SNAME MARITIME 2022 CONVENTION

26-29 September | Houston, TX

Using Artificial Intelligence (AI) to Simplify Provisioning of Navy Standard Requirements

Presented by: Vicky Dlugokecki

FINCANTIERI MARINETTE MARINE

auros™ Knowledge Best Shared™

Project Team

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Project Goal

- **Use Knowledge Provisioning to simplify and strengthen compliance tracking and verification of Navy Standard Requirements within shipyard workflows**

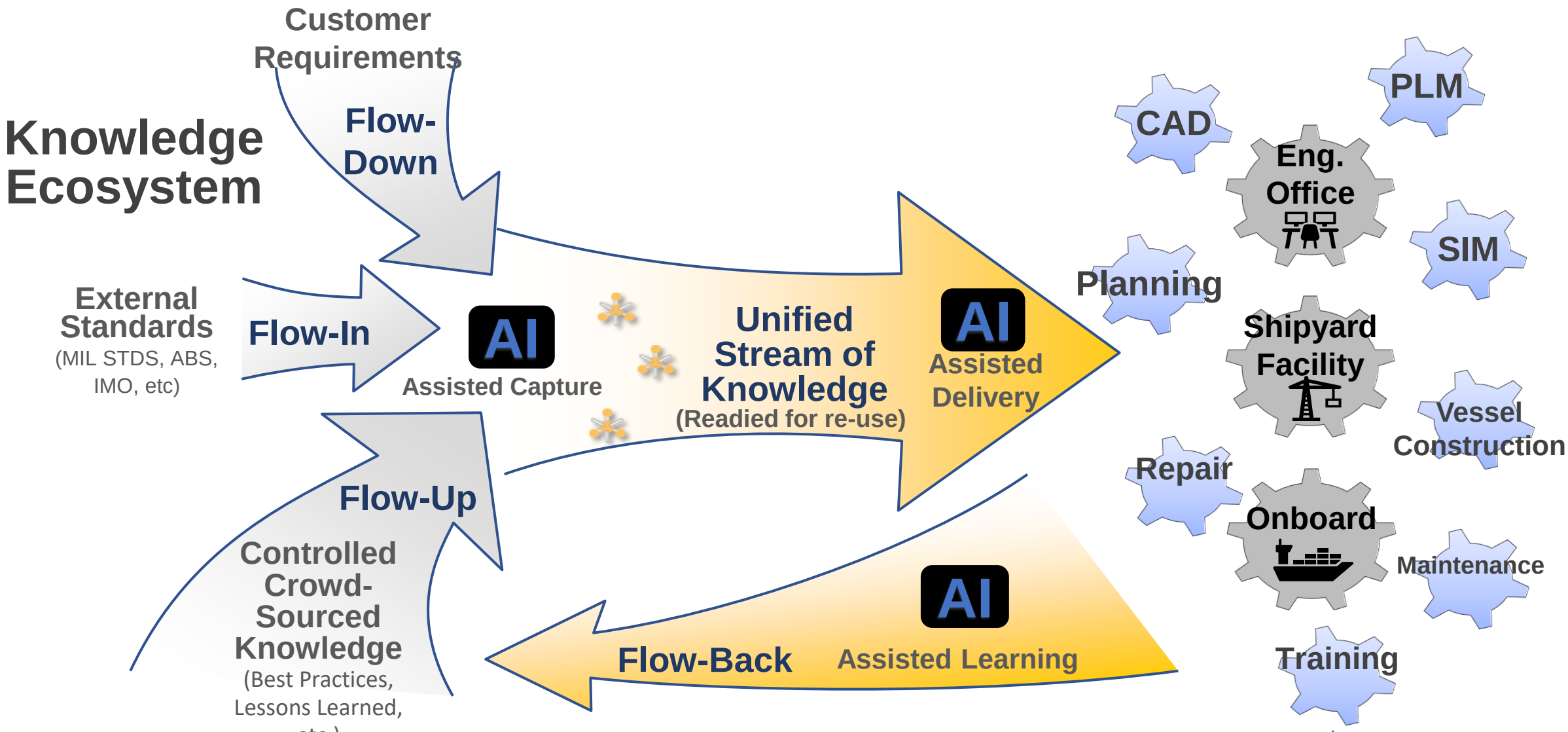
Project Objectives

- **Develop toolset to efficiently parse Navy Standard Requirements into logical individual rules**
- **Use Artificial Intelligence and Machine Learning to categorize each rule**
- **Programmatically construct Assessments of relevant rules for provisioning rules into shipyard workflows**
- **Track and capture compliance to Navy Standard Requirements to provide the Navy a more efficient mechanism to verify design**

Project Business Value

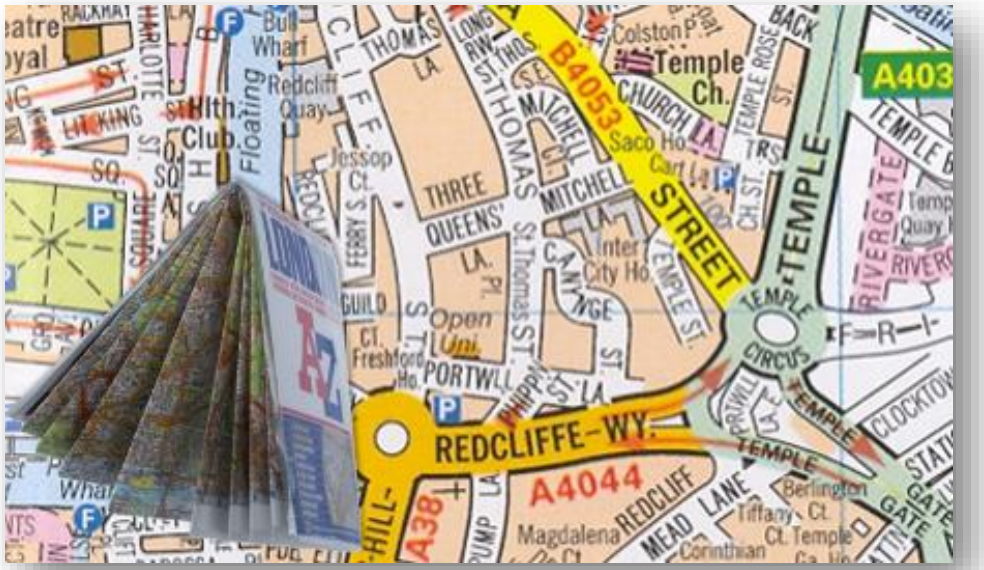
- **Eliminate inefficiency of manually parsing Navy Standard Requirements documents**
- **Avoid the need to manually develop and update design check sheets**
- **Eliminate design flaws due to human error overlooking or missing standards**
- **Provide single location for tracking compliance and capturing verification evidence**

Knowledge Operating Model



What is Knowledge Provisioning

Represents a fundamental shift in how specifications and requirements are managed and provisioned.



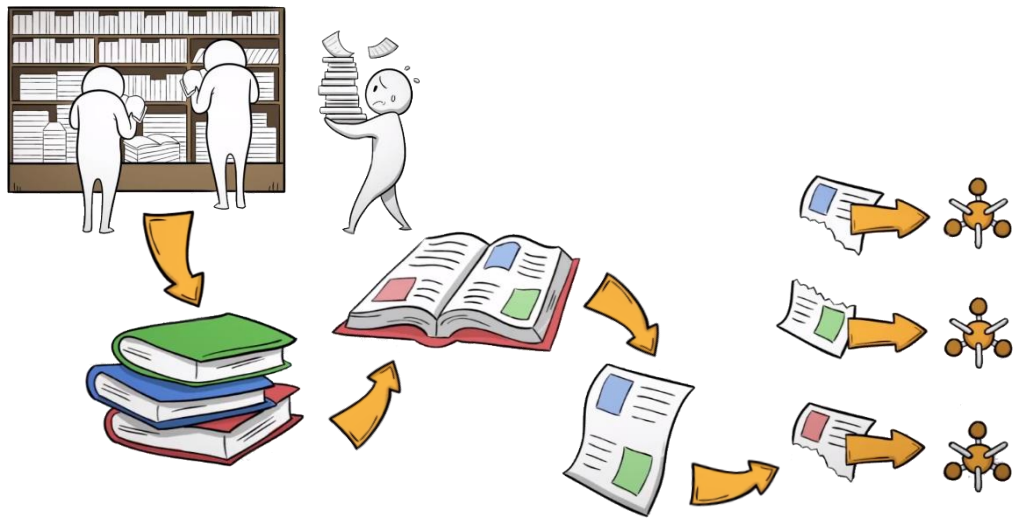
Static
Immediately out of date
Impossible to use while driving

Dynamic
Easy to use
Provisions directions as needed
Provide insights from other drivers

Knowledge Aware / Provisioning

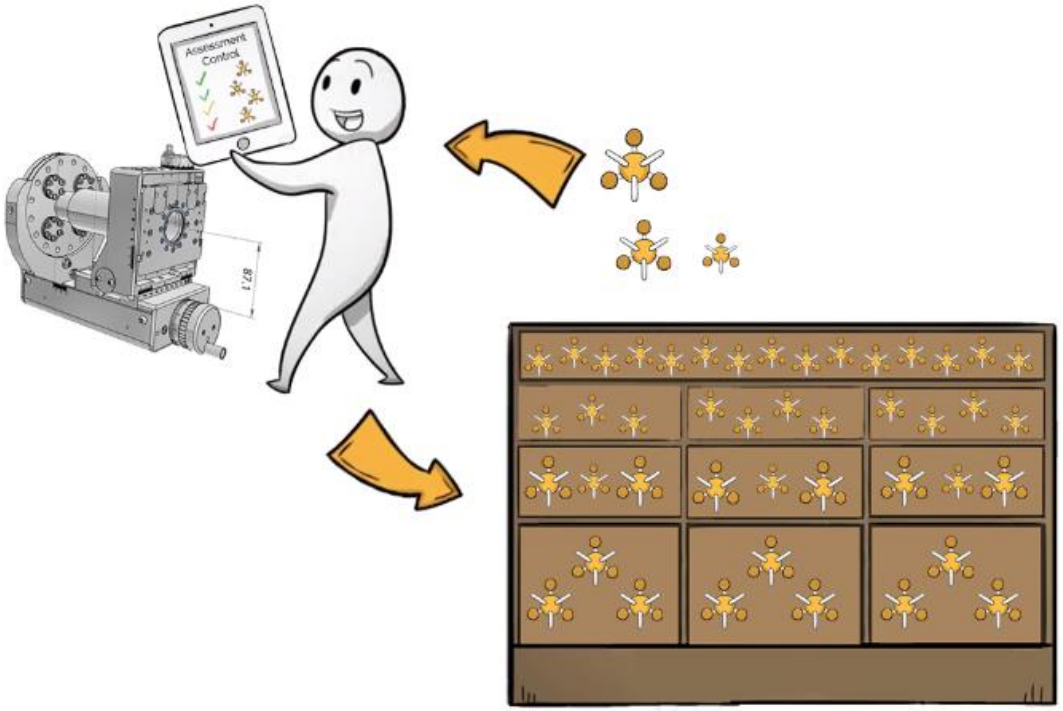
Knowledge Packets

Existing
Documentation
& Know-How

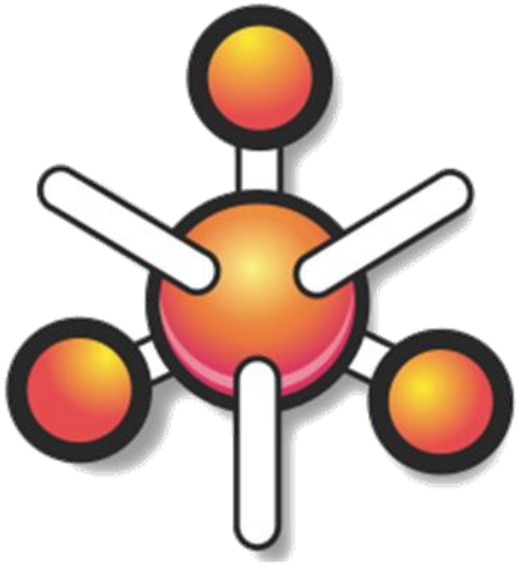


Knowledge
Packets (K-PACs)

Assessment Controls



Knowledge Provisioning Fundamentals



Knowledge Packet

Rule Processing Engine

Assessment Control

Auros Core Technology

Knowledge Packet

K-PAC Detail View - Google Chrome

fmm.aurosks.com/kpac/view/MIL-1750#details

MIL-1750 4.7.2 Filler material.

DETAILS RELATIONS TEAMS DISCUSSIONS

v1

Description

4.7.2 Filler material.(a) Unless permitted by table III, a change from a filler material listed under one A-number in table II to a material listed under another A-number or to any other material not listed (unless considered a part of a group in accordance with note 1 of table II) except as follows:

(1) For A-2C materials, the following applies:
a. A change in flux/wire classification of lower specified tensile strength to a flux/wire classification with higher specified tensile strength (e.g. MIL-F-6XX-XXXXX to MIL-F-7XX-XXXXX or MIL-70S-X).
b. When joining base metals 1/2 inch and thicker having tough- ness requirements, a change in flux/wire classification with no toughness requirements to a flux/wire classification with toughness requirements. Also a change in flux/wire classification with toughness specified at a higher temperature to a flux/wire classification with toughness specified at a lower temperature.
c. A change from neutral to active flux and vice versa for multilayered weld deposits.

(2) For MIL-120 and MIL-140 series filler materials, see table II, footnote 13.
(b) In submerged-arc process, a change in the type flux used, except as permitted in table II.
(c) In plasma-arc process, the addition or deletion of supplementary powdered filler metal.
(d) In plasma-arc process, a change in the form of filler metal from solid to fabricated wire, flux cored wire, powdered metal or vice versa.
(e) In plasma-arc weld surfacing, a change from a homogeneous powdered metal to a mechanical mixed powdered metal or vice versa.
(f) For internal tube-to-header welds in boiler components.

(1) A change in electrode coating classification, that is, MIL-XX15 to MIL-XX16 or MIL-XX18, and so forth, and vice-versa; or:

(2) An increase in electrode diameter of 1/32 inch or more from that qualified for any weld pass.

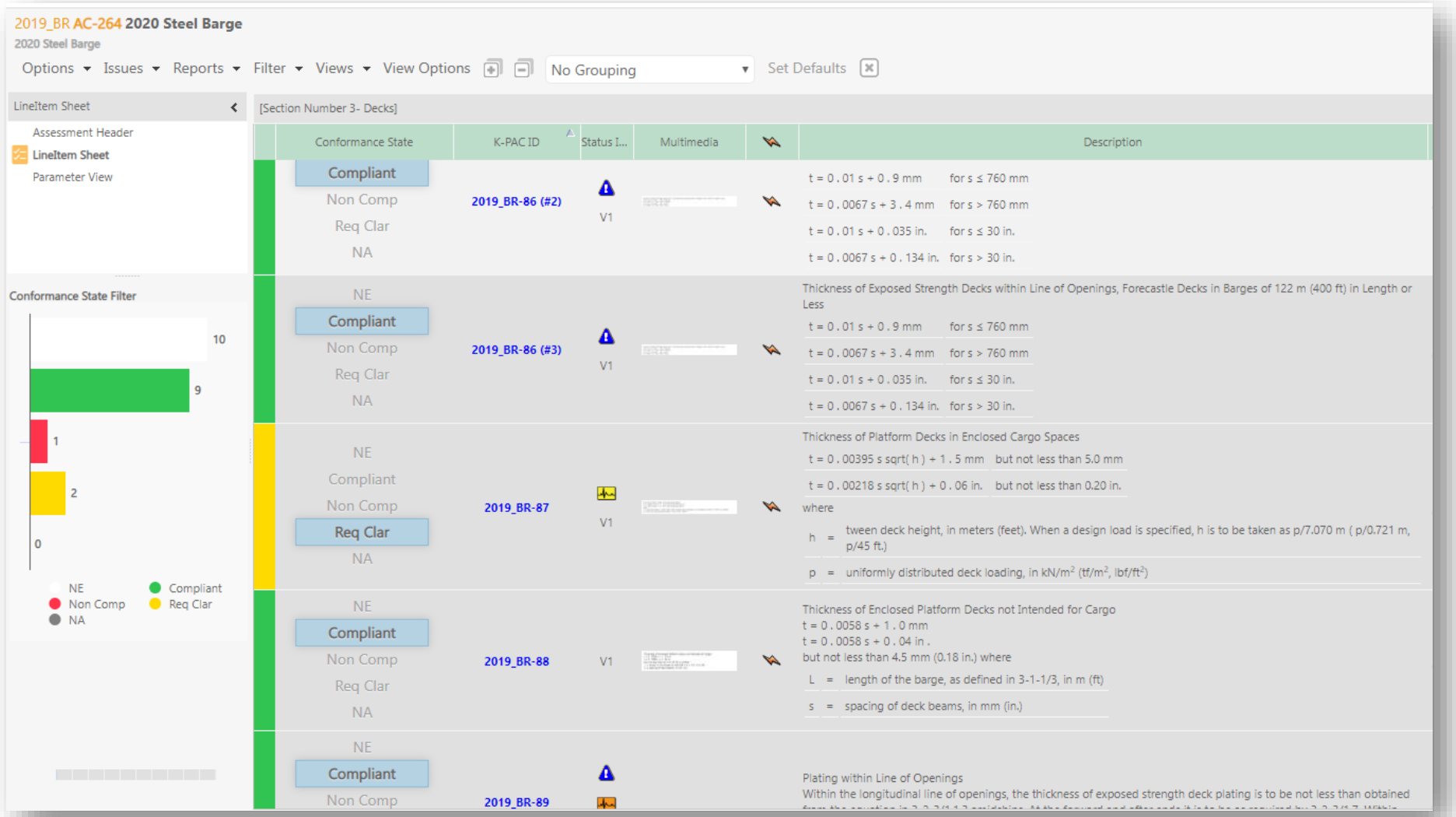
(g) In stud welding, a change in the nominal weld base diameter of the stud. (h) For weld surfacing applications, when using the automatic or mechanized gas tungsten-arc or plasma-arc processes, a reduction of 10 percent or greater in the filler wire (or powder) feed rate from that recorded in the procedure qualification record.
(i) See table II, note 2.
(j) For submerged-arc process, a change in the flux trade name when the flux is not classified in table II. Also a change in the flux type (for example, neutral to active and vice-versa) for multilayer welds in S-1 or S-2 materials. (k) See table II, note 11, for A-45 filler materials.
(l) In plasma arc weld surfacing, a change in the powdered metal particle size range recorded in the procedure qualification record.

Additional Information

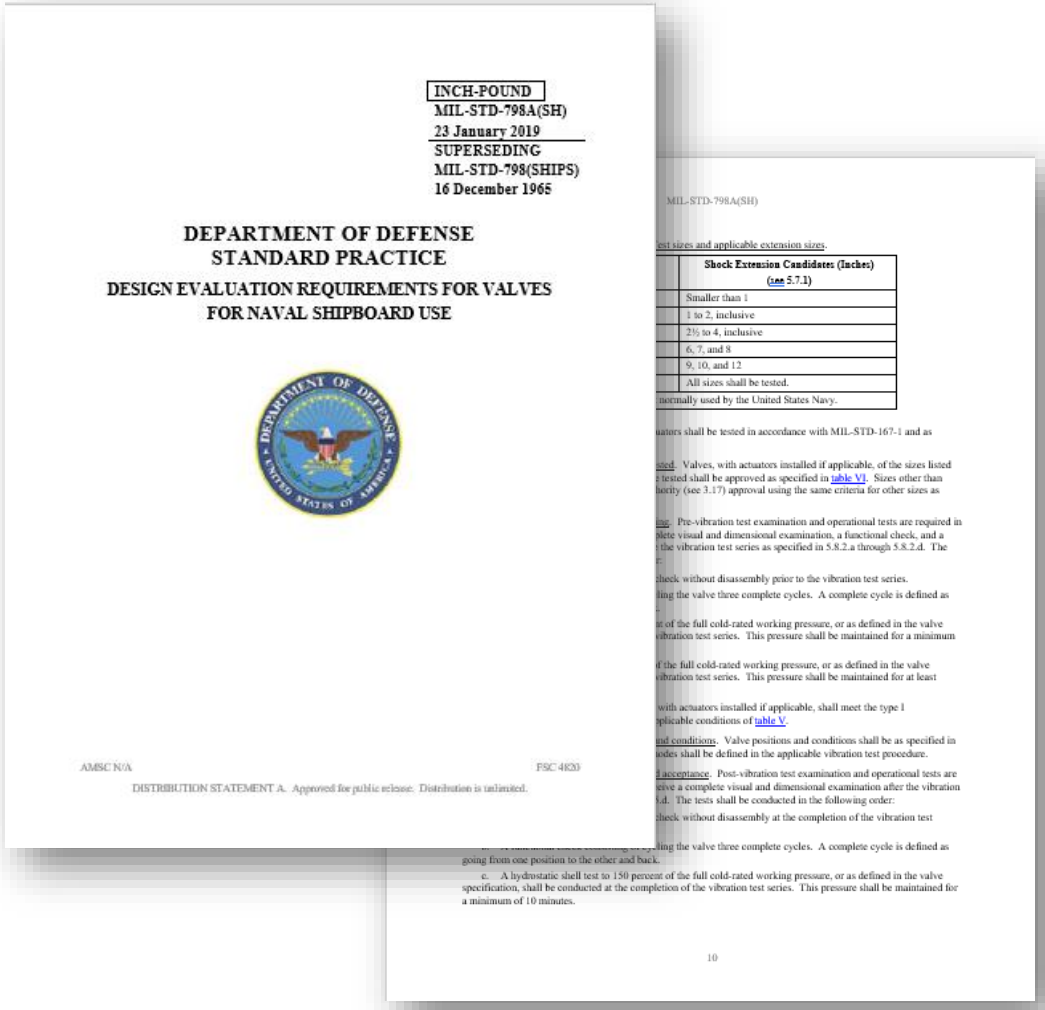
Kpac content in PDF

Auros Core Technology

Assessment Control



Knowledge Aware for Navy Requirements



INCH-POUND
MIL-STD-798A(SH)
23 January 2019
SUPERSEDING
MIL-STD-798(SHIPS)
16 December 1965

DEPARTMENT OF DEFENSE
STANDARD PRACTICE
DESIGN EVALUATION REQUIREMENTS FOR VALVES
FOR NAVAL SHIPBOARD USE

AMSC N/A FSC 4820

DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited.

MIL-STD-798A(SH)

	Shock Extension Candidates (Inches) (see 5.7.1)
	Smaller than 1
	1 to 2, inclusive
	2½ to 4, inclusive
	6, 7, and 8
	9, 10, and 12
	All sizes shall be tested.

normally used by the United States Navy.

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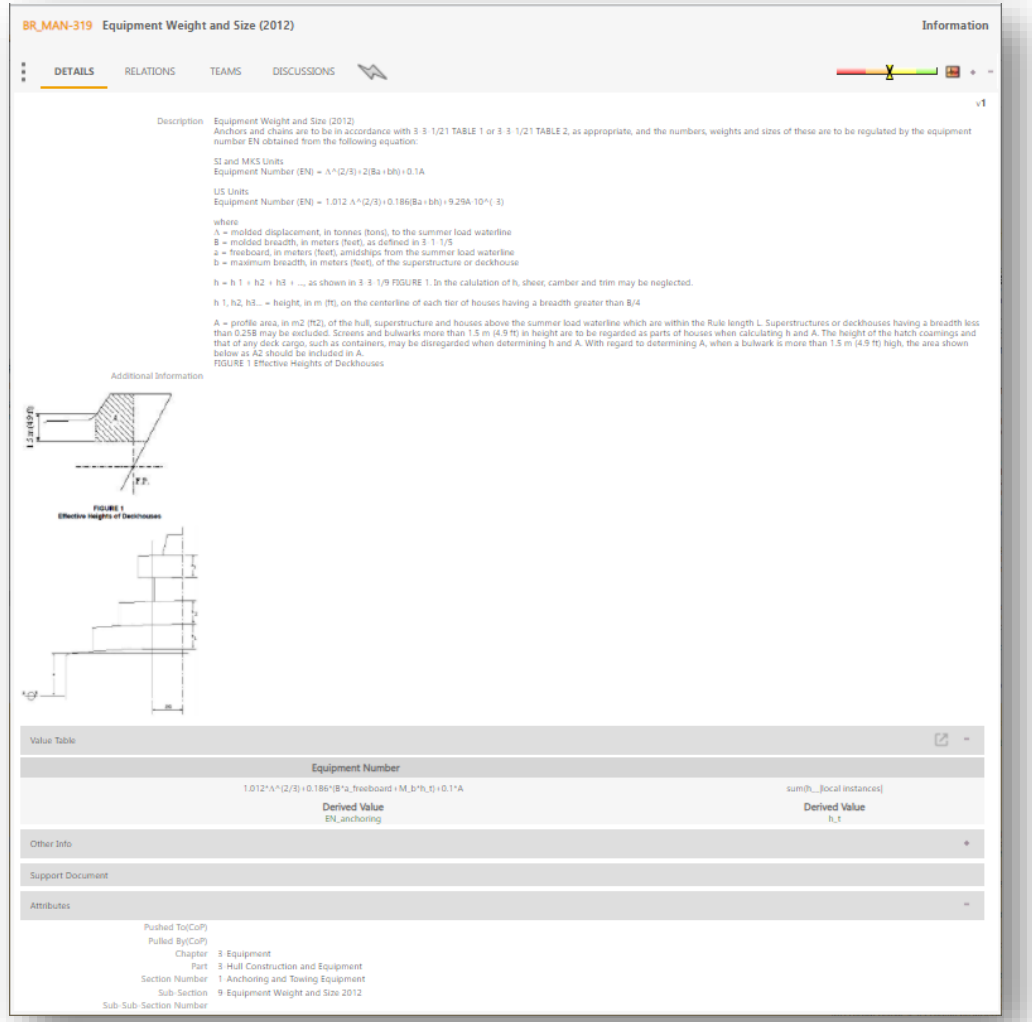
Sample Mil Standard Source Documents



BR_MAN-319 Equipment Weight and Size (2012) Information

DETAILS RELATIONS TEAMS DISCUSSIONS

Description Equipment Weight and Size (2012)
Anchors and chains are to be in accordance with 3-3-1/21 TABLE 1 or 3-3-1/21 TABLE 2, as appropriate, and the numbers, weights and sizes of these are to be regulated by the equipment number EN obtained from the following equation:

SI and MKS Units
Equipment Number (EN) = Δ^(2/3) + 2(Ba + bh) + 0.1A

US Units
Equipment Number (EN) = 1.012 Δ^(2/3) + 0.186(Ba + bh) + 9.29A·10^(-3)

where
Δ = molded displacement, in tonnes (tons), to the summer load waterline
B = molded breadth, in meters (feet), as defined in 3-1-1/5
a = freeboard, in meters (feet), amidships from the summer load waterline
b = maximum breadth, in meters (feet), of the superstructure or deckhouse

h = h 1 + h2 + h3 + ..., as shown in 3-3-1/9 FIGURE 1. In the calulation of h, sheer, camber and trim may be neglected.

h 1, h2, h3,... = height, in m (ft), on the centerline of each tier of houses having a breadth greater than B/4

A = profile area, in m2 (ft2), of the hull, superstructure and houses above the summer load waterline which are within the Rule length L. Superstructures or deckhouses having a breadth less than 0.25B may be excluded. Screens and bulwarks more than 1.5 m (4.9 ft) in height are to be regarded as parts of houses when calculating h and A. The height of the hatch coamings and that of any deck cargo, such as containers, may be disregarded when determining h and A. With regard to determining A, when a bulwark is more than 1.5 m (4.9 ft) high, the area shown below as A2 should be included in A.
FIGURE 1 Effective Heights of Deckhouses

Additional Information

Value Table

Equipment Number	
1.012*Δ^(2/3) + 0.186*(B*a_freeboard + M_b*h_t) + 0.1*A	sum(h_ [local instances]
Derived Value EN_anchoring	Derived Value h_t

Other Info

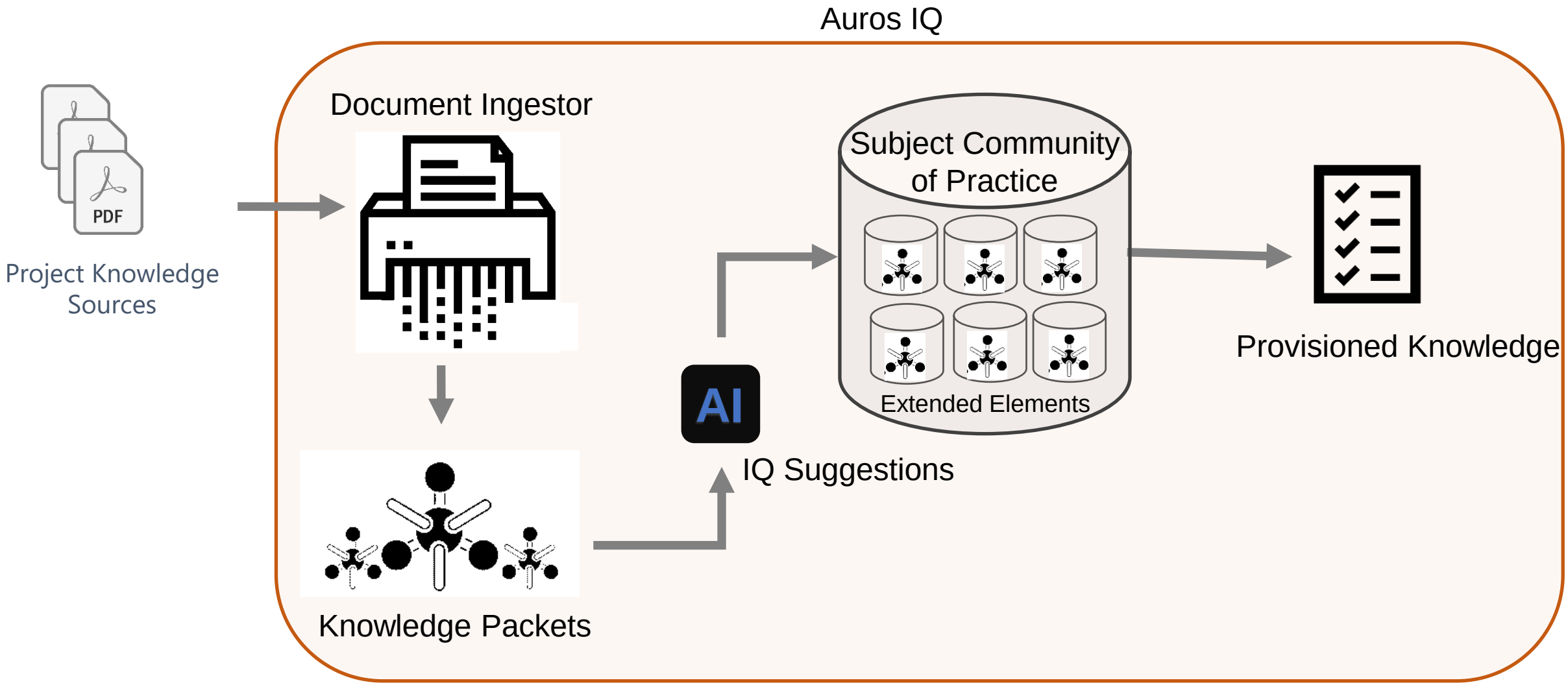
Support Document

Attributes

Pushed To(CoP)
Pulled By(CoP)
Chapter 3 Equipment
Part 3 Hull Construction and Equipment
Section Number 1 Anchoring and Towing Equipment
Sub-Section 9 Equipment Weight and Size 2012
Sub-Sub-Section Number

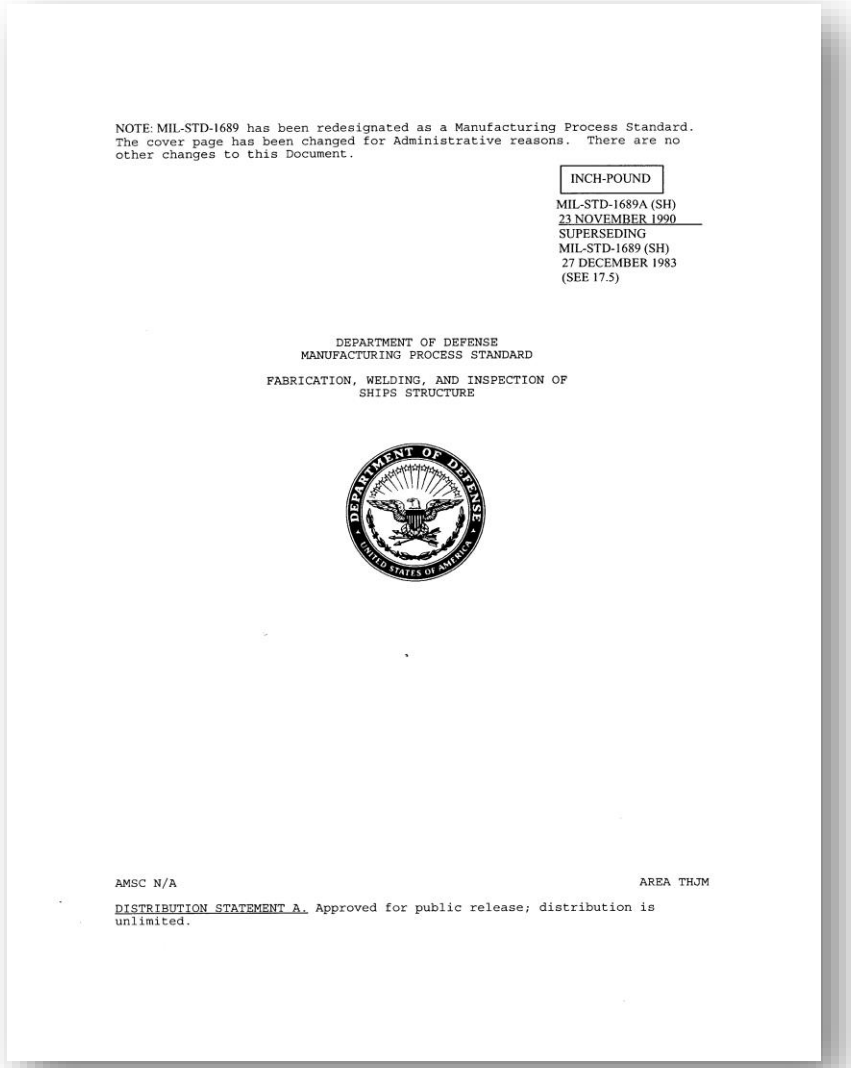
Knowledge Packet

Bulk K-PAC Creation / Classification



Document Ingestor Overview

Challenges



NOTE: MIL-STD-1689 has been redesignated as a Manufacturing Process Standard. The cover page has been changed for Administrative reasons. There are no other changes to this Document.

INCH-POUND

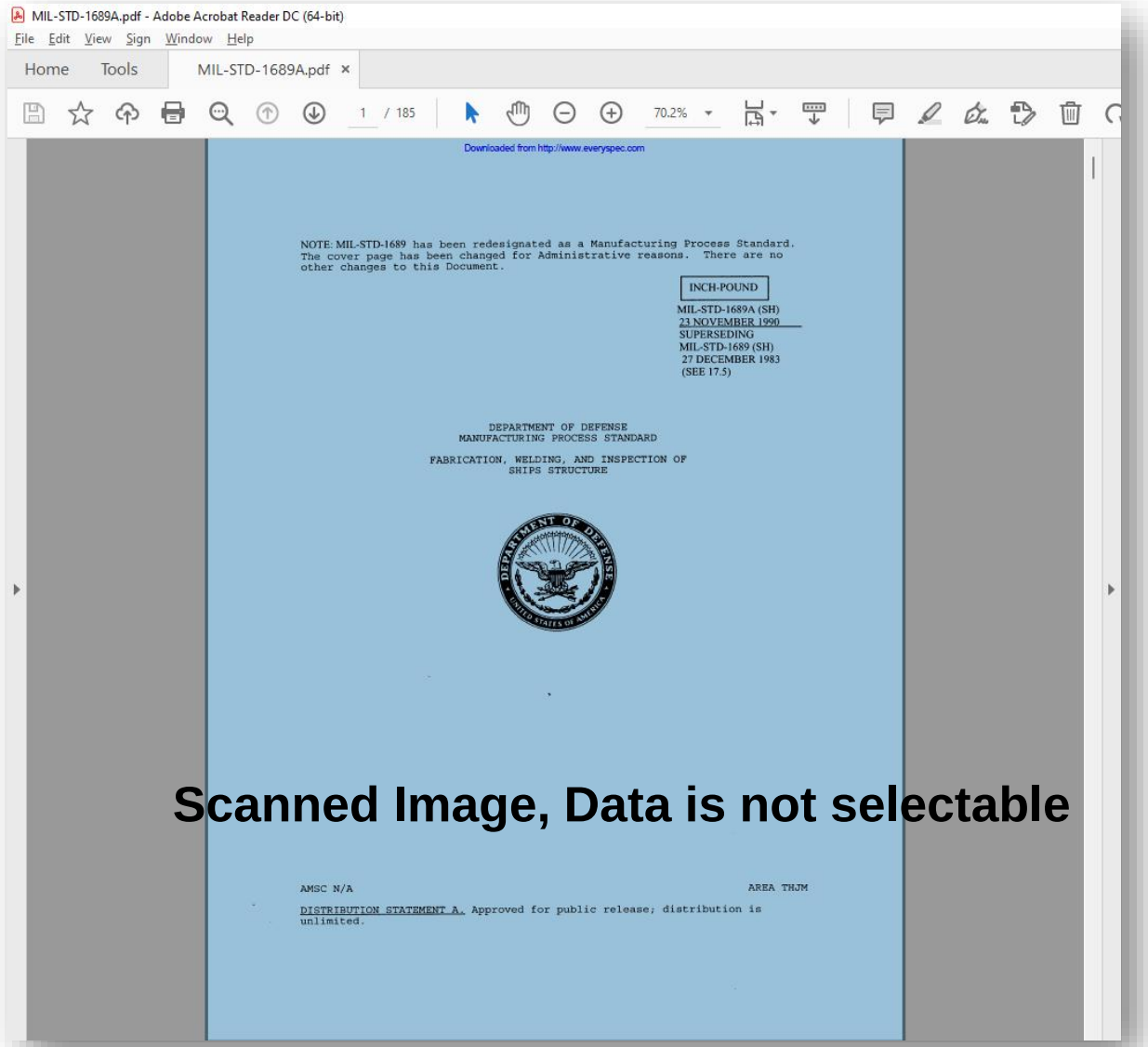
MIL-STD-1689A (SH)
23 NOVEMBER 1990
SUPERSEDING
MIL-STD-1689 (SH)
27 DECEMBER 1983
(SEE 17.5)

DEPARTMENT OF DEFENSE
MANUFACTURING PROCESS STANDARD

FABRICATION, WELDING, AND INSPECTION OF
SHIPS STRUCTURE

AMSC N/A AREA THJM

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

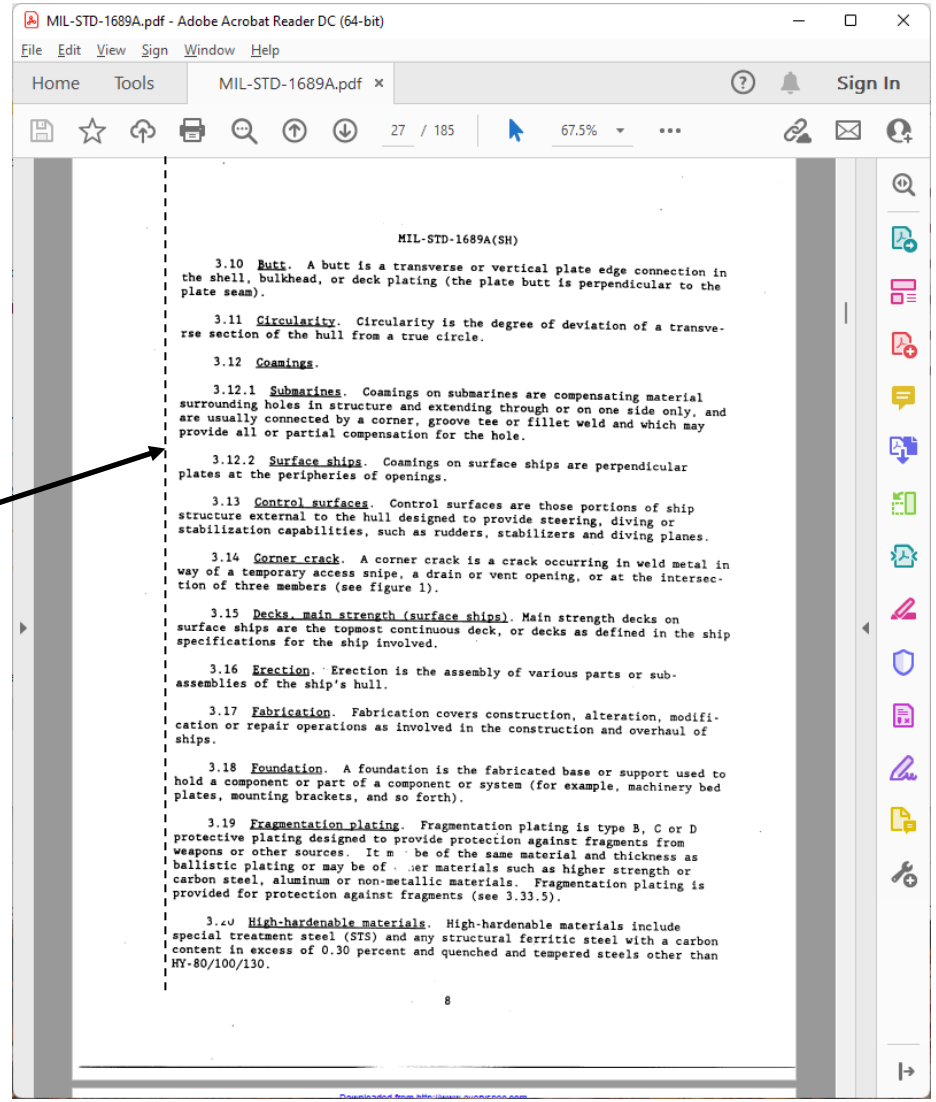


Scanned Image, Data is not selectable

Mil Standard 1689A

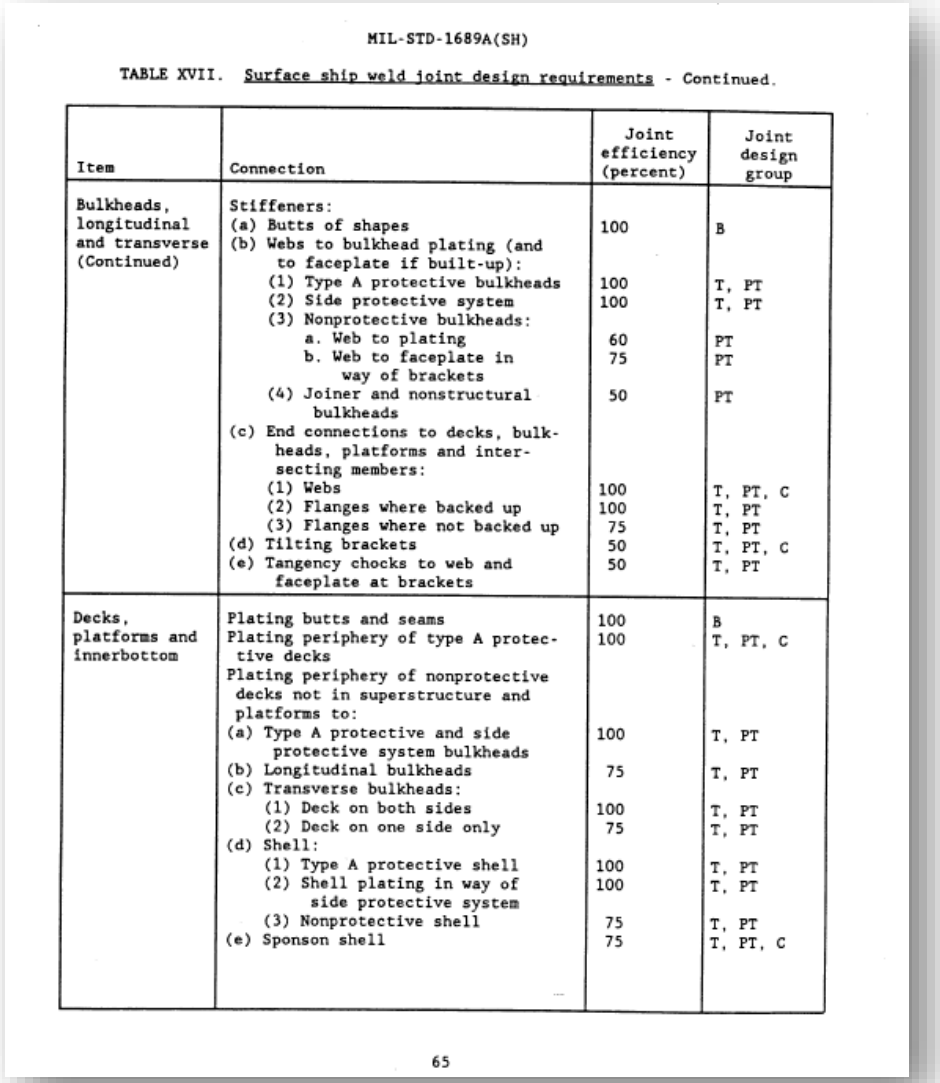
Challenges

Scanned image is skewed



Mil Standard 1689A

Challenges



MIL-STD-1689A(SH)

TABLE XVII. Surface ship weld joint design requirements - Continued.

Item	Connection	Joint efficiency (percent)	Joint design group
Bulkheads, longitudinal and transverse (Continued)	Stiffeners:		
	(a) Butts of shapes	100	B
	(b) Webs to bulkhead plating (and to faceplate if built-up):		
	(1) Type A protective bulkheads	100	T, PT
	(2) Side protective system	100	T, PT
	(3) Nonprotective bulkheads:		
	a. Web to plating	60	PT
	b. Web to faceplate in way of brackets	75	PT
	(4) Joiner and nonstructural bulkheads	50	PT
	(c) End connections to decks, bulkheads, platforms and intersecting members:		
	(1) Webs	100	T, PT, C
	(2) Flanges where backed up	100	T, PT
	(3) Flanges where not backed up	75	T, PT
	(d) Tilting brackets	50	T, PT, C
	(e) Tangency chocks to web and faceplate at brackets	50	T, PT
Decks, platforms and innerbottom	Plating butts and seams	100	B
	Plating periphery of type A protective decks	100	T, PT, C
	Plating periphery of nonprotective decks not in superstructure and platforms to:		
	(a) Type A protective and side protective system bulkheads	100	T, PT
	(b) Longitudinal bulkheads	75	T, PT
	(c) Transverse bulkheads:		
	(1) Deck on both sides	100	T, PT
	(2) Deck on one side only	75	T, PT
	(d) Shell:		
	(1) Type A protective shell	100	T, PT
	(2) Shell plating in way of side protective system	100	T, PT
	(3) Nonprotective shell	75	T, PT
	(e) Sponson shell	75	T, PT, C

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Mil Standard 1689A

Table recognition / Parsing cues

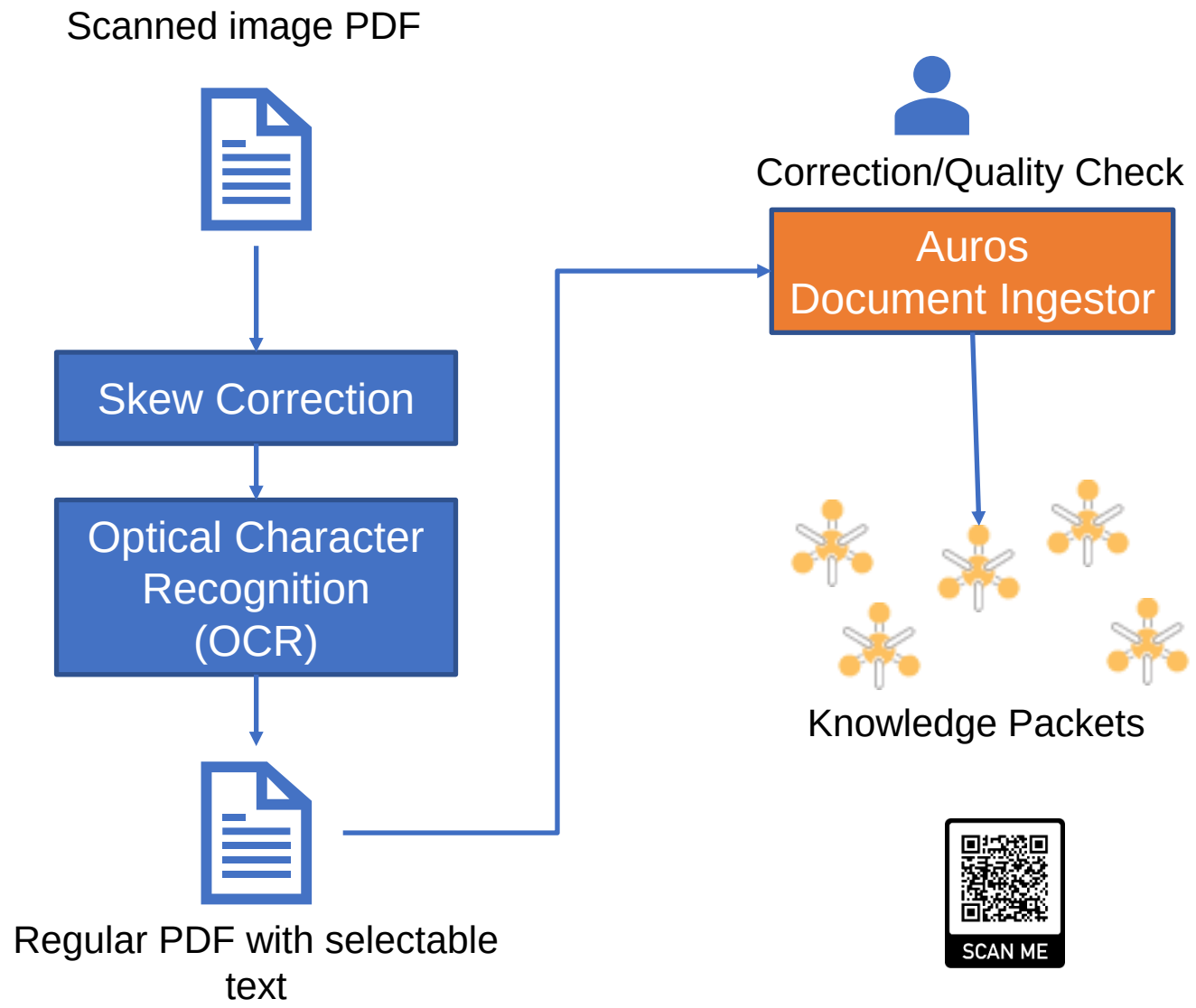
Solution Discussion

Skew Detection:

- Algorithm based on Projection profile method
- Can detect skew angle in the range of ±5°
- Takes around 1 to 3 seconds per page

OCR:

- Based on Adobe PDF services
- Takes around 1 to 3 seconds per page



Solution Discussion

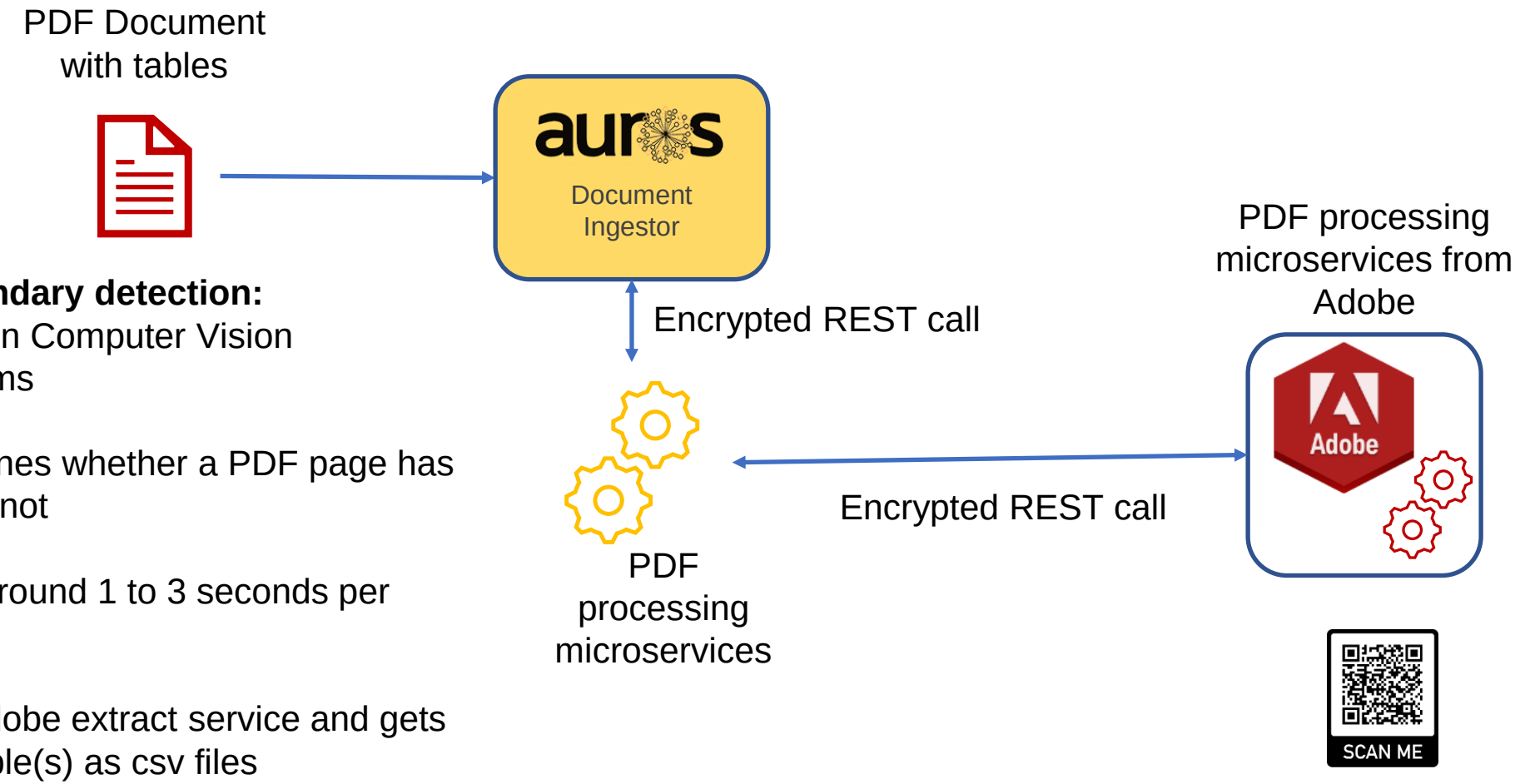


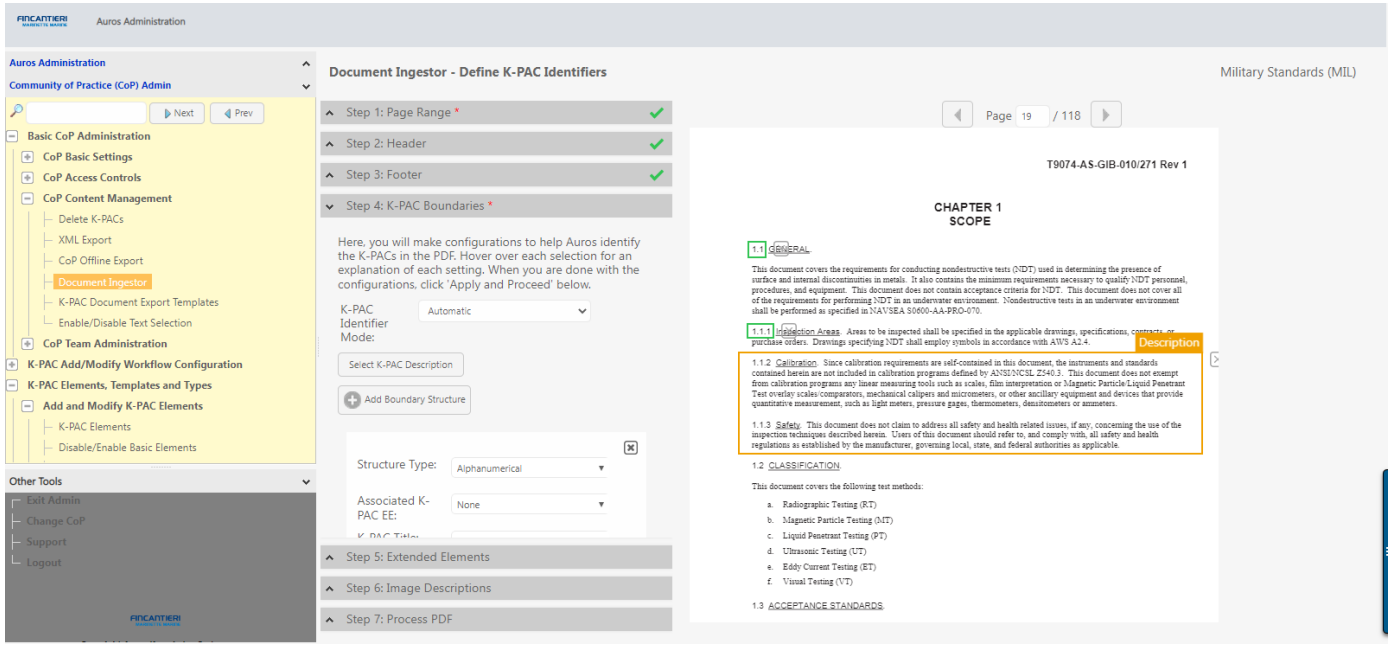
Table boundary detection:

- Based on Computer Vision algorithms
- Determines whether a PDF page has table or not
- Takes around 1 to 3 seconds per page
- Calls Adobe extract service and gets back table(s) as csv files
- CSV file to HTML table generation

Solution Demonstration

Pilot Details

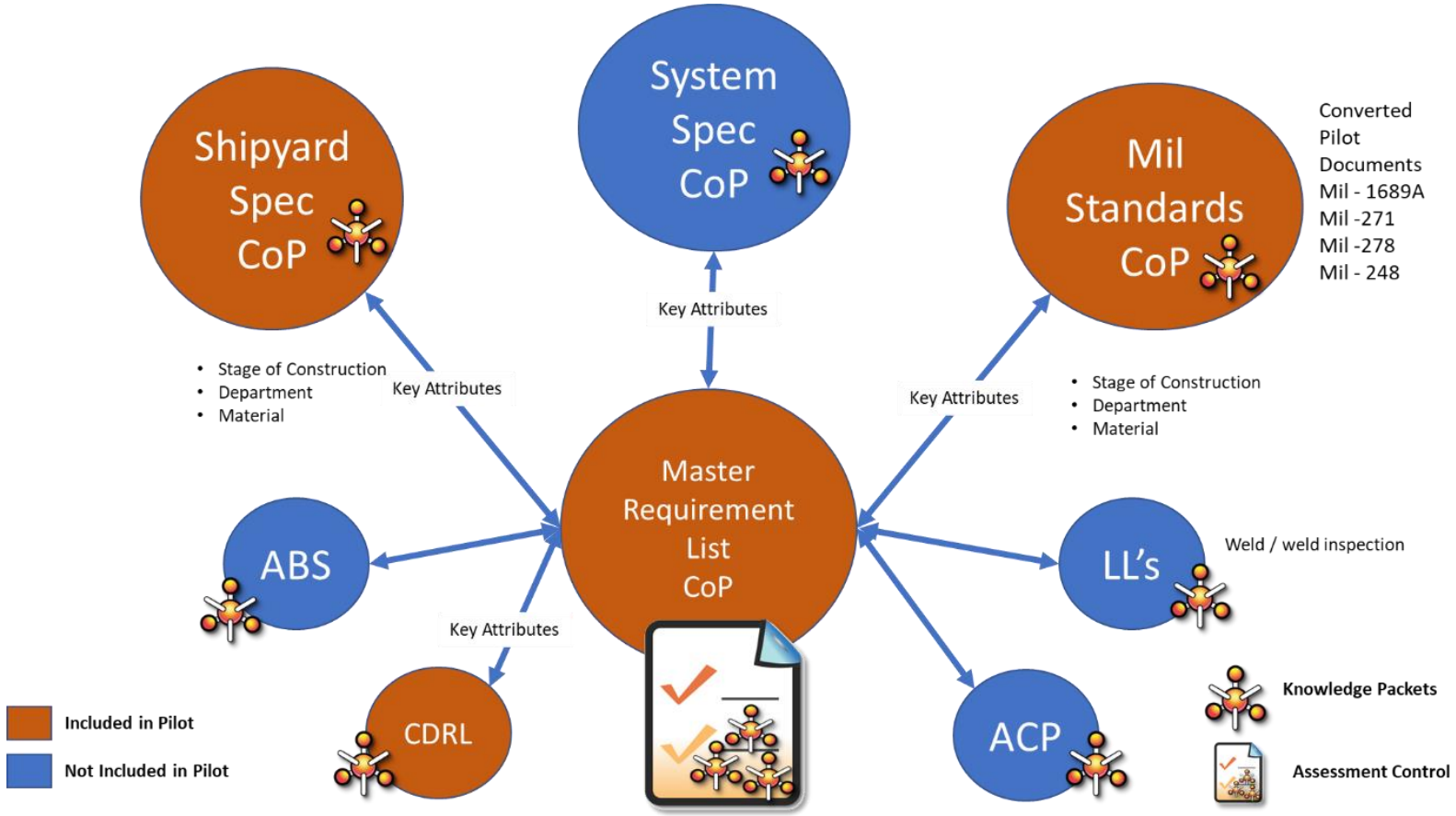
- **Focus:**
  - **Weld Procedure Evaluations***
  - **Welding / Fabrication ISO gap assessments**
- **Input files: Mil Std 1689A, Mil Std 271F, Mil Std 248D**
- **All input files processed using the Auros Document Ingestor**



Document Ingestor Setup Screen

Pilot Details

- **Welding Procedure Evaluation**



Pilot Evaluation Knowledge Structure

Pilot Document Conversion Results

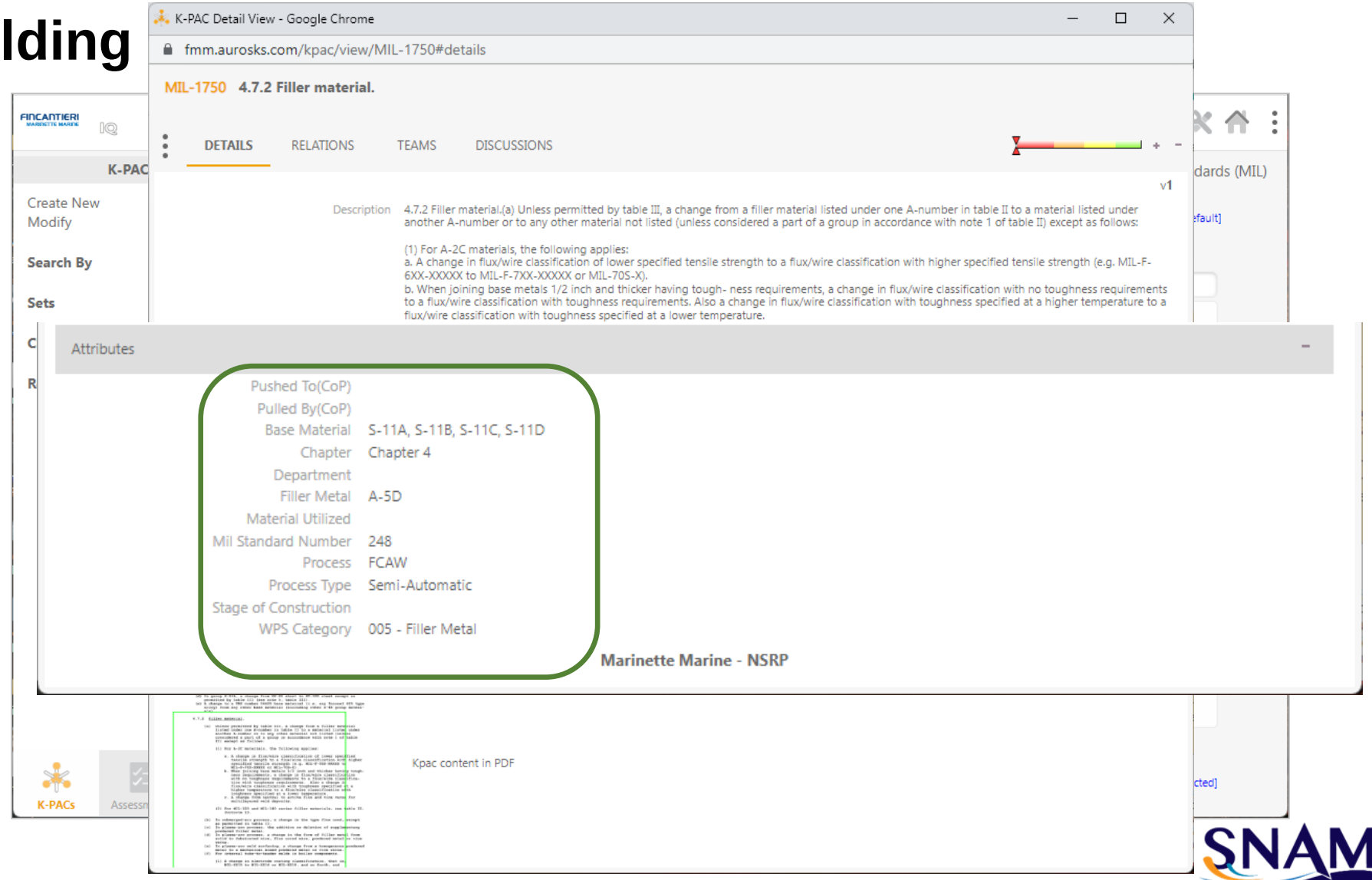
- **Data Conversion Metrics**

Document	Page Count	Estimated Time to Manually Recreate Document (Hours)	Auros OCR Conversion Time (Minutes)	Auros Document Ingestor Parsing Time (Minutes)	Auros Total Processing Time (Minutes)	Auros Number of K-PACs Created	Estimated Time Saving (Hours)
MIL-STD-1689A	185	39	12	67	79	487	37.5
S9074-AQ-GIB-010_248	137	29	5.5	62	67.5	414	28.5
MIL-STD-271F	98	21	4.5	38	42.5	340	20

Document Conversion Metrics

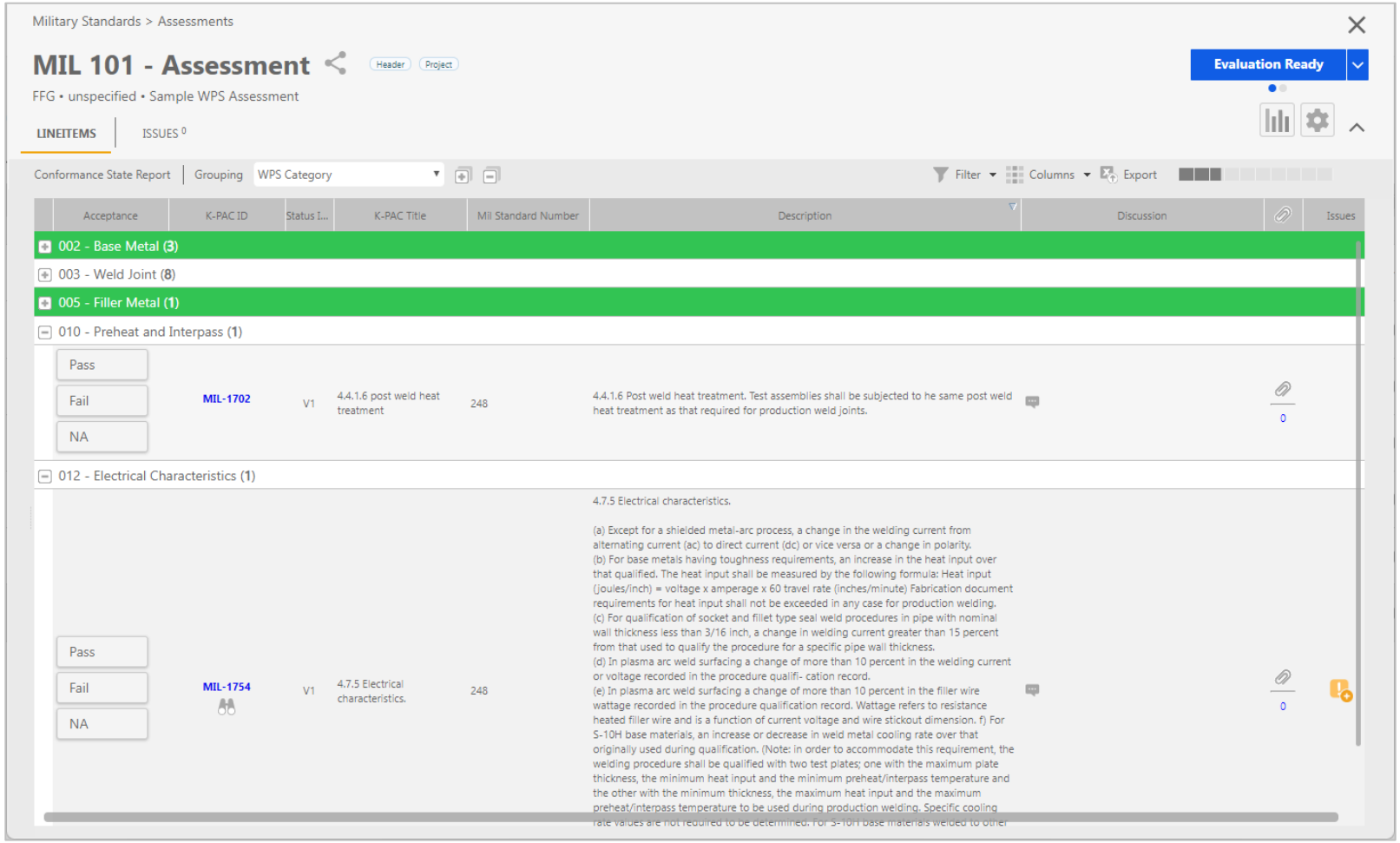
Pilot Details

- **Welding**



Pilot Details

- **Welding Procedure Evaluation**



Sample Weld Procedure Evaluation Assessment

Conclusions / Next Steps

- Developed a toolset that efficiently parses Navy Standard Requirements into logical individual rules
- Effectively applied Artificial Intelligence and Machine Learning to categorize each rule
- Verified the ability to construct Assessments of relevant rules for provisioning into shipyard workflows
- Demonstrated the ability to track and capture compliance to Navy Standard Requirements
- Continue to work with FMM and other shipyards to refine the knowledge provisioning solution for the maritime industry

Thank you for your attention this concludes the presentation

Questions?

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