

# TDP Modeling and Interoperability



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# The problem

- Lack of implementable form of MIL-STD-31000
- Lack of interoperability with popular preservation technologies
  - Digital library standards
  - Important for long term archival of TDPs



# The idea

- Attempt to represent TDP option selection worksheet in UML
- Then create an implementation model
  - Consider the METS\* packaging standard

\* **M**etadata **E**ncoding **T**ransmission **S**tandard



# Why METS?

- Encodes packaging information in XML
- Standardized by the library community
- Aligned with the Open Archival Information System reference model
- Widely implemented in digital repository software
- Customizable via profile mechanism
  - TDP profile?



# METS isn't the only game in town

- Other packaging standards exist
  - XML Formatted Digital Unit
  - 3D PDF
- PLCS DEX a possible implementable form
- But regardless of the target, conceptual modeling needed



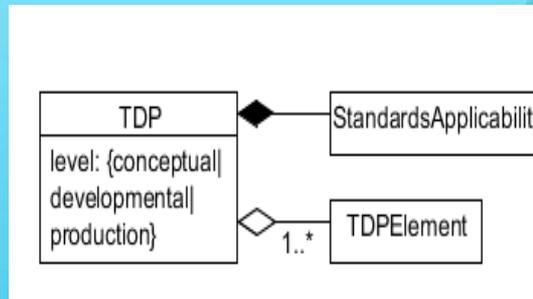
# Approach

Worksheet

Info model

METS XML

TOP OPTION SELECTION WORKSHEET			
SYSTEM:		DATE PREPARED:	
A. CONTRACT NO.	B. EXHIBIT/ATTACHMENT NO.	C. CLIN	D. CDRL DATA (ITEM NO(S))
1. TOP Level (X and complete as applicable.)			
A. <input type="checkbox"/> CONCEPTUAL LEVEL <input type="checkbox"/> DEVELOPMENTAL LEVEL <input type="checkbox"/> PRODUCTION LEVEL		B. REMARKS:	
2. TYPE AND FORMAT (X all that apply and complete as applicable.)			
A. <input type="checkbox"/> TYPE 2D: 2D DRAWINGS <input type="checkbox"/> TYPE 3D: 3D MODELS ONLY <input type="checkbox"/> TYPE 3D: 3D MODELS WITH ASSOCIATED 2D DRAWINGS		B. <input type="checkbox"/> NATIVE CAD (SPECIFY TYPE) <input type="checkbox"/> ISO 15926 STEP FORMAT (Specify STEP PROTOCOL AP203, AP 214 etc.) <input type="checkbox"/> ISO 33000 PORTABLE DOCUMENT FORMAT <input type="checkbox"/> OTHER ELECTRONIC FORMAT (SPECIFY TYPE) <input type="checkbox"/> HARDCOPY	
REMARKS:			
3. CAGE Code AND DOCUMENT NUMBERS			
A. <input type="checkbox"/> CONTRACTOR CAGE AND DOCUMENT NUMBERS		D. To Be Assigned By:	
B. USE CAGE CODE:		C. USE DOCUMENT NUMBERS:	
4. DRAWING FORMATS (X one and complete as applicable)			
<input type="checkbox"/> CONTRACTOR FORMAT. <input type="checkbox"/> GOVERNMENT FORMAT. REMARKS:			
5. TOP ELEMENTS REQUIRED (X all that apply)			
<input type="checkbox"/> ELEMENTS REQUIRED TO BE DETERMINED BY CONTRACTOR - OR THE FOLLOWING ARE REQUIRED:			
<input type="checkbox"/> CONCEPTUAL DRAWINGS/MODELS AND ASSOCIATED LISTS <input type="checkbox"/> DEVELOPMENTAL DESIGN DRAWINGS/MODELS AND ASSOCIATED LISTS <input type="checkbox"/> PRODUCT DRAWINGS/MODELS AND ASSOCIATED LISTS <input type="checkbox"/> COMMERCIAL DRAWINGS/MODELS AND ASSOCIATED LISTS <input type="checkbox"/> QUALITY ASSURANCE PROVISIONS <input type="checkbox"/> SPECIAL INSPECTION EQUIPMENT (SIE) DRAWINGS/MODELS AND ASSOCIATED LISTS <input type="checkbox"/> SPECIAL TOOLING (ST) DRAWINGS/MODELS AND ASSOCIATED LISTS <input type="checkbox"/> SPECIFICATIONS <input type="checkbox"/> SOFTWARE DOCUMENTATION <input type="checkbox"/> SPECIAL PACKAGING INSTRUCTIONS (SPI) DRAWINGS/MODELS AND ASSOCIATED LISTS			
6. ASSOCIATED LIST (X and complete as applicable)			
A. PARTS LIST (X ONE) <input type="checkbox"/> (1) INTEGRAL <input type="checkbox"/> (2) SEPARATE			
B. DATA LISTS (X ONE) <input type="checkbox"/> (1) NOT REQUIRED <input type="checkbox"/> (2) REQUIRED (SPECIFY LEVELS OF ASSEMBLY)			
C. INDEX LISTS (X ONE) <input type="checkbox"/> (1) NOT REQUIRED <input type="checkbox"/> (2) REQUIRED (SPECIFY LEVELS OF ASSEMBLY)			
D. WIRING LISTS (X ONE) <input type="checkbox"/> (1) NOT REQUIRED <input type="checkbox"/> (2) REQUIRED (SPECIFY LEVELS OF ASSEMBLY)			
E. IDENTIFIED DATA LISTS (X ONE) <input type="checkbox"/> (1) NOT REQUIRED <input type="checkbox"/> (2) REQUIRED (SPECIFY LEVELS OF ASSEMBLY)			
F. APPLICATION LISTS (X ONE) <input type="checkbox"/> (1) NOT REQUIRED <input type="checkbox"/> (2) REQUIRED (SPECIFY LEVELS OF ASSEMBLY)			
7. APPLICABILITY OF STANDARDS: The following Standards apply: (X as applicable)			
<input type="checkbox"/> ASME Y14.100 ENGINEERING DRAWING PRACTICES WITH APPENDICES: <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D <input type="checkbox"/> E		<input type="checkbox"/> OTHER STANDARDS APPLY AS DESCRIBED:	
<input type="checkbox"/> ASME Y14.20 TYPES AND APPLICATIONS OF ENGINEERING DRAWINGS <input type="checkbox"/> ASME Y14.34 ASSOCIATED LIST <input type="checkbox"/> ASME Y14.35 REVISION OF ENGINEERING DRAWINGS AND ASSOCIATED LIST <input type="checkbox"/> ASME Y14.41 DIGITAL PRODUCT DEFINITION DATA PRACTICES <input type="checkbox"/> ASME Y14.5 DIMENSIONING AND TOLERANCING		COMPANY STANDARDS PERMITTED <input type="checkbox"/> YES <input type="checkbox"/> NO	



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      <fptr FILEID="fuel-oil-system-material-list-excel"/>
      <fptr FILEID="fuel-oil-system-material-list-xml"/>
    </div>
    <div DMDID="DMD4" TYPE="Technical Service Manual">
      <div DMDID="DMD5">
        <fptr FILEID="TSM000"/>
      </div>
      <div DMDID="DMD6">
        <fptr FILEID="TSM154"/>
      </div>
      <div TYPE="2D Drawing">
        <div DMDID="DMD7">
          <fptr FILEID="TWR_Fuel-oil-transfer_6200949"/>
        </div>
        <div DMDID="DMD8">
          <fptr FILEID="TWR_Fuel-oil-transfer_6200950"/>
        </div>
        <div DMDID="DMD9" TYPE="Photo">
          <fptr FILEID="tr841photo"/>
        </div>
      </div>
    </div>
  </structMap>
  
```



# TDP option selection worksheet

TDP OPTION SELECTION WORKSHEET			
SYSTEM:		DATE PREPARED:	
A. CONTRACT NO.	B. EXHIBIT/ATTACHMENT NO.	C. CLIN	D. CDRL DATA ITEM NO(s).
<b>1. TDP Level (X and complete as applicable .)</b>			
A. <input type="checkbox"/> CONCEPTUAL LEVEL <input type="checkbox"/> DEVELOPMENTAL LEVEL <input type="checkbox"/> PRODUCTION LEVEL		B. REMARKS:	
<b>2. TYPE AND FORMAT (X all that apply and complete as applicable .)</b>			
A. <input type="checkbox"/> TYPE 2D: 2D DRAWINGS  <input type="checkbox"/> TYPE 3D: 3D MODELS ONLY <input type="checkbox"/> TYPE 3D: 3D MODELS WITH ASSOCIATED 2D DRAWINGS		B. <input type="checkbox"/> NATIVE CAD (SPECIFY TYPE) _____ <input type="checkbox"/> ISO 10303 STEP FORMAT (Specify STEP PROTOCOL AP203, AP 214 etc.) _____ <input type="checkbox"/> ISO 32000 PORTABLE DOCUMENT FORMAT _____ <input type="checkbox"/> OTHER ELECTRONIC FORMAT (SPECIFY TYPE) _____ <input type="checkbox"/> HARDCOPY _____ REMARKS :	
<b>3. CAGE Code AND DOCUMENT NUMBERS</b>		D. To Be Assigned By:	
A. <input type="checkbox"/> CONTRACTOR CAGE AND DOCUMENT NUMBERS <input type="checkbox"/> GOVERNMENT CAGE (COMPLETE 3B & 3C OR 3D)			
B. USE CAGE CODE:			
<b>4. DRAWING FORMATS (X one and complete as applicable)</b>			
<input type="checkbox"/> CONTRACTOR FORMAT. <input type="checkbox"/> GOVERNMENT FORMAT. REMARKS: _____			



# Continued

## 5. TDP ELEMENTS REQUIRED (X all that apply )

ELEMENTS REQUIRED TO BE DETERMINED BY CONTRACTOR - OR THE FOLLOWING ARE REQUIRED:

- CONCEPTUAL DRAWINGS/MODELS AND ASSOCIATED LISTS
- DEVELOPMENTAL DESIGN DRAWINGS/MODELS AND ASSOCIATED LISTS
- PRODUCT DRAWINGS/MODELS AND ASSOCIATED LISTS
- COMMERCIAL DRAWINGS/MODELS AND ASSOCIATED LISTS
- QUALITY ASSURANCE PROVISIONS
- SPECIAL INSPECTION EQUIPMENT (SIE) DRAWINGS/MODELS AND ASSOCIATED LISTS
- SPECIAL TOOLING (ST) DRAWINGS/MODELS AND ASSOCIATED LISTS
- SPECIFICATIONS
- SOFTWARE DOCUMENTATION
- SPECIAL PACKAGING INSTRUCTIONS (SPI) DRAWINGS/MODELS AND ASSOCIATED LISTS

## 6. ASSOCIATED LIST (X and complete as applicable)

<input type="checkbox"/> A. PARTS LIST (X ONE)	<input type="checkbox"/> (1) INTEGRAL	<input type="checkbox"/> (2) SEPARATE
<input type="checkbox"/> B. DATA LISTS (X ONE)	<input type="checkbox"/> (1) NOT REQUIRED	<input type="checkbox"/> (2) REQUIRED (SPECIFY LEVELS OF ASSEMBLY)
<input type="checkbox"/> C. INDEX LISTS (X ONE)	<input type="checkbox"/> (1) NOT REQUIRED	<input type="checkbox"/> (2) REQUIRED (SPECIFY LEVELS OF ASSEMBLY)
<input type="checkbox"/> D. WIRING LISTS (X ONE)	<input type="checkbox"/> (1) NOT REQUIRED	<input type="checkbox"/> (2) REQUIRED (SPECIFY LEVELS OF ASSEMBLY)
<input type="checkbox"/> E. INDENTURED DATA LISTS (X ONE)	<input type="checkbox"/> (1) NOT REQUIRED	<input type="checkbox"/> (2) REQUIRED (SPECIFY LEVELS OF ASSEMBLY)
<input type="checkbox"/> F. APPLICATION LISTS (X ONE)	<input type="checkbox"/> (1) NOT REQUIRED	<input type="checkbox"/> (2) REQUIRED (SPECIFY LEVELS OF ASSEMBLY)

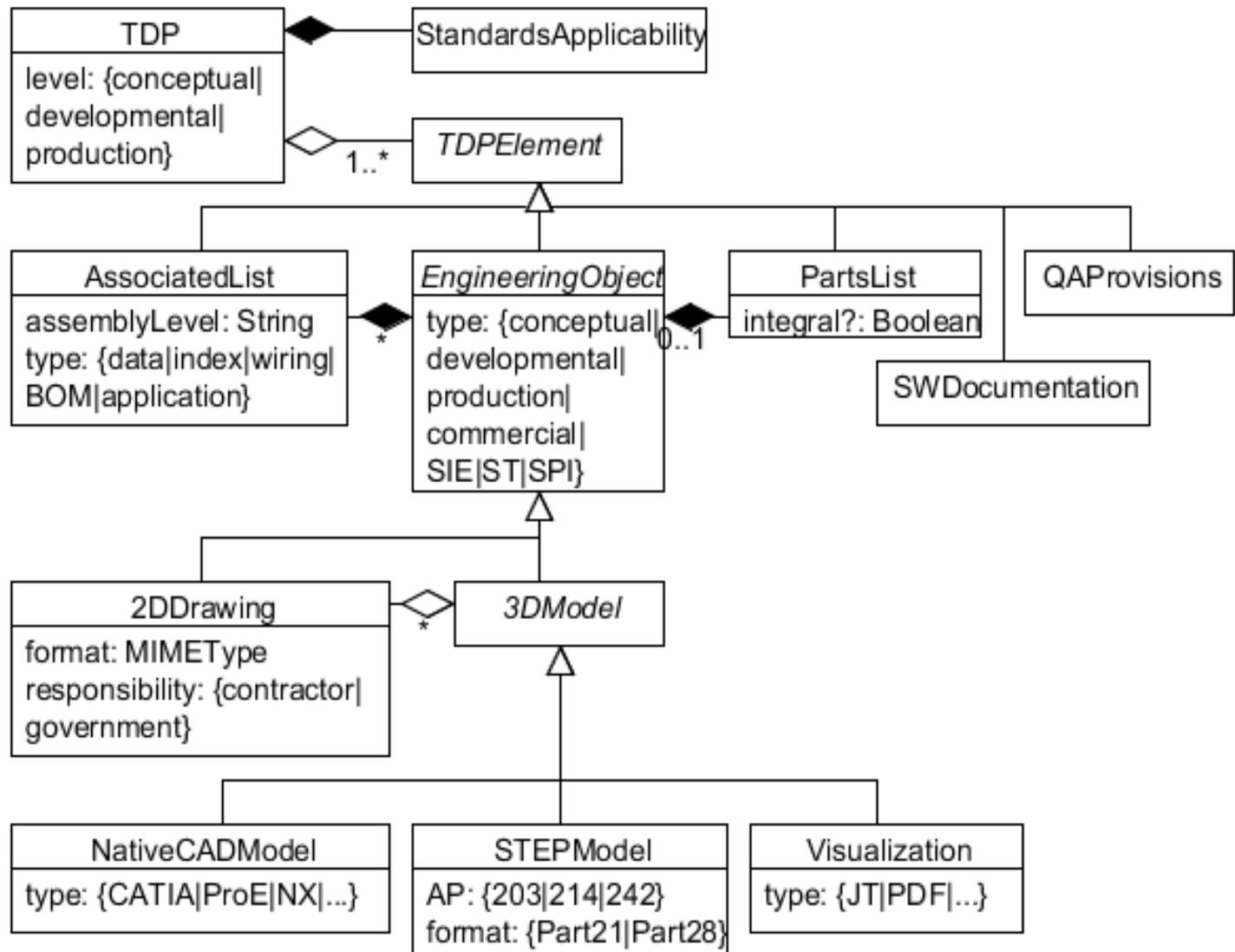
## 7. APPLICABILITY OF STANDARDS. The following Standards apply: (X as applicable)

<input type="checkbox"/> ASME Y14.100 ENGINEERING DRAWING PRACTICES WITH APPENDICES: <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D <input type="checkbox"/> E	<input type="checkbox"/> ASME Y14.24 TYPES AND APPLICATIONS OF ENGINEERING DRAWINGS <input type="checkbox"/> ASME Y14.34 ASSOCIATED LIST <input type="checkbox"/> ASME Y14.35 REVISION OF ENGINEERING DRAWINGS AND ASSOCIATED LIST <input type="checkbox"/> ASME Y14.41 DIGITAL PRODUCT DEFINITION DATA PRACTICES <input type="checkbox"/> ASME Y14.5 DIMENSIONING AND TOLERANCING	<input type="checkbox"/> OTHER STANDARDS APPLY AS DESCRIBED:  COMPANY STANDARDS PERMITTED <input type="checkbox"/> YES <input type="checkbox"/> NO
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# TDP options as a UML model....





# Caveats

- This is a straw man
  - Feel free to burn it ;-)
- It's incomplete
- It makes assumptions

*But it's a starting point for discussion*



# METS top-level elements

**<metsHdr>**  
mets Header

**<dmdSec>**  
descriptive metadata Section

**<amdSec>**  
administrative metadata Section

**<fileSec>**  
file Section

**<structMap>**  
structural Map section

**<structLink>**  
structural Link section

**<behaviorSec>**  
behavior Section



# TDP/METS mapping

<b>METS section</b>	<b>TDP metadata</b>
<b>Descriptive Metadata (&lt;dmdSec&gt;)</b>	<b>TDP Level, Drawing Formats, Applicability of Standards</b>
<b>Administrative Metadata (&lt;admSec&gt;)</b>	<b>Type and Format, CAGE Code and Document Numbers</b>
<b>File Section (&lt;fileSec&gt;)</b>	<b>[locations of required TDP elements and associated lists]</b>
<b>Structural Map (&lt;structMap&gt;) and possibly Structural Link (&lt;structLink&gt;)</b>	<b>TDP Elements Required, Associated lists, derived drawings, visualizations</b>



# METS profile for TDP

- Seems straightforward
- Would make MIL-STD-31000 easier to implement
  - XML tools could determine validity of a TDP
  - TDP requirements computer-interpretable
  - Digital repository tools could ingest, manage, and provide access to TDPs



# MIL-STD-31000 Issues

- Does TDP Level (Conceptual, Developmental, Production) apply to TDP as a whole, each element, or both?
- Is the 'responsibility' attribute really necessary? It looks like a relic from the paper-based drawing days.



# Dependencies not explicit

- Relevancy of associated lists and applicable standards with respect to TDP elements
- Use cases not considered, even though they influence model contents



# Derived models

- Need to capture relationships between native CAD, STEP, visualizations
  - Show traceability
  - Ensure consistent interpretation and preservation of semantics



# Issues with METS (and library packaging standards)

- Document-centric
  - Hierarchical structures assumed to be document structures
  - Links assumed to be hyperlinks
- Structural links use the W3C XML Linking (XLink) standard
  - Not much software support
- Repository tools impose additional constraints



# Summary

- Representation, exchange, long-term retention of TDPs a challenge
- We can learn from the librarians
- Technical Data Package metadata can be represented using METS
- But first we must agree on an *unambiguous* MIL-STD-31000 information model

