



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

Presented by: Vicky Dlugokecki

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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**

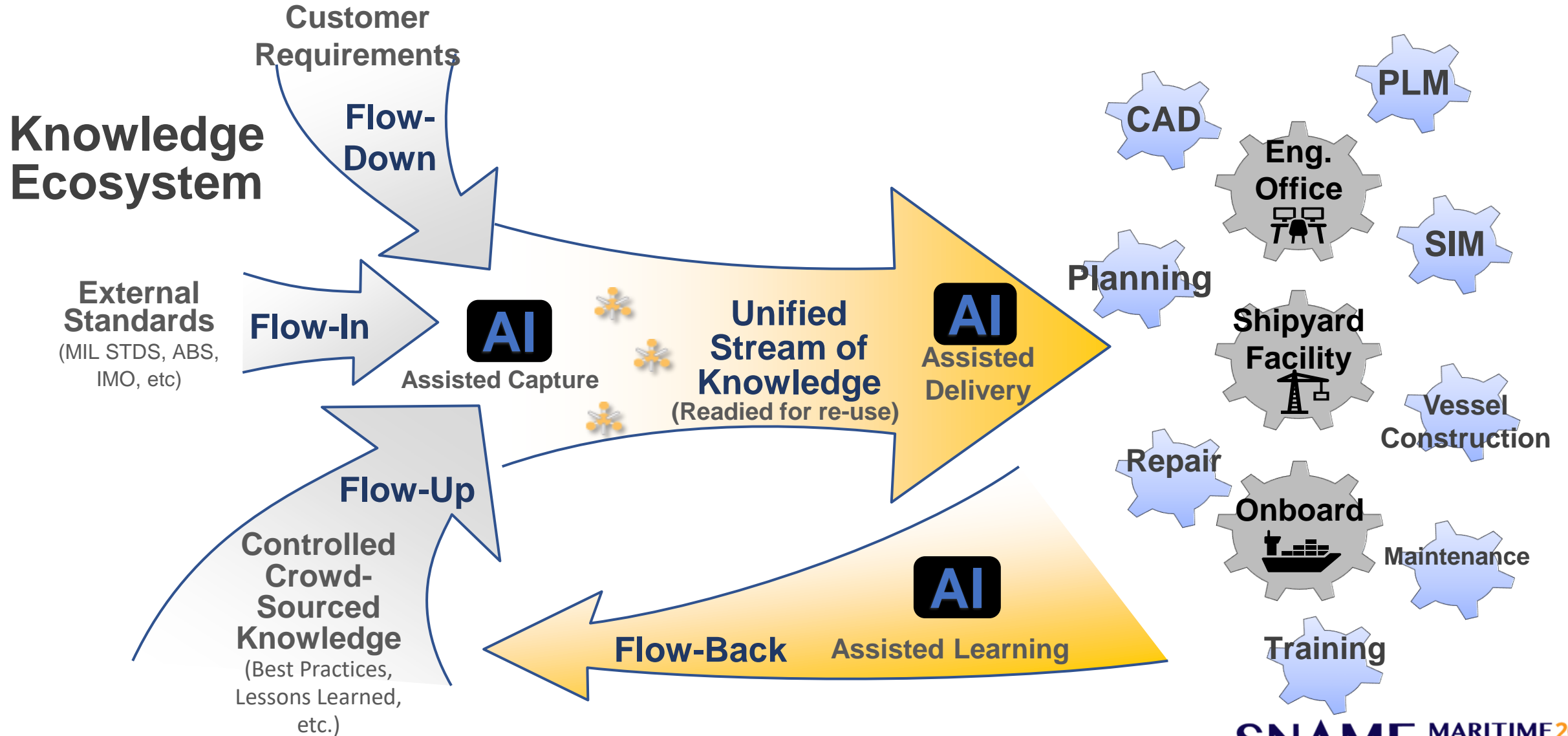
Project Objectives

- **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Immediately out of date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

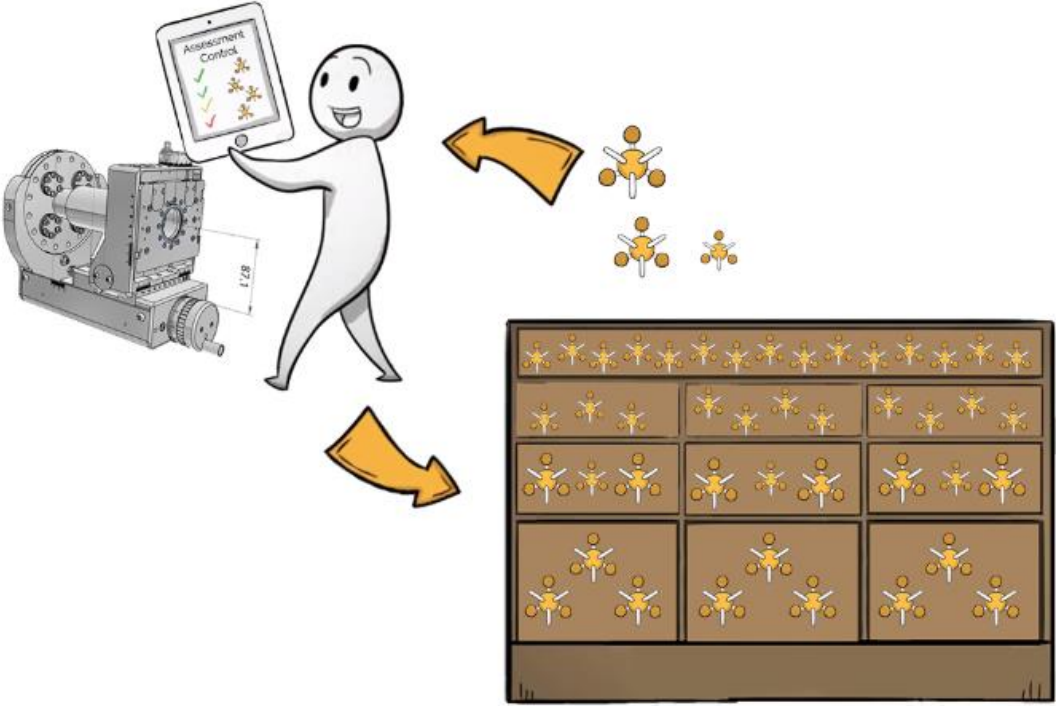
Knowledge Packets

Existing Documentation & Know-How

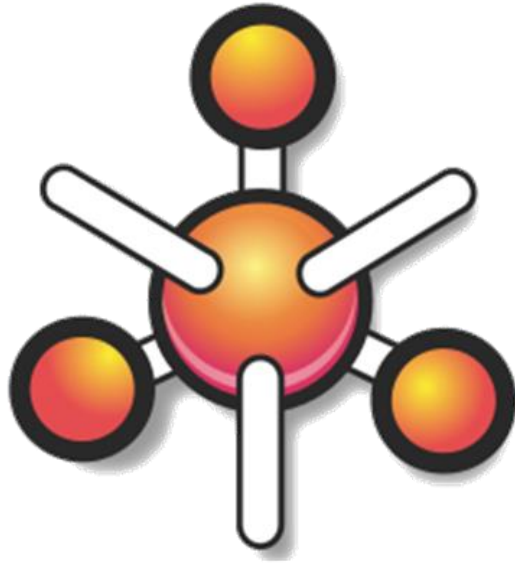


Knowledge Packets (K-PACs)

Assessment Controls



Knowledge Provisioning Fundamentals



Knowledge
Packet



Rule Processing
Engine



Assessment
Control

Auros Core Technology



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-XXXX to MIL-F-7XX-XXXX or MIL-70S-X).
 - b. When joining base metals 1/2 inch and thicker having toughness 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

2019_BR AC-264 2020 Steel Barge
2020 Steel Barge

Options ▾ Issues ▾ Reports ▾ Filter ▾ Views ▾ View Options [+] [-] No Grouping ▾ Set Defaults [X]

LineItem Sheet [Section Number 3- Decks]

Conformance State	K-PAC ID	Status I...	Multimedia	Description
Compliant				$t = 0.01 s + 0.9 \text{ mm}$ for $s \leq 760 \text{ mm}$
Non Comp	2019_BR-86 (#2)	V1		$t = 0.0067 s + 3.4 \text{ mm}$ for $s > 760 \text{ mm}$
Req Clar				$t = 0.01 s + 0.035 \text{ in.}$ for $s \leq 30 \text{ in.}$
NA				$t = 0.0067 s + 0.134 \text{ in.}$ for $s > 30 \text{ in.}$
NE				Thickness of Exposed Strength Decks within Line of Openings, Forecastle Decks in Barges of 122 m (400 ft) in Length or Less
Compliant				$t = 0.01 s + 0.9 \text{ mm}$ for $s \leq 760 \text{ mm}$
Non Comp	2019_BR-86 (#3)	V1		$t = 0.0067 s + 3.4 \text{ mm}$ for $s > 760 \text{ mm}$
Req Clar				$t = 0.01 s + 0.035 \text{ in.}$ for $s \leq 30 \text{ in.}$
NA				$t = 0.0067 s + 0.134 \text{ in.}$ for $s > 30 \text{ in.}$
NE				Thickness of Platform Decks in Enclosed Cargo Spaces
Compliant				$t = 0.00395 s \sqrt{h} + 1.5 \text{ mm}$ but not less than 5.0 mm
Non Comp	2019_BR-87	V1		$t = 0.00218 s \sqrt{h} + 0.06 \text{ in.}$ but not less than 0.20 in.
Req Clar				where
NA				$h =$ tween deck height, in meters (feet). When a design load is specified, h is to be taken as $p/7.0721 \text{ m}$ ($p/45 \text{ ft.}$)
				$p =$ uniformly distributed deck loading, in kN/m^2 (tf/m^2 , lb/ft^2)
NE				Thickness of Enclosed Platform Decks not Intended for Cargo
Compliant				$t = 0.0058 s + 1.0 \text{ mm}$
Non Comp	2019_BR-88	V1		$t = 0.0058 s + 0.04 \text{ in.}$
Req Clar				but not less than 4.5 mm (0.18 in.) where
NA				$L =$ length of the barge, as defined in 3-1-1/3, in m (ft)
				$s =$ spacing of deck beams, in mm (in.)
NE				Plating within Line of Openings
Non Comp	2019_BR-89	V1		Within the longitudinal line of openings, the thickness of exposed strength deck plating is to be not less than obtained from the equation in 3-2-1.3.2.2. At the forward end of openings, it is to be increased by 25%.


Conformance State Filter

Legend: NE (white), Non Comp (red), NA (grey), Compliant (green), Req Clar (yellow)

Knowledge Aware for Navy Requirements

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

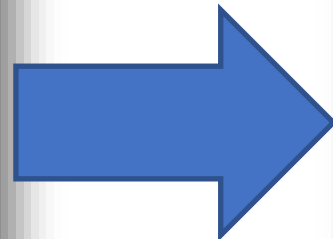
DEPARTMENT OF DEFENSE
STANDARD PRACTICE
DESIGN EVALUATION REQUIREMENTS FOR VALVES
FOR NAVAL SHIPBOARD USE



AMSC N/A FSC 4K03

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Information

BR_MAN-319 Equipment Weight and Size (2012)

DETAILS RELATIONS TEAMS DISCUSSIONS

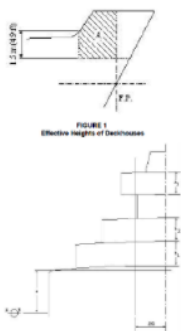
Description: Equipment Weight and Size (2012)
 Anchors and chains are to be in accordance with 3 3 1/21 TABLE 1 or 3 3 1/21 TABLE 2, as appropriate, and the numbers, weights and sizes of these are to be regulated by the equipment number EN obtained from the following equation:

SI and MKS Units
 Equipment Number (EN) = $A^2(2/S) + 2(Ba + bB) + 0.1A$

US Units
 Equipment Number (EN) = $1.012 A^2(S) + 0.186(Ba + bB) + 9.25A \cdot 10^{-4} S$

where
 A = molded displacement, in tonnes (tons), to the summer load waterline
 B = molded breadth, in meters (feet), as defined in 3 1 1/5
 z = freeboard, in meters (feet), amidships from the summer load waterline
 b = maximum breadth, in meters (feet), of the superstructure or deckhouse
 $h = h_1 + h_2 + h_3 + \dots$, as shown in 3 3 1/9 FIGURE 1. In the calculation of h, sheer, camber and trim may be neglected.
 h₁, h₂, h₃, ... = height, in m (ft), on the centerline of each tier of houses having a breadth greater than 8/4

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	Derived Value
$1.012 A^2(2/S) + 0.186(Ba + bB) + 0.1A$	EN, anchoring
	h _{1,2}

Other Info

Support Document

Attributes

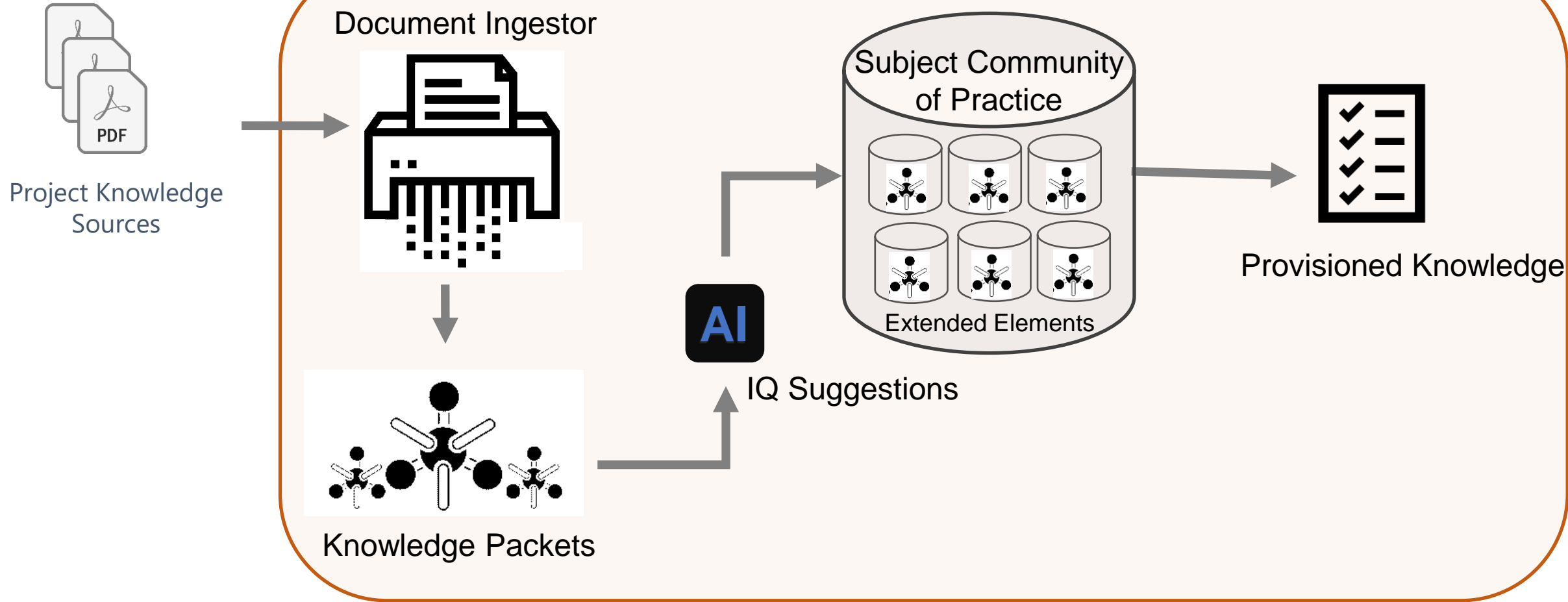
Pushed To(CoP)
 Pulled By(CoP)
 Chapter: 3 Equipment
 Part: 3 Hull Construction and Equipment
 Section Number: 1 Anchoring and Towing Equipment
 Sub-Section: 9 Equipment Weight and Size 2012
 Sub-Sub-Section Number

Sample Mil Standard Source Documents

Knowledge Packet

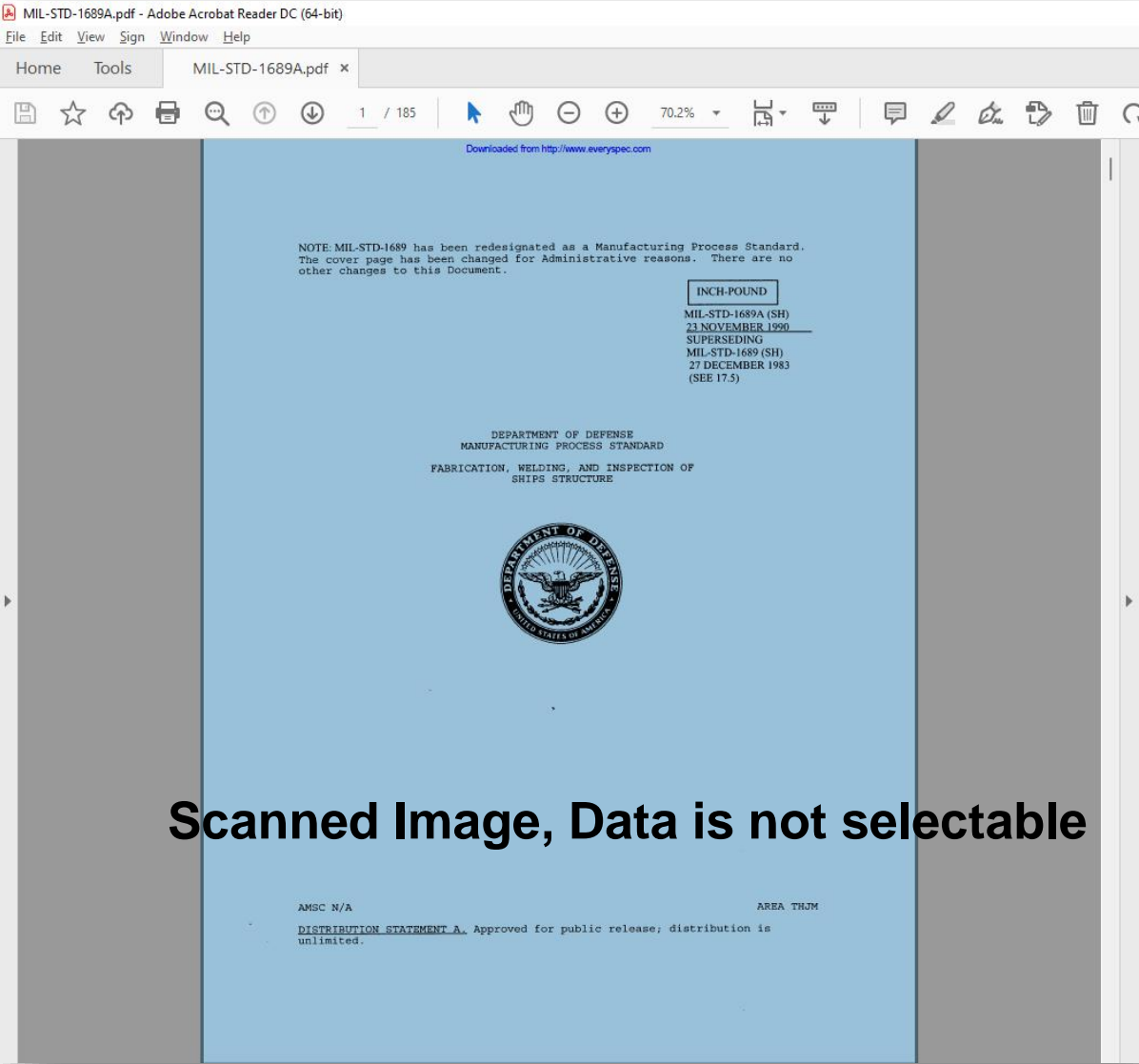
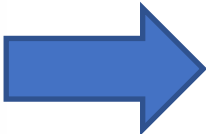
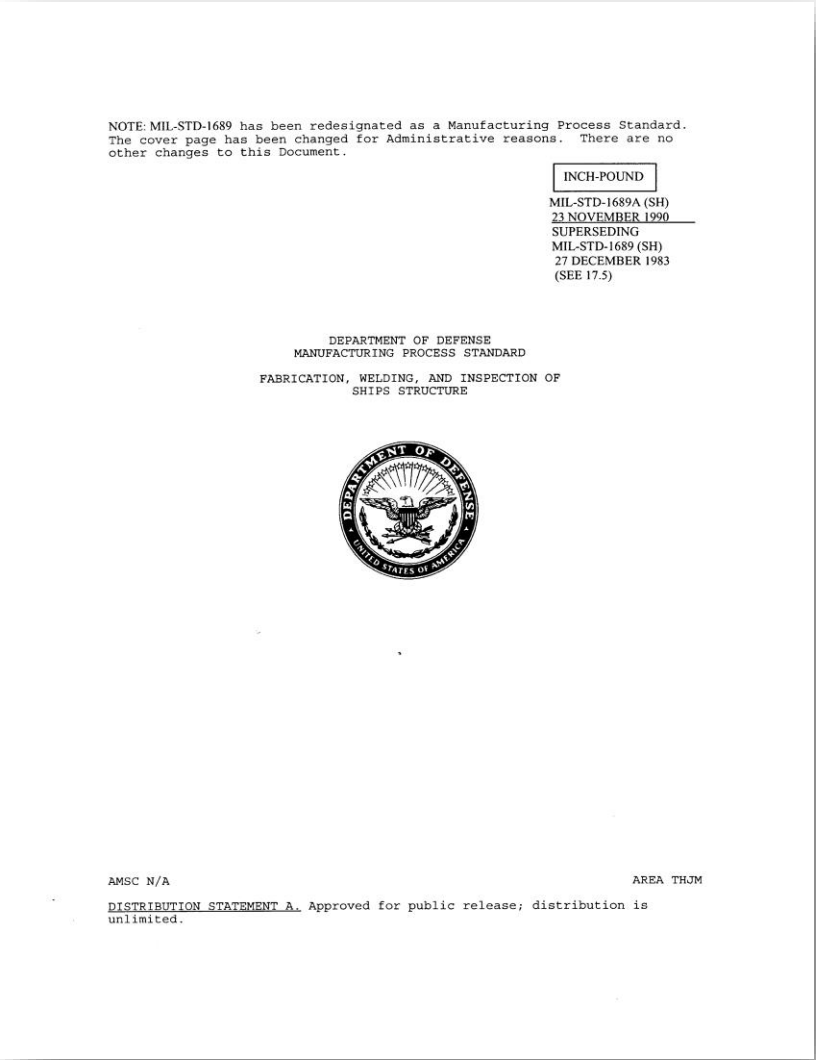
Bulk K-PAC Creation / Classification

Auros IQ



Document Ingestor Overview

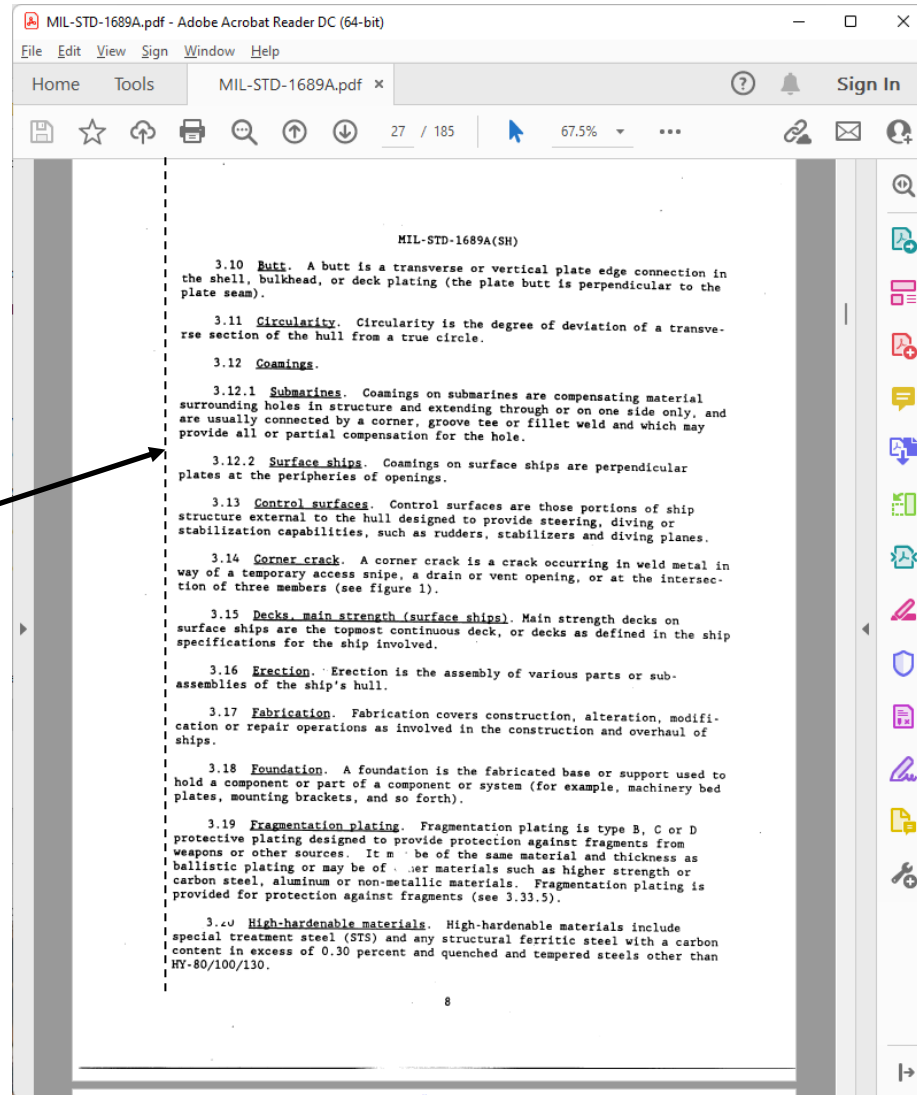
Challenges



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	

Table recognition / Parsing cues

Solution Discussion

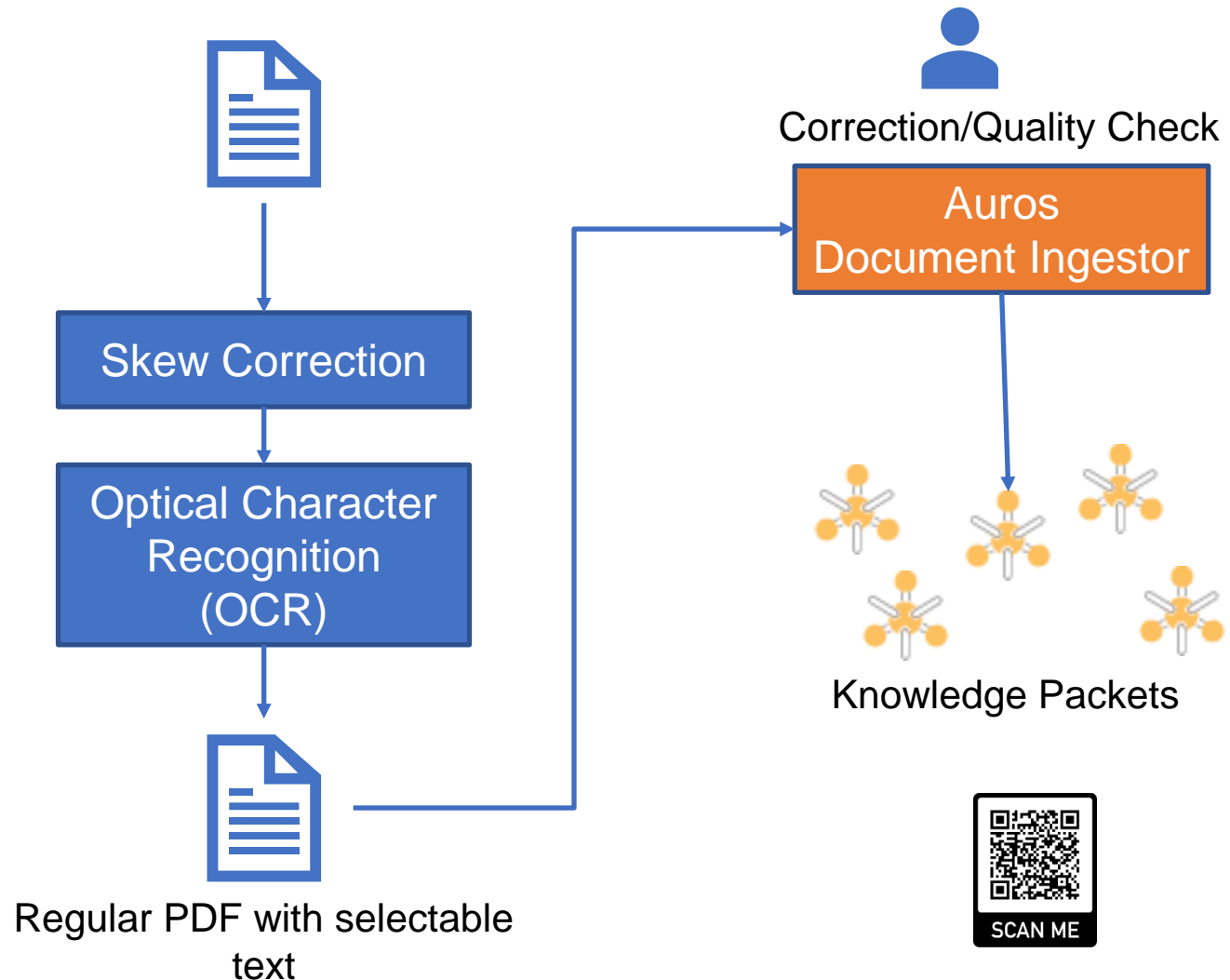
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Skew Detection:

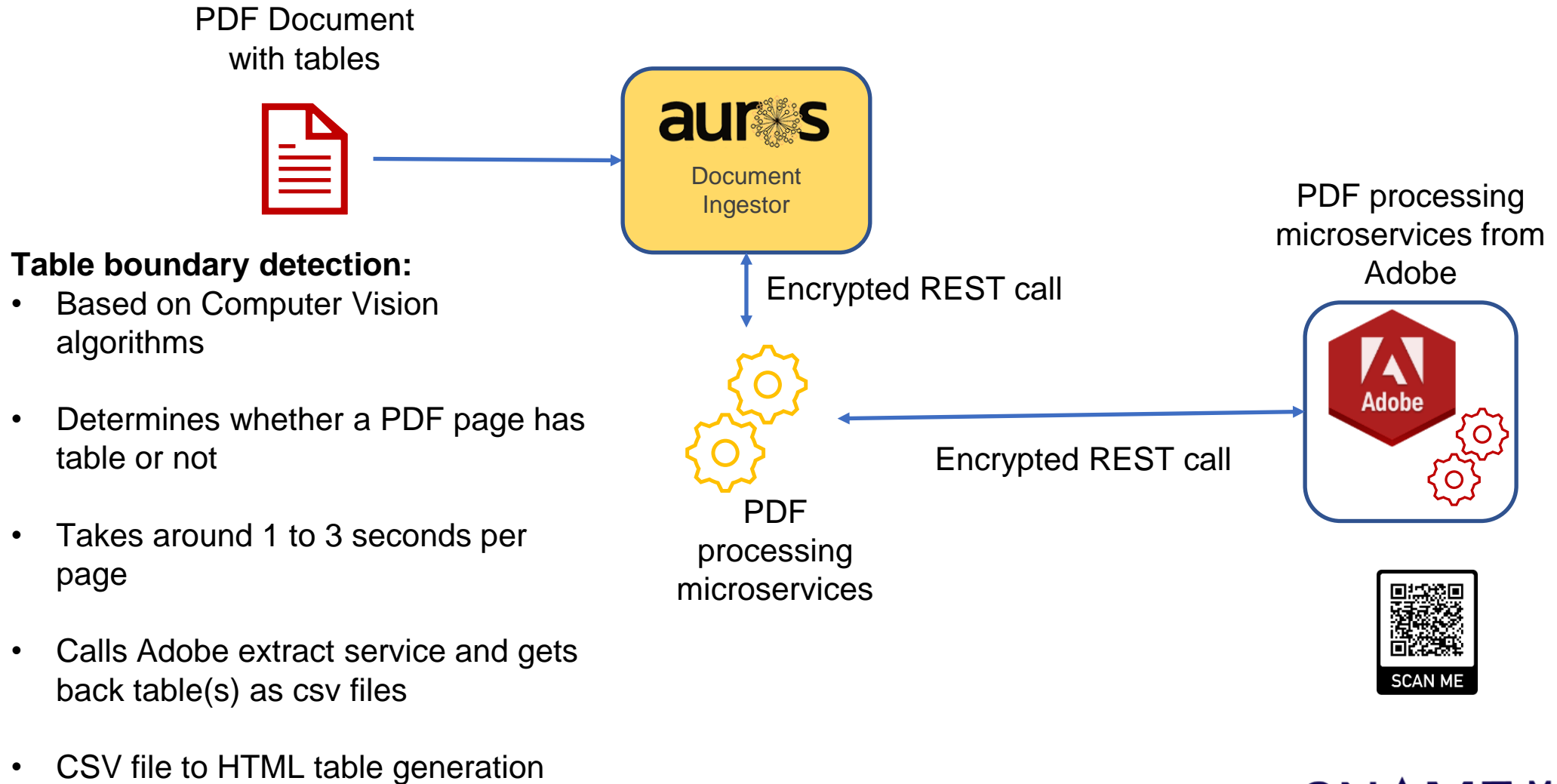
- Algorithm based on Projection profile method
- Can detect skew angle in the range of $\pm 5^\circ$
- Takes around 1 to 3 seconds per page

OCR:

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



Solution Discussion



Solution Demonstration



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

Presented by:
Vicky Dlugokecki



Pilot Details

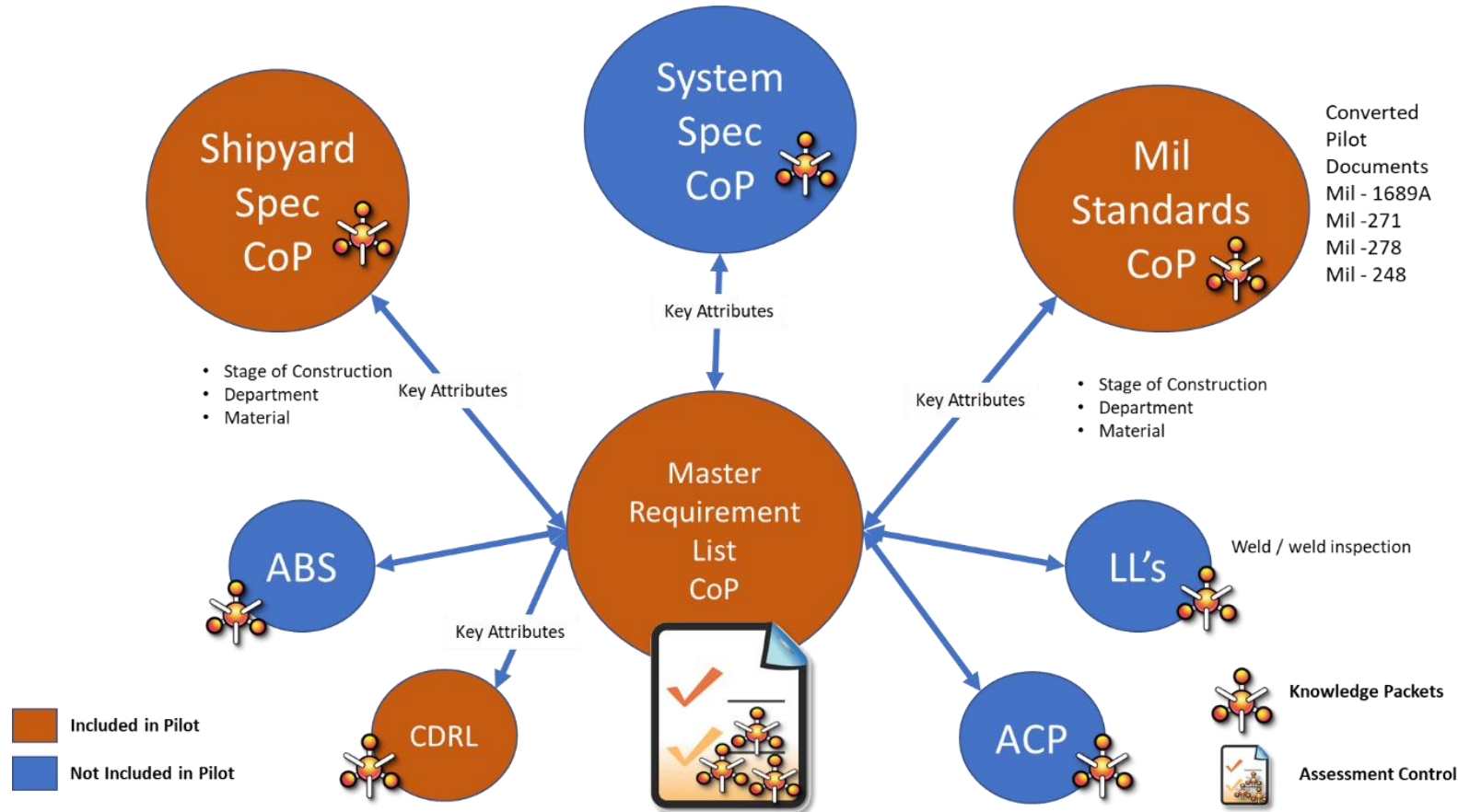
- **Focus:**
Weld Procedure Evaluations*
Welding / Fabrication ISO gap assessments
- **Input files: Mil Std 1689A, Mil Std 271F, Mil Std 248D**
- **All input files processed using the Auros Document Ingestor**

The screenshot displays the 'Auros Administration' interface for configuring the 'Document Ingestor'. The left sidebar shows a navigation tree with 'Document Ingestor' highlighted. The main workspace is titled 'Document Ingestor - Define K-PAC Identifiers' and shows a multi-step configuration process. Step 4, 'K-PAC Boundaries', is currently active, displaying a preview of a document page with highlighted sections and a 'Description' tooltip. The document preview shows 'CHAPTER 1 SCOPE' and various technical specifications. The configuration panel includes fields for 'K-PAC Identifier Mode' (set to Automatic), 'Structure Type' (set to Alphanumerical), and 'Associated K-PAC EE' (set to None).

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

MIL-1750 4.7.2 Filler material.

DETAILS RELATIONS TEAMS DISCUSSIONS

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 toughness 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.

Attributes

Pushed To(CoP)	
Pulled By(CoP)	
Base Material	S-11A, S-11B, S-11C, S-11D
Chapter	Chapter 4
Department	
Filler Metal	A-5D
Material Utilized	
Mil Standard Number	248
Process	FCAW
Process Type	Semi-Automatic
Stage of Construction	
WPS Category	005 - Filler Metal

Marinette Marine - NSRP

Kpac content in PDF

Pilot Details

- Welding Procedure Evaluation

Military Standards > Assessments

MIL 101 - Assessment

FFG • unspecified • Sample WPS Assessment

Evaluation Ready

LINETEMS | ISSUES 0

Conformance State Report | Grouping | WPS Category

Acceptance	K-PAC ID	Status I...	K-PAC Title	MIL Standard Number	Description	Discussion	Issues
002 - Base Metal (3)							
003 - Weld Joint (8)							
005 - Filler Metal (1)							
010 - Preheat and Interpass (1)							
<input type="button" value="Pass"/>							
<input type="button" value="Fail"/>	MIL-1702	V1	4.4.1.6 post weld heat treatment	248	4.4.1.6 Post weld heat treatment. Test assemblies shall be subjected to the same post weld heat treatment as that required for production weld joints.		0
<input type="button" value="NA"/>							
012 - Electrical Characteristics (1)							
<input type="button" value="Pass"/>							
<input type="button" value="Fail"/>	MIL-1754	V1	4.7.5 Electrical characteristics.	248	4.7.5 Electrical characteristics. (a) Except for a shielded metal-arc process, a change in the welding current from alternating current (ac) to direct current (dc) or vice versa or a change in polarity. (b) For base metals having toughness requirements, an increase in the heat input over that qualified. The heat input shall be measured by the following formula: Heat input (Joules/inch) = voltage x amperage x 60 travel rate (inches/minute) Fabrication document requirements for heat input shall not be exceeded in any case for production welding. (c) For qualification of socket and fillet type seal weld procedures in pipe with nominal wall thickness less than 3/16 inch, a change in welding current greater than 15 percent from that used to qualify the procedure for a specific pipe wall thickness. (d) In plasma arc weld surfacing a change of more than 10 percent in the welding current or voltage recorded in the procedure qualification record. (e) In plasma arc weld surfacing a change of more than 10 percent in the filler wire wattage recorded in the procedure qualification record. Wattage refers to resistance heated filler wire and is a function of current voltage and wire stickout dimension. f) For S-10H base materials, an increase or decrease in weld metal cooling rate over that originally used during qualification. (Note: In order to accommodate this requirement, the welding procedure shall be qualified with two test plates; one with the maximum plate thickness, the minimum heat input and the minimum preheat/interpass temperature and the other with the minimum thickness, the maximum heat input and the maximum preheat/interpass temperature to be used during production welding. Specific cooling rate values are not required to be determined. For S-10H base materials welded to other		0
<input type="button" value="NA"/>							

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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