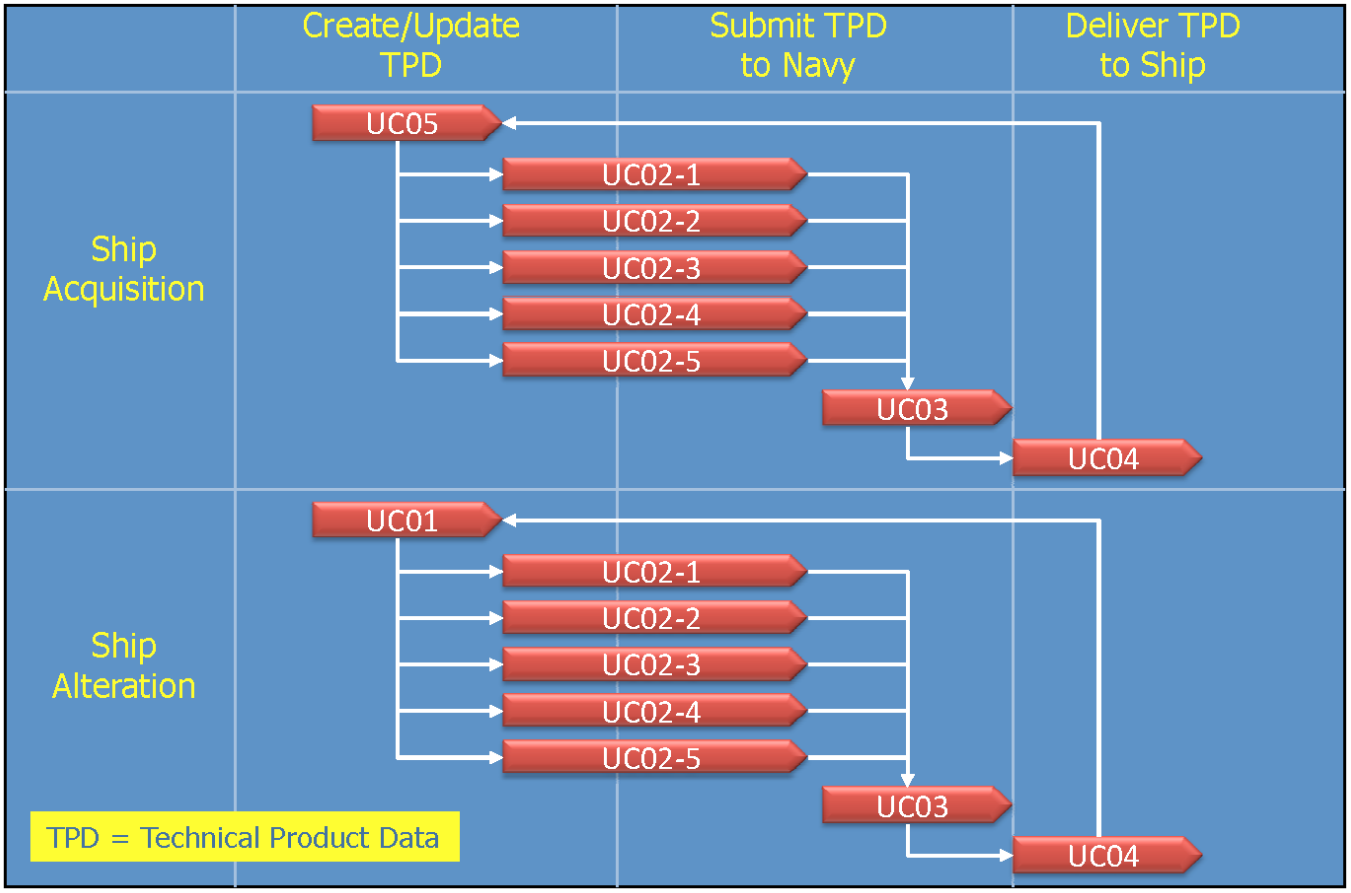


Figure 10. Use Case Sequence Diagram

6.2 Use Case Summary

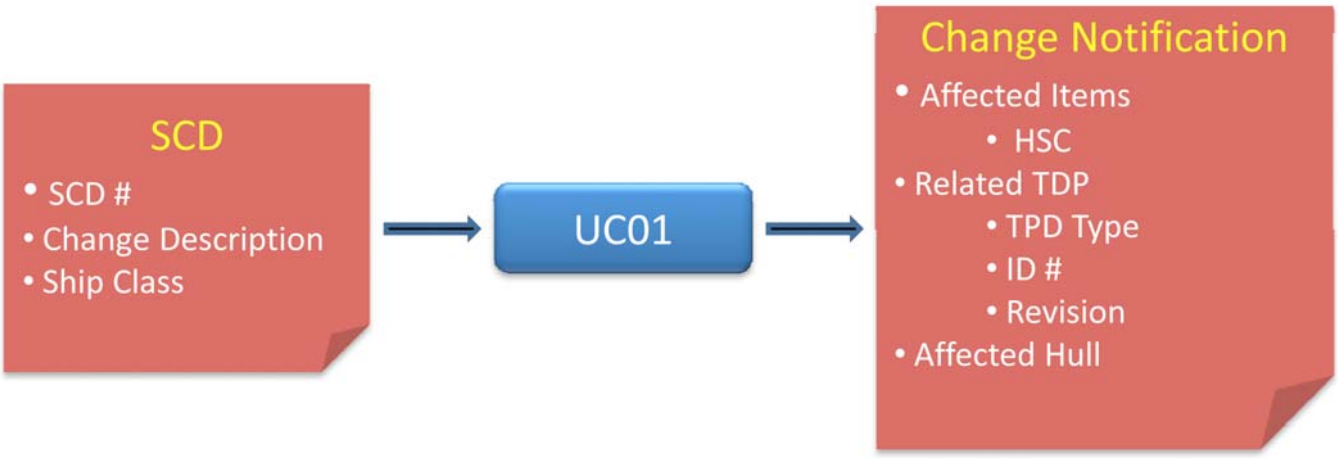
The use cases described in this section provide a high-level view of the development, management, and delivery of TPD, and serve as a framework to develop more detailed use cases, identify gaps in current processes and/or capabilities, and derive recommendations for improvements in Navy TPD management. The relationship among the use cases described in this report is shown in **Figure 10**. An attempt was made to partition the uses cases by product and lifecycle phase of the products, understanding that certain activities may be applicable to multiple phases.

The following provides a summary of each use case (UC) depicted in Figure 10. Detailed use case descriptions can be found in section 7.

6.2.1 UC01: Identify Ship Change Document (SCD)-impacted Product Data

This use case describes the process by which TPD affected by a design change are identified.

1. Issue SCD.
2. Determine design changes.
3. Identify equipment affected by change.
4. Identify logistics products related to affected equipment.
5. Publish list of all affected equipment and related logistics products to the applicable CSDB or other Navy system.



6.2.2 UC02: Update Technical Product Data

The following use cases describe the process by which TPD CSDBs receive change information to drive the change to all the TPD related to the equipment affected by the change.

6.2.3 UC02-1: Update Technical Manuals

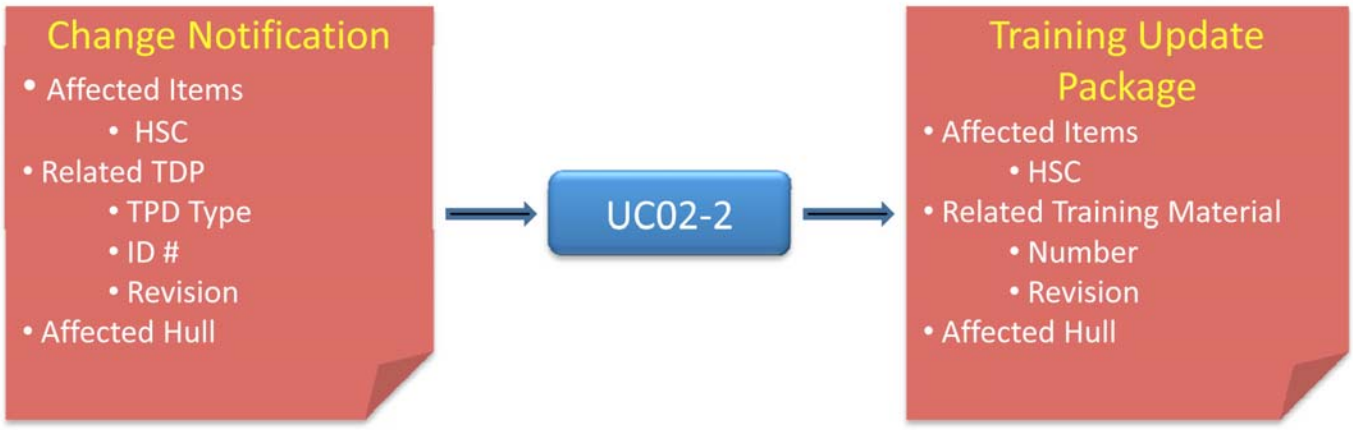
This use case describes the process by which a TM Developer updates a TM based on a notification of an equipment change. Once complete, the updated TM metadata is published to CDMD-OA and any updated TMs are published to TDKM-W.

1. Receive change notification.
2. Review list of TMs related to affected equipment.
3. Update TM.
4. Submit TM to Contenta.
5. Publish TM to TDKM-W.
6. Publish TM metadata to TDMIS.
7. TDMIS publishes updated TM metadata to CDMD-OA.

6.2.4 UC02-2: Update Training Material

This use case describes the process by which a Training Developer updates Training Material based on a notification of an equipment change. Once complete the updated Training Material metadata is published to CDMD-OA.

1. Receive change notification.
2. Review list of Training Material related to affected equipment.
3. Update Training Material.
4. Submit Training Material to CSDB.
5. Publish Training Material metadata to CDMD-OA.



6.2.5 UC02-3: Update EOSS Manuals

This use case describes the process by which an EOSS Developer updates EOSS manuals based on a notification of an equipment change. Once complete the updated EOSS metadata is published to CDMD-OA and EOSS Accountability.

1. Receive change notification.
2. Review list of EOSS documents related to affected equipment.
3. Update EOSS documents.
4. Submit EOSS documents to Contenta.
5. Publish EOSS metadata to CDMD-OA.
6. Publish EOSS metadata to EOSS Accountability.

6.2.6 UC02-4: Update PMS Products

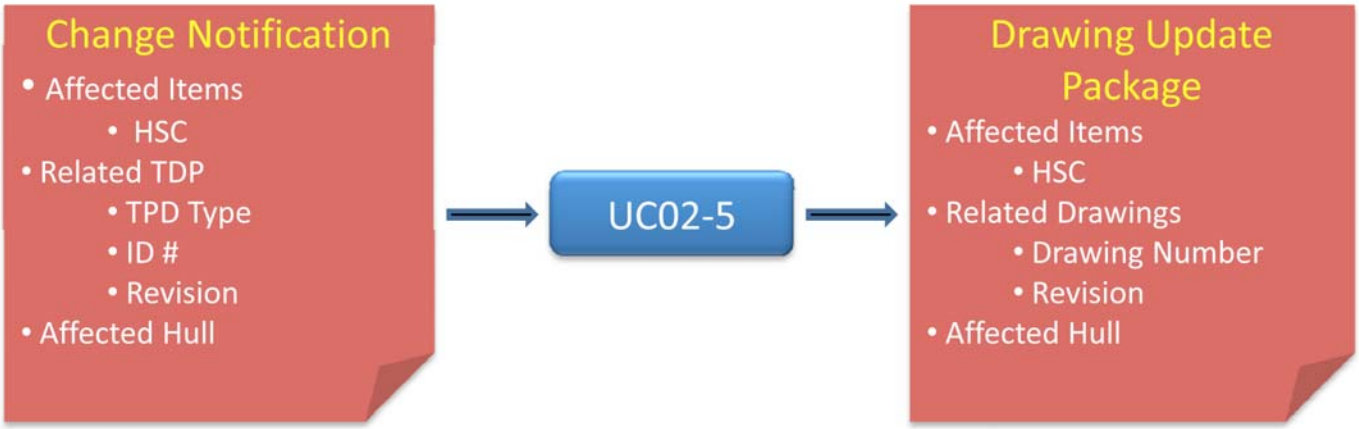
This use case describes the process by which a PMS Data Developer updates PMS products based on a notification of an equipment change. Once complete the updated PMS metadata is published to CDMD-OA.

1. Receive change notification.
2. Review list of PMS products related to affected equipment.
3. Update PMS products.
4. Submit PMS products to CSDB.
5. Publish PMS metadata to CDMD-OA.

6.2.7 UC02-5: Update Engineering Drawings

This use case describes the process by which a Designer updates Engineering Drawings based on a notification of an equipment change. Once complete the updated Drawing metadata is published to CDMD-OA and the drawing is loaded to the Navy Ship Engineering Drawing Repository (NSEDR).

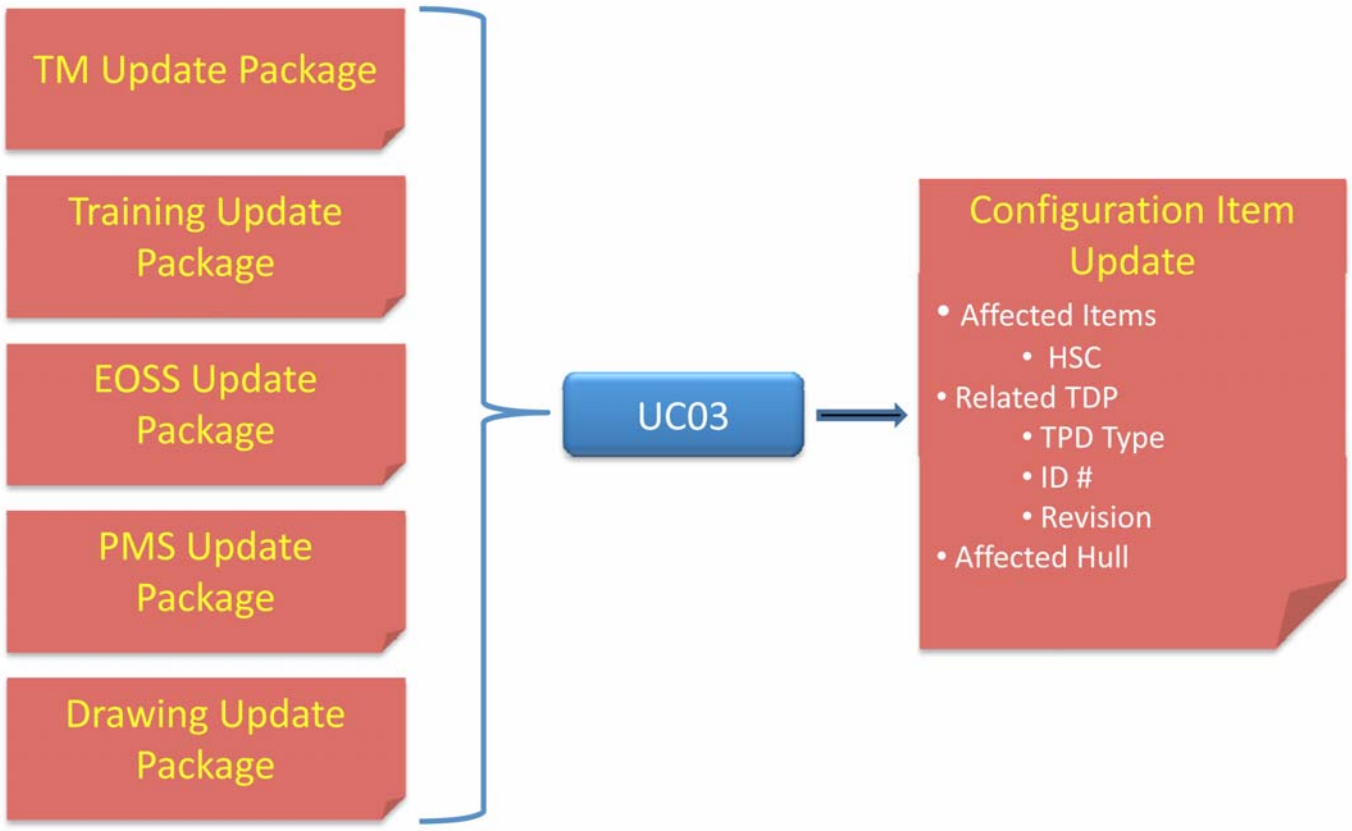
1. Receive change notification.
2. Review list of Drawings related to affected equipment.
3. Update Drawings.
4. Submit Drawings to NSEDR.
5. Publish Drawing metadata to SDI.
6. Publish Drawing metadata to CDMD-OA.



6.2.8 UC03: Update Configuration Data

This use case describes the process by which the CDM updates the Configuration Data in CDMD-OA once all of the TPD related to the affected equipment has been updated and submitted back to CDMD-OA.

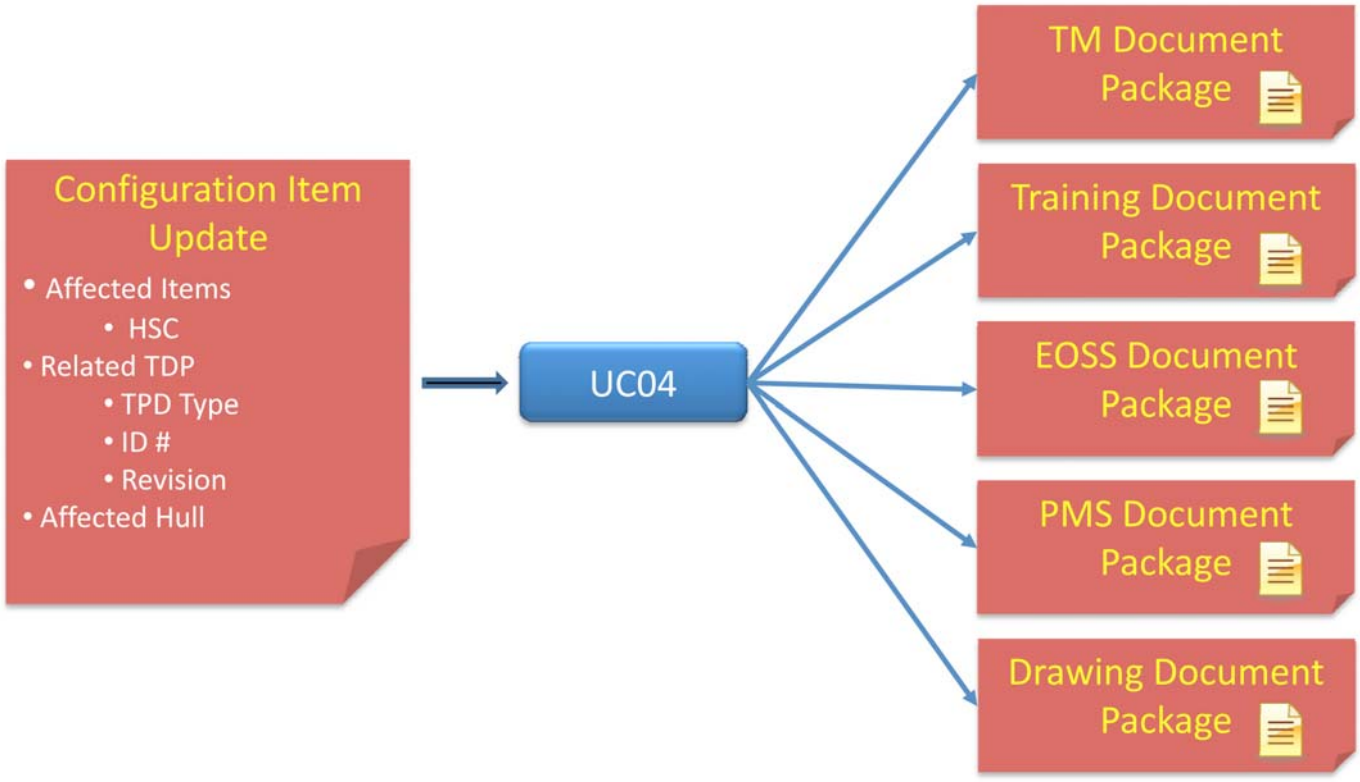
1. CDM checks to ensure all TPD associated to the affected equipment has been updated in CDMD-OA.
2. CDM updates Configuration Data for equipment affected by the change specified in the SCD.
3. CDMD-OA notifies NDE-FMP that the SCD is complete.



6.2.9 UC04: Distribute Technical Product Data to Ship

This use case describes the process by which a ship is updated to include the current version of TPD based on an equipment change.

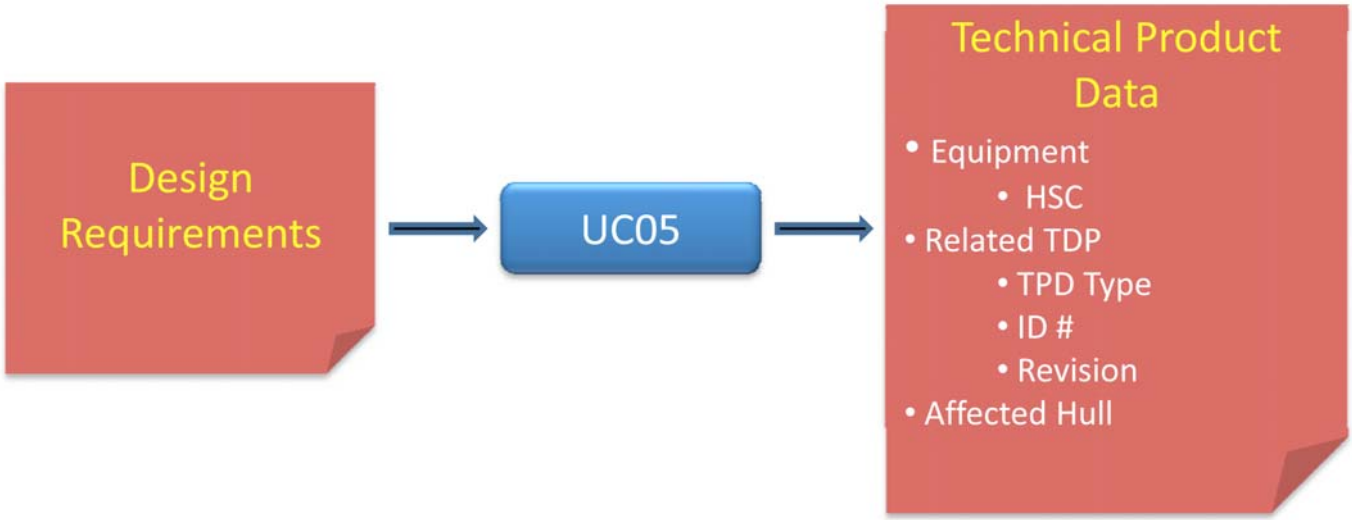
1. The ship requests the latest updates to TDP.
2. CDMD-OA identifies all changes for the requesting hull.
3. TDKM delivers all updated and new TMs to the ship.
4. The Engineering Drawings are copied to a CD and delivered to the ship.
5. The Training Materials are copied to a CD and delivered to the ship.
6. The EOSS documents are copied to a CD and delivered to the ship.
7. The PMS products are copied to a CD and delivered to the ship.
8. The Configuration Data is delivered to the ship.



6.2.10 UC05: Deliver Technical Product Data to Navy during Ship Acquisition

This use case describes the process by which TPD is delivered from the Shipyard or OEM to the Navy shore systems during ship acquisition and at final delivery of the ship to the Navy. The engineering and logistics products are transferred to the appropriate Navy repository and applicable configuration data is transferred to the respective Navy configuration management systems. Relationships between the engineering products, logistics products, and configuration data are maintained in order to facilitate change identification during subsequent design changes or maintenance activities.

1. Develop Engineering and Logistics Products.
2. Associate Engineering and Logistics Products to Equipment.
3. Transfer Engineering and Logistics Products and associated metadata to respective Navy systems.

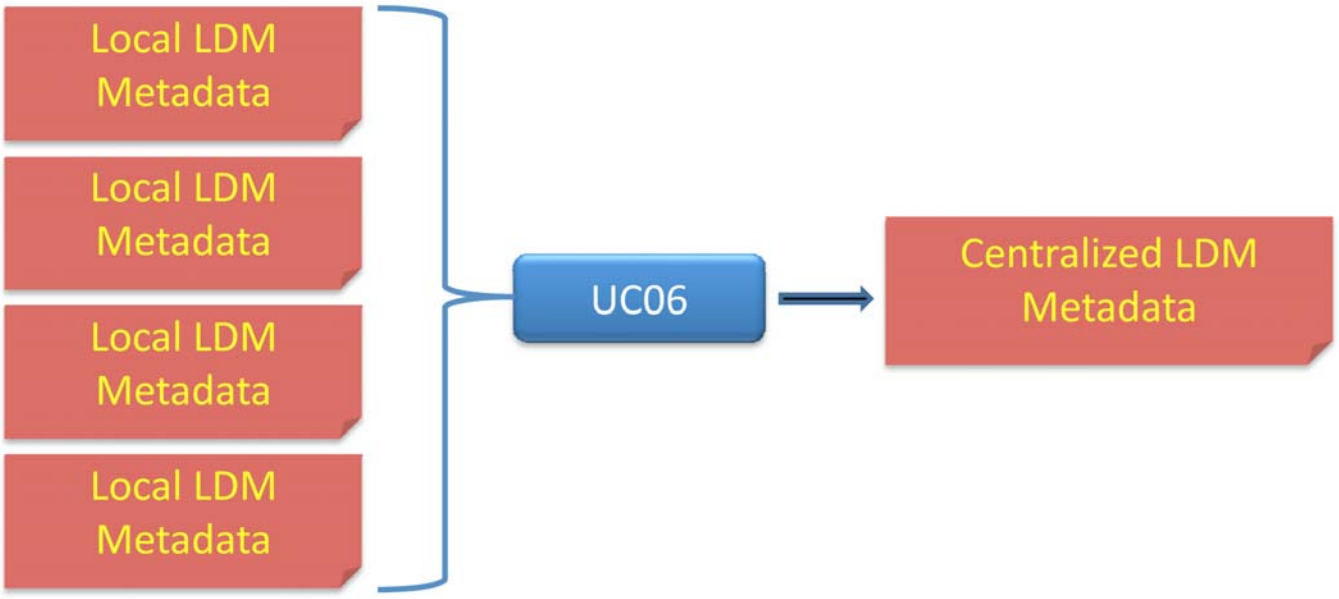


6.2.11 UC06: Register Learning Content in ADL-R

This use case describes the process by which learning content is registered with the ADL-R.

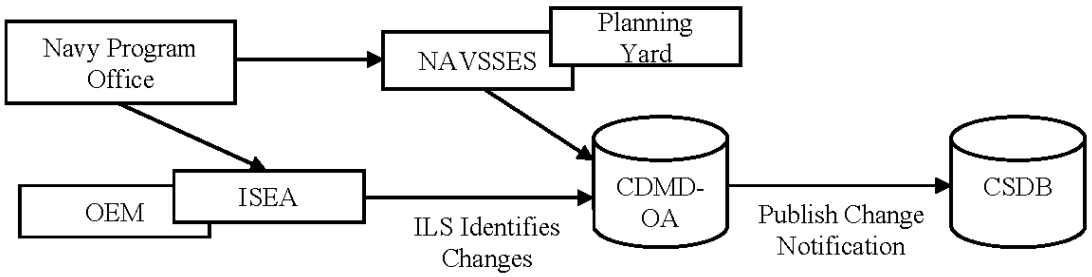
The benefits of data reusability afforded by the inclusion of Learning Data Modules (LDMs) conforming to S1000D Issue 4.0 cannot be fully realized across the Navy without a content registration process to support data search and discovery. S1000D supports the reuse and repurposing of data through the aggregation of many data modules (DMs) (the smallest self-contained information unit in technical publications) to create technical logistics products. The large numbers of LDMs anticipated to be developed by the US DoD training community using S1000D will significantly increase the inventory of training objects that could be reused, repurposed and/or aggregated into innovative products yet to be envisioned. Automatic registration of LDM metadata with the ADL-R can be accomplished using data communication properties native to a CSDB.

1. Develop Training Material.
2. Submit Training Material to CSDB.
3. Submit Training Material metadata to ADL-R.

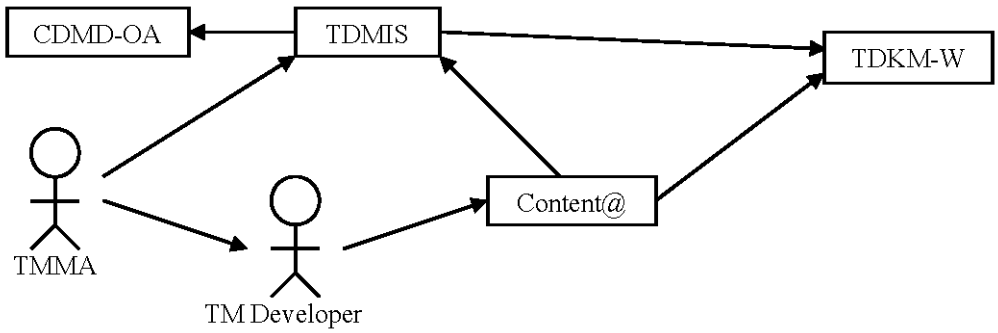


7 Detailed Use Cases

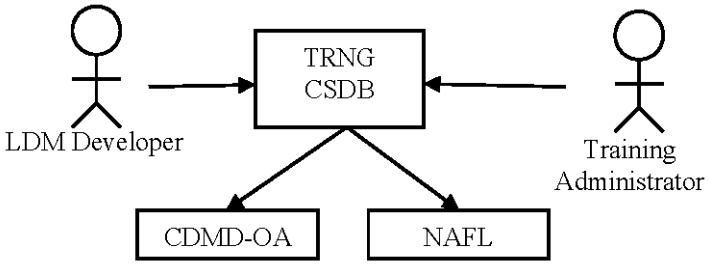
7.1 UC01: Identify Ship Change Document (SCD)-impacted Product Data

Summary	This use case describes the process by which TPD affected by a design change are identified.
Actors	
Preconditions	1. The SCD has been created and authorized by the Navy and the appropriate Planning Yard and/or OEM have been contracted and funded to execute the SCD. 2. The current ship configuration records and current Logistics Support Document (LSD) records are available in CDMD-OA. 3. Current versions of the TPD are available in the applicable Navy CSDB.
Basic Course of Events	1. NAVSSES and Planning Yard determine HM&E design changes required to implement the SCD. 2. ISEA and OEM determine Combat Systems design changes required to implement the SCD. 3. ILS determines HSC of equipment affected by design change. 4. ILS queries CDMD-OA for all logistics products related to the affected equipment. 5. CDMD-OA publishes a list of all affected equipment and related logistics products to the applicable CSDB or other Navy system.
Exception Paths	None identified
Post-conditions	1. The design is updated and all affected logistics products and configuration data impacted by the change are identified.
Issues	1. (Step 3) How does ILS get the HSCs for the affected equipment based on the data received from steps 1 and 2? 2. (Step 4) This identifies all logistics products for existing equipment affected by the design change. New equipment may not be loaded into CDMD-OA at this time. The identification of new TPD may have to be performed by other mechanisms.
Reference Documents	TDS2-agenda-minutes-july.doc

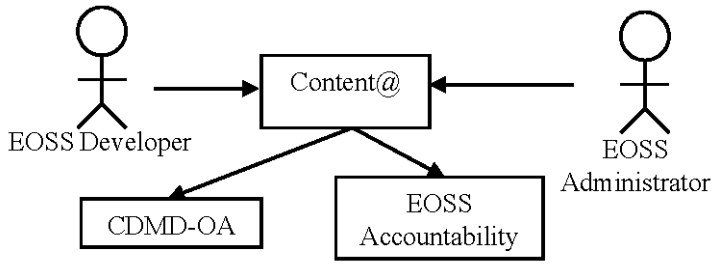
7.2 UC02-1: Update Technical Manuals

Summary	This use case describes the process by which a TM Developer updates a TM based on a notification of an equipment change. Once complete, the updated TM metadata is published to CDMD-OA and the updated TM is published to the TDKM-W.
Actors	
Preconditions	1. A Change Notification package has been published from CDMD-OA (see UC01).
Basic Course of Events	1. TDMIS receives the Change Notification from CDMD-OA and updates the appropriate records. 2. The TMMA is notified of updates in TDMIS. 3. The TMMA requests the list of all affected TMs. 4. TDMIS presents the user with a list of all affected TMs. 5. The TMMA notifies all TM Developers to update the TMs to reflect the recent changes. 6. The TM Developers update the documents and submit the new versions to Contenta. 7. The TM Developers approve all TMs. 8. Contenta exports a. the configuration data for each identified TM to TDMIS, including: i. TMIN. ii. Revision. iii. Applicable Ship. b. the updated TMs to the TDKM-W. 9. TDMIS exports the updated configuration data to CDMD-OA and TDKM-W. 10. CDMD-OA records are modified to reflect the updated TM metadata
Exception Paths	1. (Step 5) The TM Authors create a new document to support the change. a. The TM Developer requests a document number (TMIN) from TDMIS. b. The TM Developer submits the new document to Contenta. c. Contenta exports the configuration data for each identified TM to TDMIS, including the following: i. TMIN ii. Revision iii. Applicable Ship
Post-conditions	1. The TDKM-W is updated with the latest approved versions of the TMs. 2. TDMIS is updated with the latest configuration data for the updated TMs. 3. CDMD-OA is updated with the latest configuration data for the updated TMs.
Issues	1. (Step 1) Which system should receive the Change Notification? TDMIS or Contenta? 2. If TDMIS does not represent the relationship between the TM and the equipment it references, how is that data delivered to CDMD-OA.
Reference Documents	TDS2-agenda-minutes-july.doc UC01-Identify SCD-impacted Technical Product Data.docx

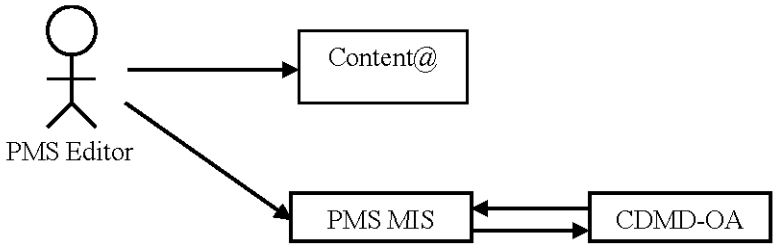
7.3 UC02-2: Update Training Material

Summary	This use case describes the process by which a Training Developer updates Training Material based on a notification of an equipment change. Once complete the updated Training Material product data is published to CDMD-OA.
Actors	
Preconditions	1. A Change Notification package has been published from CDMD-OA (see UC01).
Basic Course of Events	1. TRNG CSDB receives the Change Notification from CDMD-OA and updates the appropriate records. 2. The Training Administrator is notified of updates in TRNG CSDB. 3. The Training Administrator requests the list of all affected LDMs. 4. TRNG CSDB presents the user with a list of all affected LDMs. 5. The Training Administrator notifies all LDM Developers to update the LDM documents to reflect the recent changes. 6. The LDM Developers update the documents and submit the new versions to the TRNG CSDB. 7. The Training Administrator approves all the LDM documents. 8. The TRNG CSDB exports the configuration data for the approved LDM documents to CDMD-OA. 9. CDMD-OA records are modified to reflect the updated LDM metadata. 10. The TRNG CSDB exports the configuration data for the approved LDM documents to NAFL. 11. NAFL records are updated to reflect the updated data.
Exception Paths	1. (Step 5) The LDM Developer creates a new document to support the change. a. The LDM Developer requests a document number from the appropriate Training system. b. The LDM Developer submits the new document to TRNG CSDB. c. TRNG CSDB exports the configuration data for each identified LDM document to CDMD-OA.
Post-conditions	1. The latest approved LDM documents are in TRNG CSDB. 2. CDMD-OA is updated with the latest configuration data for the updated LDM documents. 3. NAFL is updated with the latest configuration data for the updated LDM documents.
Issues	1. (Exception Path Step 1a) What system, if any, provides document numbers for Training Material?
Reference Documents	TDS2-agenda-minutes-july.doc UC01-Identify SCD-impacted Technical Product Data.docx

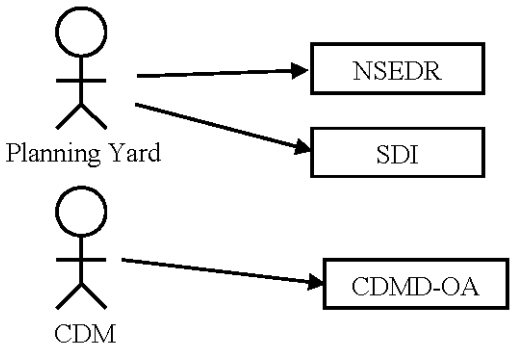
7.4 UC02-3: Update EOSS Manuals

Summary	This use case describes the process by which an EOSS Developer updates EOSS manuals based on a notification of an equipment change. Once complete the updated EOSS product data is published to CDMD-OA.
Actors	
Preconditions	1. A Change Notification package has been published from CDMD-OA (see UC01).
Basic Course of Events	1. Contenta receives the Change Notification from CDMD-OA and updates the appropriate records. 2. The EOSS Administrator is notified of updates in Contenta. 3. The EOSS Administrator requests the list of all affected EOSS documents. 4. Contenta presents the user with a list of all affected EOSS documents. 5. The EOSS Administrator notifies all EOSS Developers to update the EOSS documents to reflect the recent changes. 6. The EOSS Developers update the documents and submit the new versions to Contenta. 7. The EOSS Administrator approves all the EOSS documents. 8. Contenta exports the configuration data for the approved EOSS documents to CDMD-OA. 9. CDMD-OA records are modified to reflect the updated EOSS metadata. 10. Contenta exports the configuration data for the approved EOSS documents to EOSS Accountability. 11. EOSS Accountability records are updated to reflect the updated data.
Exception Paths	1. (Step 5) The EOSS Developer creates a new document to support the change. a. The EOSS Developer requests a document number from the appropriate Navy system. b. The EOSS Developer submits the new document to Contenta. c. Contenta exports the configuration data for each identified EOSS document to CDMD-OA and EOSS Accountability.
Post-conditions	1. The latest approved EOSS documents are in Contenta. 2. CDMD-OA is updated with the latest configuration data for the updated EOSS documents. 3. EOSS Accountability is updated with the latest configuration data for the updated EOSS documents.
Issues	1. (Exception Path Step 1a) What system, if any, provides document numbers for EOSS Manuals?
Reference Documents	TDS2-agenda-minutes-july.doc UC01-Identify SCD-impacted Technical Product Data.docx

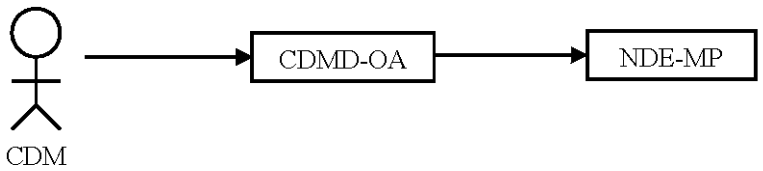
7.5 UC02-4: Update PMS Products

Summary	This use case describes the process by which a PMS Editor updates PMS products based on a notification of an equipment change. Once complete the updated PMS product data is published to CDMD-OA.
Actors	
Preconditions	1. A Change Notification package has been published from CDMD-OA (see UC01).
Basic Course of Events	1. PMS MIS receives the Change Notification from CDMD-OA and updates the appropriate records. 2. The PMS Editor is notified of updates in PMS MIS. 3. The PMS Editor requests the list of all affected MRCs and MIPs. 4. PMS MIS presents the user with a list of all affected MRCs and MIPs. The PMS Editor updates the documents and submits the new versions to Contenta. 5. The PMS Editor updates PMS MIS with the MRC and MIP metadata. 6. PMS MIS exports the updated metadata to CDMD-OA. 7. CDMD-OA records are modified to reflect the updated PMS metadata.
Exception Paths	1. (Step 5) The PMS Editor creates a new document to support the change. a. The PMS Editor requests a document number from PMS MIS. b. The PMS Editor submits the new document to Contenta. c. The PMS Editor adds the metadata for each new MRC or MIP document to PMS MIS.
Post-conditions	1. The latest approved MRCs and MIPs are in Contenta. 2. CDMD-OA and PMS MIS are updated with the latest configuration data for the updated MRC and MIP.
Issues	1. (Step 1) Which system should receive the Change Notification, PMS MIS or PMS CSDB?
Reference Documents	TDS2-agenda-minutes-july.doc UC01-Identify SCD-impacted Technical Product Data.docx

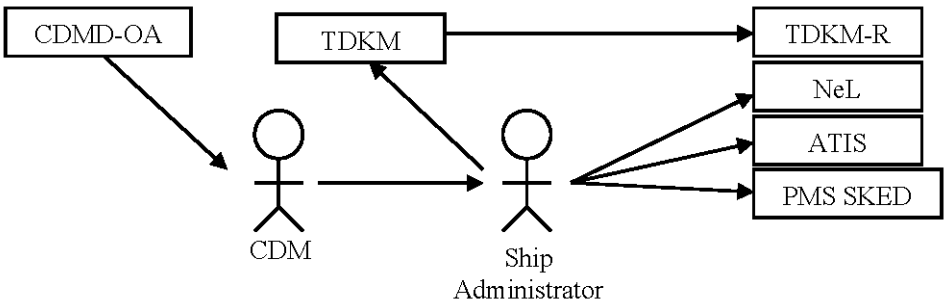
7.6 UC02-5: Update Engineering Drawings

Summary	This use case describes the process by which the Planning Yard updates Engineering Drawings based on an SCD. Once complete the updated Drawing product data is published to CDMD-OA and the drawing is loaded to NSEDR.
Actors	
Preconditions	1. SCD has been created and authorized by the Navy and the appropriate Planning Yard and/or OEM have been contracted and funded to execute the SCD.
Basic Course of Events	1. NAVSSES and Planning Yard determine HM&E design changes required to implement the SCD. 2. ISEA and OEM determine Combat Systems design changes required to implement the SCD. 3. The Navy provides drawing numbers to the Planning Yard. 4. The Planning Yard Designer updates existing drawings or creates new drawings to reflect the design changes. 5. After appropriate internal and quality reviews and updates, the Planning Yard issues the new or updated drawings. 6. The Planning Yard transfers the drawings and required metadata to NSEDR. 7. The Planning Yard updates the SDI to reflect the current drawings applicable to a specific hull. 8. The CDM updates the drawing configuration data in CDMD-OA.
Exception Paths	None identified
Post-conditions	1. The latest approved Drawings are in NSEDR. 2. CDMD-OA is updated with the latest configuration data for the updated Drawings.
Issues	1. (Step 8) Need to investigate how the SDI is created and where it is stored. Should it be created from one of the databases that store the configuration data for the drawings such as CDMD-OA? 2. (Step 4) What Navy system provides drawing numbers for Engineering Drawings?
Reference Documents	TDS2-agenda-minutes-july.doc

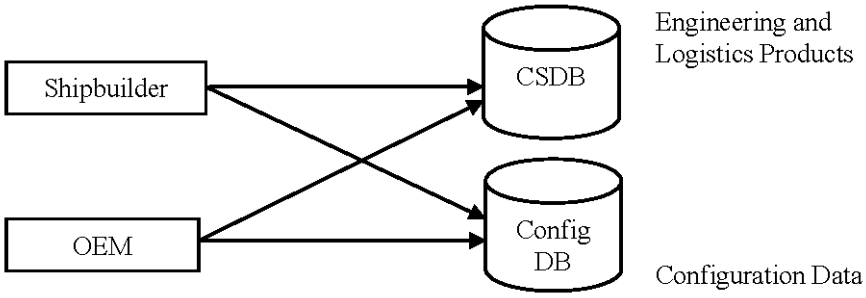
7.7 UC03: Update Configuration Data

Summary	This use case describes the process by which the CDM updates the Configuration Data in CDMD-OA once all of the TPD related to the affected equipment has been updated and submitted back to CDMD-OA.
Actors	
Preconditions	1. All TPD deliverables (TMs, Drawings, EOSS, PMS, and Training) have been updated to reflect the equipment change. 2. All TPD configuration data has been successfully uploaded into CDMD-OA (see use cases UC02-1 through UC02-5).
Basic Course of Events	1. The CDM logs into CDMD-OA. 2. The CDM requests to view the configuration data of the modified equipment. 3. CDMD-OA presents the user with the configuration data of the specified piece of equipment. 4. The CDM requests to view the TPD related to the equipment. 5. CDMDO-OA presents the user with every related document of the following types: a. TM b. Drawing c. EOSS d. PMS e. Training Product 6. The CDM reviews the list to ensure all TPD deliverables are at their most current version. 7. The CDM updates the configuration data for the specified piece of equipment and identifies it as approved as the current revision. 8. CDMD-OA saves the updated information in the database. 9. CDMD-OA notified NDE-MP that the SCD is complete.
Exception Paths	None identified
Post-conditions	1. CDMD-OA contains the updated version of the equipment along with the correct versions of all its related TPD.
Issues	1. (Step 9) Is there feedback to NDE-MP that the SCD has been completed and all configuration data and TPD has been updated?
Reference Documents	TDS2-agenda-minutes-july.doc UC02-1-Update Technical Manuals.doc UC02-2-Update Training Material.doc UC02-3-Update EOSS Manuals.doc UC02-4-Update PMS Products.doc UC02-5-Update Engineering Drawings.doc

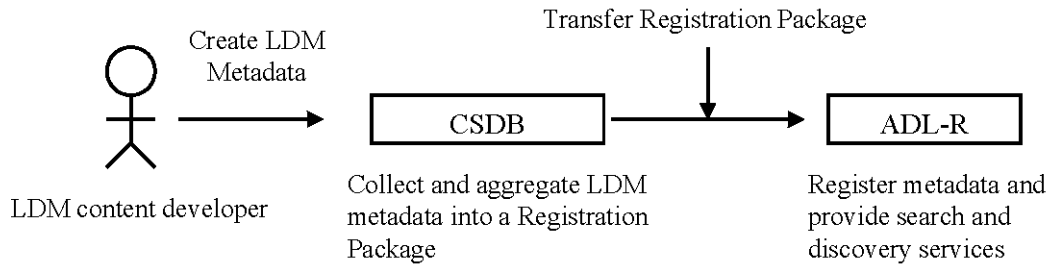
7.8 UC04: Distribute Technical Product Data to Ship

Summary	This use case describes the process by which a ship is updated to include the current version of TPD based on an equipment change.
Actors	
Preconditions	1. All equipment changes and related TPD modifications have been completed. 2. CDMD-OA contains all the correct and updated records as verified by the CDM (see UC03).
Basic Course of Events	1. The Ship Administrator requests all TMs that are the most current applicable versions. 2. TDKM compares the most current list with versions of the TMs that reside on the ship. 3. TDKM uploads the versions of the TMs that are applicable to the ship and are not already onboard. 4. TDKM-R stores the new TM versions on the ship. 5. The Ship Administrator requests to download the remaining TPD. 6. The CDM identifies all TPD that are the most current applicable versions. 7. The CDM retrieves the files from each of the respective CSDBs for each TPD type. 8. The CDM creates CDs for each data set and sends it to the Ship Administrator. 9. The Ship Administrator uploads the Training Material from CD to NEL. 10. The Ship Administrator uploads the PMS data from CD to PMS SKED. 11. The Ship Administrator uploads theSS Manuals from CD to ATIS. 12. The Ship Administrator uploads theEngineering Drawings from CD to ATIS.
Exception Paths	None identified
Post-conditions	1. The ship is updated to include all the most currently available TPD.
Issues	1. This use case has the CDM acting as the human interface between the Ship Admin request and the distribution of the data to the ship. We assume that many different people help fulfill this role. 2. (Step 11) What system stores the EOSS Manuals and Engineering Drawings on the Ship?
Reference Documents	TDS2-agenda-minutes-july.doc UC02-1-Update Technical Manuals.doc UC02-2-Update Training Material.doc UC02-3-Update EOSS Manuals.doc UC02-4-Update PMS Products.doc UC02-5-Update Engineering Drawings.doc UC03-Update Configuration Data.doc

7.9 UC05: Deliver Technical Product Data to Navy during Ship Acquisition

Summary	This use case describes the process by which TPD is delivered from the Shipyard or OEM to the Navy shore systems during ship acquisition and at final delivery of the ship to the Navy. The engineering and logistics products are transferred to the appropriate Navy repository and applicable configuration data is transferred to the respective Navy configuration management systems. Relationships between the engineering products, logistics products, and configuration data are maintained in order to facilitate change identification during subsequent design changes or maintenance activities.
Actors	
Pre-conditions	1. During the design and build phase, the Shipyards and OEMs maintain TPD in their internal systems and deliver the data to the Navy shore systems at times specified by their respective contracts. 2. The Shipyard and OEM internal systems maintain relationships between the equipment configuration and engineering and logistics products.
Basic Course of Events	1. Develop Engineering and Logistics Products. 2. Associate Engineering and Logistics Products to Equipment. 3. Transfer Engineering and Logistics Products and associated metadata to respective Navy systems.
Exception Paths	None identified
Post-conditions	1. At ship delivery, the Shipyards and OEMs deliver final TPD reflecting the as-built ship to the Navy shore systems. 2. The Navy shore systems transfer the final TPD to the ship prior to the ship becoming operational (see Use Case 04).
Issues	None identified
Reference Documents	TDS2-agenda-minutes-july.doc

7.10 UC06: Register Learning Content in ADL-R

Summary	This use case describes the process by which learning content is registered with the ADL-R.
Actors	
Pre-conditions	1. The CSDB can accept, collect and aggregate LDM metadata. 2. The CSDB has communication capability.
Basic Course of Events	1. An LDM content developer populates LDM metadata fields conforming to the metadata XML schema. This can be accomplished while the LDM content is under development. 2. The LDM metadata is stored within the CSDB. 3. The LDM is approved for Final release/issue. 4. A batch process is conducted by the CSDB that collects all final issue LDM metadata and aggregates it to conform to an existing ADL-R Registration Package schema. 5. A Registration Process command is executed that transfers the Registration Package to the ADL-R. 6. Bi-directional communication between the ADL-R and the CSDB confirms the receipt of the Registration Package. 7. Subsequent trusted DoD content developers login into the ADL-R and search/discover reusable training objects via stored metadata. 8. Metadata results include a link to the repository containing the actual content and identification of content owner. 9. The content developer contacts repository/content owner to request/retrieve object. 10. A notification service is enabled to permit update notification when source object is modified.
Exception Paths	None identified
Post-conditions	1. Training content in the form of S1000D data modules is registered in ADL-R and available for search/discovery.
Issues	1. (Step 9) LDM metadata must be expanded to include content owner contact information (email? Phone number?) 2. (Step 9) Trusted agent security procedures and processes must be developed to permit retrieval of content. 3. (Step 10) Notification service (email? RSS?) must be developed.
Reference Documents	DoDI 1322.26 ADL-R Registration Requirements

8 Findings and Next Steps

8.1 Findings

The objective of this project was to support the improvement of the Navy change management process by identifying processes and data exchanges that facilitate the identification of all impacted TPD during design of a planned equipment or system modification. This was accomplished by evaluating and documenting the lifecycle processes for various TPD and identifying areas where process efficiencies could be introduced to improve the quality and timeliness of delivery to the ship and to potentially reduce cost. As stated earlier in this report, the TPD lifecycle process is supported by a number of different methodologies, technologies, and systems based on a multitude of variables such as ship class, technical product type, program and/or command.

In order to understand some of the complexity of this problem, a generalized process framework for TPD was constructed. This framework provides a baseline from which the effectiveness of any one TPD development and delivery process can be evaluated. In addition, it enables the consideration of improvements to the overall, integrated process of developing and delivering all TPD to the ship.

The following conclusions can be derived from this report:

- Many systems, some new, some legacy, are currently being used to support the TPD lifecycle processes.
- Some systems (CDMD-OA, TDMIS, Contenta, etc.) are well established and could potentially be more effectively utilized.
- Some systems, such as TDKM, provide an essential set of services that could be extended to additional TPD types.
- The same fundamental services are being provided by similar systems (TDMIS, PMS MIS, EOSS Accountability, NAFL) for different TPD types or different commands, and the opportunity to consolidate should be considered.
- The data exchange between systems is often manual or non-existent.
- The coordination and synchronization across TPD for a specific change is not easily managed or audited.

The initial findings identified many opportunities for improvement. Additionally, it is clear that all TPD lifecycle process permutations could not be represented to the extent where a detailed solution can be proposed without further investigation. The next section describes a logical progression of steps to utilize the findings of this report.

8.2 Next Steps

A recommended approach for future work related to this effort is presented below. The approach is organized into a sequence of follow-on activities that further the analysis of the TPD lifecycle processes and systems. This further analysis will facilitate the identification of potential interoperability enhancements among Navy systems in an effort to improve the change management process.

Table 2 lists the recommended follow-on tasks derived from the use cases in this report. The recommended tasks are intended to be distinct tasks that can be performed as separate projects or groups of projects that will improve technical product data development, management, and distribution within the Navy. The Task ID in the table is used to uniquely identify each task and indicate from which use case the follow-on task was derived. The letter G denotes a general task that is applicable across multiple use cases. Multiple tasks derived from a single use case are denoted by a period and sequential number following the use case number (or following the letter G for general tasks).

Table 2. Recommended Follow-on Tasks

Task ID	Task Name	Task Description
G.1	Standard TPD Lifecycle	Investigate the benefits of creating a standard author-manage-register-distribute-use lifecycle for all TPD.
G.2	TPD Authoritative Source	Identify the authoritative source for all TPD and define how that information is distributed to all the other downstream systems.
G.3	Lifecycle Support Data Model	Document a standard data model to define the data exchange requirements between each of the systems that are involved in the lifecycle support of TPD.
G.4	TPD Process Improvement	Interview the SMEs in each discipline to determine opportunities to improve efficiency or integrity of system functionality and data exchanges.
G.5	Navy Lifecycle IDE	Investigate the effect of introducing a Navy Lifecycle IDE into the process.
G.6	SCD Data to CDMD-OA	Investigate the process and capability for transferring SCD data from NDE-MP to CDMD-OA.
UC01.1	Change Identification	Investigate process and capability to automatically identify HSC of equipment affected by a design change.
UC01.2	LSD Data in CDMD-OA	Investigate process and capability required for CDMD-OA to maintain LSD data for all TPD within the scope of this.
UC01.3	Change Notification from CDMD-OA	Investigate the capability to publish a change notification list of equipment and LSD data from CDMD-OA to a CSDB or product registry (such as TDMIS or PMS MIS).
UC01.4	Change Notification to ILS	Investigate the process by which a change request is delivered to ILS and then identify how the change is communicated to all the TPD development organizations.How and when are they notified of the specifics of the change so that they can act accordingly?Is there a way to find out the status of the overall process?
UC02-1.1	TM Change Notification from Contenta	Investigate the capability to publish configuration changes from Contenta to TDMIS.
UC02-2.1	Training Registry	Investigate the benefits of developing a registry for training products. Consider using existing systems (such as TDMIS) for this purpose.
UC02-2.2	Training CSDB	Investigate the benefits of developing a centralized CSDB for training products.
UC02-3.1	EOSS Change Notification from Contenta	Investigate the capability to publish configuration changes from Contenta to CDMD-OA and EOSS Accountability.
UC02-3.2	EOSS Registry	Investigate the benefits of developing a TDMIS-like registry for EOSS or expanding TDMIS to include EOSS manual information.
UC02-4.1	PMS Change Notification from PMS MIS	Investigate the capability to publish configuration changes from PMS MIS to CDMD-OA.
UC02-5.1	Drawing Registry	Investigate whether the SDI is sufficient as a registry for Drawings. Investigate how the SDI is created and where it is stored. Should it be created and maintained in one of the databases that store the configuration data for the drawings (such as CDMD-OA or NSEDR)?
UC03.1	TPD in CDMD-OA	Investigate the processes and capability for storing record type 3 data in CDMD-OA for all TPD types.
UC04.1	Training Material Distribution	Investigate the capability to automate the distribution of training material to the ship based on hull applicability.

Task ID	Task Name	Task Description
UC04.2	EOSS Distribution	Investigate the capability to automate the distribution of EOSS Manuals to the ship based on hull applicability.
UC04.3	PMS Distribution	Investigate the capability to automate the distribution of PMS Data to the ship based on hull applicability.
UC04.4	Engineering Drawing Distribution	Investigate the capability to automate the distribution of Engineering Drawings to the ship based on hull applicability.
UC05.1	Deliver TPD and relationships to Navy systems during ship acquisition	Investigate the mechanisms and data required to deliver engineering products, logistics products, configuration data, and appropriate relationships to the Navy systems in order to facilitate change identification during subsequent design changes or maintenance activities.
UC06.1	Register learning content in ADL-R	Investigate the capability to automatically publish learning content registration information from a CSDB to ADL-R.

The following describes a recommended approach for future work related to this effort is listed below. These overall tasks encompass all of the specific tasks defined in Table 1 and provide a recommended priority and grouping of tasks that will facilitate the completion of the follow-on tasks in an efficient and logical manner.

1. Interview the Subject Matter Experts (SMEs) for each of the TPD types and determine opportunities for improving processes, systems, and data exchanges. Use the TPD lifecycle framework described in this report to facilitate this discussion [G.1, G.4]

2. Document a detailed lifecycle support data model and system interface model for each TPD type. Analyze the data model and system interfaces to determine the ability to link related TPD for change notification purposes, determine potential improvements such as system consolidation, expansion of systems to account for additional TPD types, or development of interfaces between systems to improve interoperability. Include a matrix or inventory of systems required to support each TPD type, by command, ship type, and class as appropriate [G.2, G.3, UC01.1, and UC01.4].

3. Since CDMD-OA is a central system for maintaining configuration data and related logistics support data, analyze the process and capability required to fully utilize this system to maintain accurate information for each TPD type and provide information on TPD related to specific equipment to external systems [G.6, UC01.2, and UC01.3, and UC03.1].

4. Evaluate the use of system registries to maintain hull and equipment applicability for TPD types. Investigate the relationship between these systems and CDMD-OA. Look for commonality across TPD types and gaps in capability for specific TPD types [G1, UC02-2.1, UC02-3.2, UC02-4.1, and UC02-5.1].

5. Evaluate the management of TPD using CSDBs with an eye toward automation and commonality among all types. Investigate the relationship between CSDBs and registry systems and the ability to publish changes notifications from CSDBs to external systems [G.1, UC02-1.1, UC02-2.2, UC02-3.1, and UC06.1].

6. Evaluate the distribution of all TPD types with an eye toward automation and commonality among all types. Investigate the relationship between distribution systems, registry systems, and CSDB systems [G.1, UC04.1, UC04.2, UC04.3, and UC04.4].

7. Investigate the mechanisms and data required to deliver engineering products, logistics products, configuration data, and appropriate relationships to the Navy systems in order to facilitate change identification during subsequent design changes or maintenance activities. Investigate the issues with maintaining the proper relationships among the data as information is transferred to the respective PORs. Investigate the effect of introducing a Navy Lifecycle IDE into the process [G1, G5, and UC05.1].

8. Analyze how Naval Education Training Command (NETC) applications can interface with Navy technical product data management systems [G.1, UC02-2.1, UC02-2.2, UC03.1, UC04.1, UC05.1, and UC06.1].

9 Terms and Definitions

Term	Definition
Advanced Distributed Learning Registry (ADL-R)	An operational registration system for distributed eLearning content in the U.S. military. It is the first instance of a registry-based approach to repository federation resulting from the Content Object Repository Discovery and Registration/Resolution Architecture (CORDRA) project.
Common Source Database (CSDB)	An information store and management tool for all objects required to produce the TPD within projects.CSDB is often used in connection with the S1000D specification to describe the repository for data and publication modules. However, in this report it is used to denote the repository used to store all TPD including S1000D modules, TMs, training materials, etc,).
Configuration Data Managers Database - Open Architecture (CDMD-OA)	The CDMD-OA tracks the status and maintenance of naval equipment and their related logistics items (drawings, manuals, etc.) on ships and naval activities around the world. The status of a given piece of equipment on a ship determines what and how many spare parts for it will be stored on that ship, making this tracking extremely important in terms of cost, shipboard space and weight, and the operational availability of the ship.
Engineering Operational Sequencing System (EOSS)	EOSS was developed to provide watchstanders with technically correct, logically sequenced written procedures, charts and diagrams tailored to each ship's specific configuration. It dictates the procedures to be followed to complete major plant status changes. Use of EOSS ensures proper operation and minimizes damage to equipment or injury to personnel.
Hierarchical Structure Code (HSC)	The index into the Logistics Product Structure. The HSC is composed of the Expanded Ship Work Breakdown Structure (ESWBS), 5 characters, plus 7 additional characters to fully identify top-down breakdowns of systems to equipment at the lowest functionally significant member. The 5 ESWBS characters are defined by the Navy to identify like systems and equipment.
Integrated Logistics Support (ILS)	The Integrated Logistics Support (ILS) Branch within CCD develops and maintains full-spectrum integrated logistics products for the life cycle support of multi-service watercraft and equipment and provides accountability and inventory management for Navy boat assets. The Branch is a key player in warfighter support assisting resource sponsors in defining boat budget requirements, and assisting the program manager and other stakeholders in choosing the right boats/systems acquisition solutions.
Joint Engineering Data Management Information and Control System (JEDMICS)	The Joint Engineering Data Management Information and Control System (JEDMICS), formerly known as EDMICS before the 'joint' services status was added, is designed to provide a modern means of storing and retrieving engineering drawings and data in electronic repositories through the use of various optical, digital and magnetic mass storage devices, digitizing scanners, graphics hard copy devices, graphics display workstations and communications devices. JEDMICS addresses the needs of the primary and secondary engineering repositories for the United States Armed Services and the Defense Logistics Agency, including activities such as Navy Shipyards, Naval Aviation Depots and Army and Air Force maintenance depots.
Logistics Support Document (LSD)	In CDMD-OA, a term that refers to a document that is related to a piece of equipment. LSDs are represented in CDMD-OA as a Record Type 3 which contain metadata on the document, but do not store the physical document.

Term	Definition
Navy Data Environment (NDE)	Centralized database and web-based application used to manage Navy Modernization, Maintenance, Logistics, and Workload & Performance. The Navy Data Environment (NDE) is a centralized database and web-based application used to manage Navy Modernization, Maintenance, Logistics, and Workload & Performance. NDE is for UNCLASSIFIED use only. NDE was designed as an enterprise data model to integrate and merge existing modernization, maintenance, and logistics legacy data structures into a single design. The objective of NDE is to consolidate Fleet modernization business processes and legacy data systems. The following applications have been merged into the NDE common model: • FMPMIS (Logistics Module) and Alteration Installation Planning System (AIPS) became NDE-NM • FMPMIS (Program Module) and FMPMIS (Execution Module) became NDE Program & Execution Modules respectively • Afloat Master Planning System became NDE AMPS Module • Integrated Logistics Support (ILS) Cert/Master List became ILS Cert/Master List Module The following systems replicate data and interface with NDE to share alteration, scheduling, material, and financial data: • NDE-SPAWAR Integrated Data Environment (NDE-SIDE) • Configuration Data Managers Database-Open Architecture (CDMD-OA) The following systems will replicate data and interface with NDE to share alteration, scheduling, material and financial data: • Type Commander (TYCOM) • Alteration Management System (TAMS) • Integrated Modernization Planning for Aircraft Carriers (IMPAC)
Navy Data Environment-Modernization Plan (NDE-MP)	The portion of the Navy Data Environment (NDE) which maintains the Ship Alteration planning information including the Ship Change Document (SCD).
Navy eLearning (NeL)	The Navy program which manages the on-line courses for shore-based and afloat personnel. The courses are accessible via the web by more than a million personnel (active duty, civilian, employees, retirees and family members).
Navy Ships Engineering Drawing Repository (NSEDR)	Navy Program of Record for Engineering Drawings Management
Organizational Maintenance Management System Next Generation (OMMS-NG)	The Naval Tactical Command Support System (NTCSS) software application that has been designed to provide the operating forces with accurate, timely and relevant maintenance information. OMMS-NG supports the Maintenance and Material Management (3-M) programs, policies and procedures for Navy ships, submarines and supporting shore sites. OMMS-NG provides Navy maintenance personnel with access to the maintenance information required for configuration items, work candidates (formerly called maintenance actions or 2-Kilos), and part ordering.

Term	Definition
Ship Change Document (SCD)	The single authorized document for all ship changes (including SHIPALTs) within the Navy Fleet Modernization Program (FMP) process. The FMP process is described in the Surface Ships and Carriers Entitled Process for Modernization (SSCEPM) Management and Operations Manual. The intent of the SCD is to be the common lifecycle management document depicting a modernization change from concept to completion. The SCD is developed in increasing detail throughout each phase of the ship change development process to provide comprehensive documentation of the change. The SCD is reviewed at defined decision points in the process to provide Navy insight into the programmatic and technical details of the change. The SCD includes a Technical Analysis (TA), Cost Benefit Analysis (CBA) and Alteration Figure of Merit (AFOM) to aid in the decision to include the ship change in the Navy Modernization Process (NMP).
Technical Data Management Information System (TDMIS)	TDMIS is a Department of the Navy (DoN) database used to manage and track the life-cycle history of TMs. TDMIS currently contains TMs from Naval Sea Systems Command (NAVSEASYSCOM), Space and Naval Warfare Systems Command (SPAWARSYSCOM) and Naval Air Systems Command (NAVAIRSYSCOM) Air Traffic Control and Landing System (ATC&LS).
Technical Data Knowledge Management (TDKM)	TDKM synchronization allows a ship to download their ship-specific TMs from the Naval Engineering Technical Library (NETL), which is managed by NSDSA at NSWC Port Hueneme. All TMs developed in support of operation and maintenance of naval ships are required to be housed in the NETL. TDKM gives the fleet the ability to identify all TMs applicable to them and retrieve them if not already onboard.
Technical Manual Maintenance Activity (TMMA)	Maintenance of over 1,200 TMs for U.S. Navy boats including Boat Information Books, Ship's Information Books, Logistics Information Books, Custom Engine Parts Manuals and Operation and Maintenance Manuals.