*Host (on behalf of ASD):*

ADS is the Premier Trade Organisation for companies in the UK Aerospace, Defence, Security and Space Sectors.

# Automated Auditing of S1000D Aircraft Manuals: A Case Study

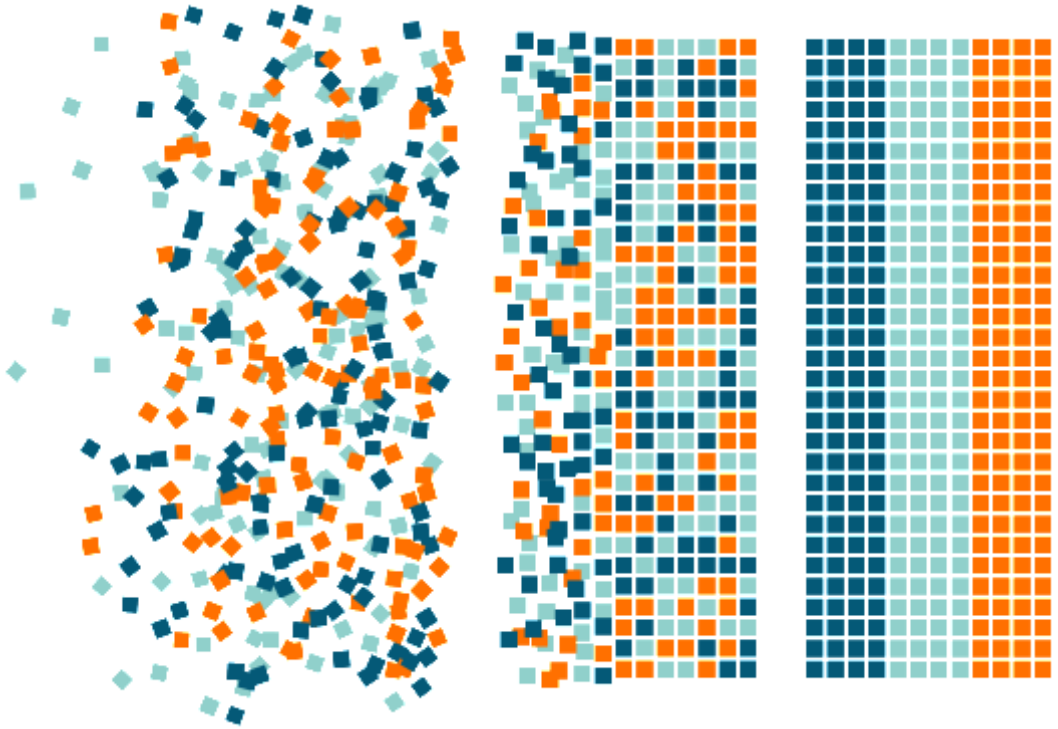

***Name of presenter:*** Naveh Greenberg

***Rank/title of presenter:*** Director, Defense Development

***Company/organization:*** Data Conversion Laboratory Inc


*S1000D User Forum, London* *October 14-16, 2019*

# Agenda

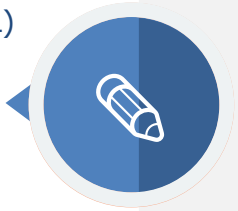


- Early Process
- Automation v Manual QA
- Planning
- Project Methodology
- Case Study
- Q&A

# Idiosyncrasies to Identify Early in the Process

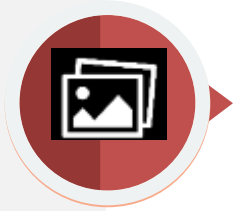
## Content Issues

- Flag headings (will be used in the DMRL)
- Identify proper Data Module Code/Information Code
- Applicability usage
- Missing required text (e.g., preliminary requirements)
- Extra text that doesn't fit S1000D structure (*do the following steps*, *The following paragraphs apply to the next set of procedures*, *Refer to page/chapter/section*)



## Tables & Images

- Content Tables downgrade to CALS Tables (or vise versa)
- How to handle graphics

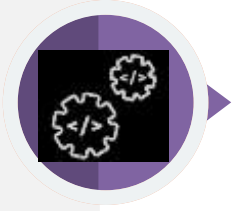


## Business Decisions

- Conflicts with business rules

## Automation Considerations

- Auto-generated text - if not cautious can cause duplicated text
- Properly used – helpful with automation



# Find the Balance Between Automation and Manual QA

## Depends on…

What are you checking

Volume of data

Legacy format

## And what about the approach…

WYSIWYG?

Hand tagging?

# The Plan

## Things you must know

- Stakeholders
- Budget
- Schedule

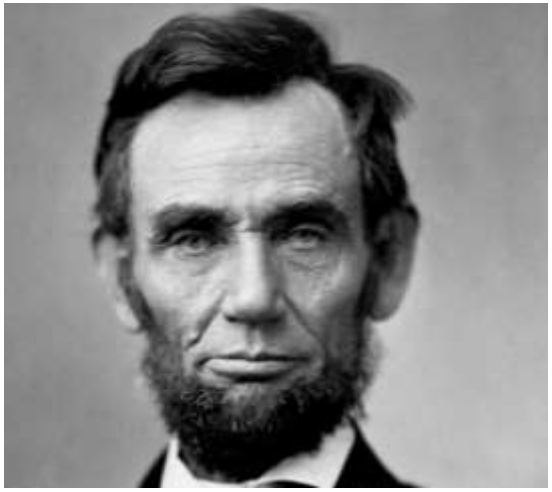
## Things you need

- Legacy data, business rules, schemas, samples
- The "right people"

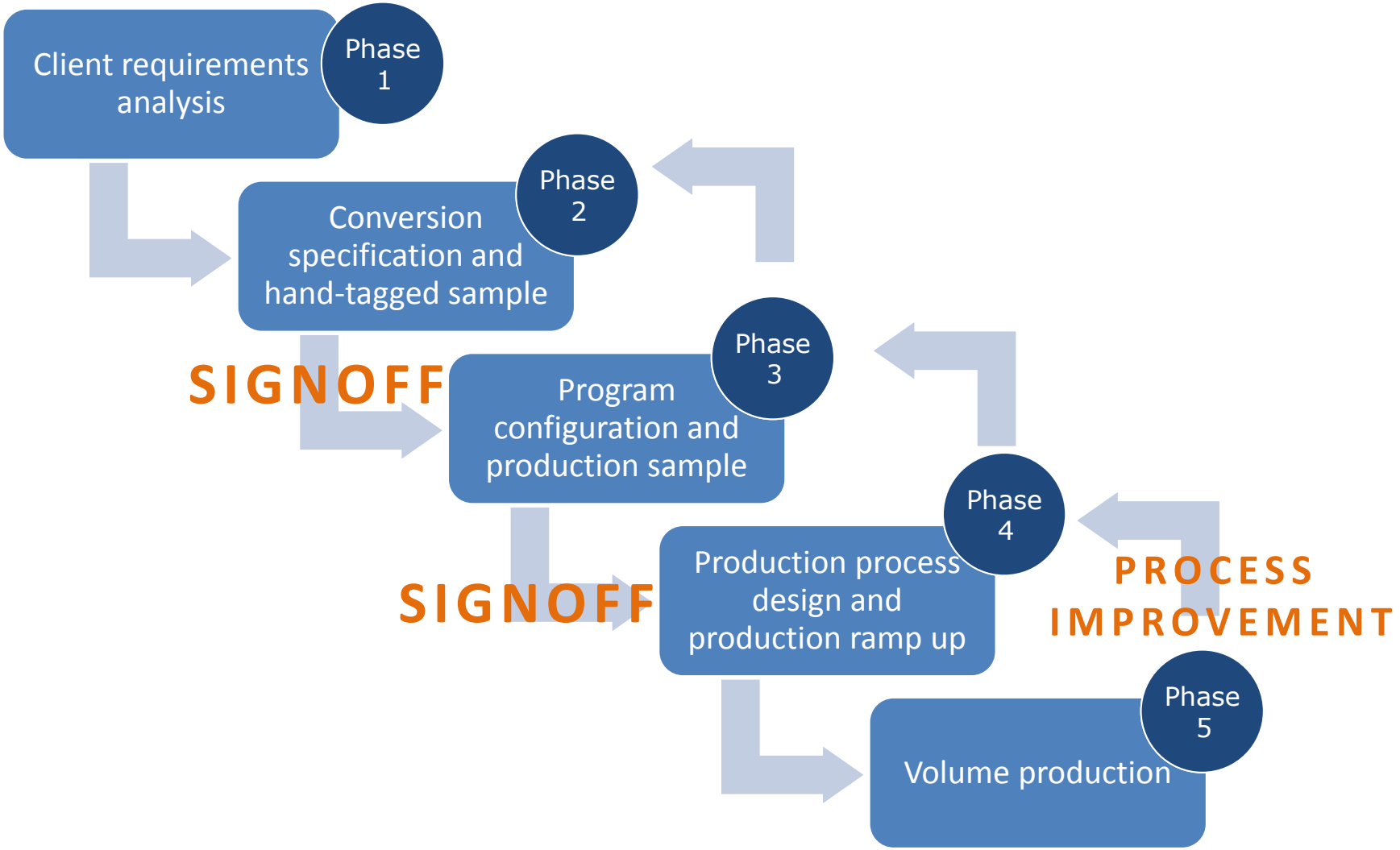
## Things to do

- Plan QA process
- Agree on the business rules
- Prepare samples
- Pilot and/or limited production run

*"If I had 8 hours to chop down a tree, I'd spend 6 sharpening my ax."*



# Project Methodology (Conversion or QA projects)



# Case Study

## Business Challenge

- OEM provided the Military service with an automated conversion of complex content from SGML to S1000D.
- To assure a high level of accuracy, the military service requested an independent audit of the final XML.

## DCL Solution

- 100% audit of all materials and reported results.
- Parallel conversion with customized tools to
  - ✓ duplicate and compare output
  - ✓ Verify inventory accuracy, tagging, and textual accuracy of the tag values

## Results

- Delivered a formal improvement plan to the client and the military service.
- Highly-improved end product.
- Fully-audited document set that satisfied independent review requirement.

## Technologies

- ❖ S1000D
- ❖ Harmonizer - software application that **analyzes document collections using natural language processing (NLP)** to identify redundant content in the collection
- ❖ Automation software
- ❖ Customized tools

## Business Metrics

**100%** Content audited

**100K+** Pages analyzed

Content improvement

# Applicability Tracing

**Issue**: Internal “applicability” may be allowed in legacy but not in S1000D

**Need to be creative (like repeating para)**

Error:

```
* ERR * #e444, Condition 34GLL (<torque model_effect="34GLL">) is not in level
model_effect='5D;7E;4G;88-7Z;' <subtask chapnbr="72" chg="N" func="420" key=
"wmm-72-00-33-420-001" model_effect="5D;7E;4G;88-7Z" revdate="Nov 1/03" sectnb
"001" subjnbr="33"> (after When segments are positioned evenly, torque nuts
)(DMC-TYZZ2A-AAA-72-00-33-420-801-A-C)
```

Source:

```
<subtask chapnbr="72" chg="N" func="420" key="zxx-72-00-33-420-001"
model_effect="5D;7E;4G;88-7Z" revdate="Nov 1/03" sectnbr="00" seq="
subjnbr="33">
<list1><l1item>
<para>Install the IP compressor stator (stage 1-2) as follows:</par
<list2><l2item>
<para>Position fairing support ring (1-65) to align with segment bo
</l2item><l2item>
<caution>
<para> MAKE SURE THAT SEGMENT HARDWARE IS TORQUED EVENLY TO PREVENT
</caution>
<para>When segments are positioned evenly, torque nuts <torque
model_effect="44ALL">26 to 29 inch-pounds (2.9 to 3.2 N.m)</torque
<torque model_effect="34GLL">18 to 20 inch-pounds (2.0 to 2.2 N.m)<
</l2item><l2item>
<para>Torque 15 bolts (1-60) <torque model_effect="44ALL">26 to 29
inch-pounds (2.9 to 3.2 N.m)</torque><torque model_effect="34GLL">
18 to 20 inch-pounds (2.0 to 2.2 N.m)</torque>. Do not use an air
```

# Legacy Mapping

**Issue:** In automated process, if you don't cover all the variations, tagging will be inconsistent.

There should be only one graphic with multiple sheets

Error:
```
* WARN * #d333, number of sheets 1 in <graphic><sheet chg="N" gnbr="ZZX88-7235-49" id=
"ZZX88-7235-49-2" sheetnbr="2"> DMC-TYZZ88-AAA-72-35-26-220-801-A-C procedure
```

Source:
```
<graphic chg="N" func="990" key="ZZX88-7235-48" seq="001">
<title>Acceptance/Rejection Table &mdash; No. 1 Ball Bearing</title>
<sheet chg="N" gnbr="ZZX88-7235-48" key="ZZX88-7235-48-1" sheetnbr="1">
</sheet>
</graphic>
<graphic chg="N" func="990" key="ZZX88-7235-49" seq="002">
<title>Acceptance/Rejection Table &mdash; No. 1 Ball Bearing (Sheet 2)</title>
<sheet chg="N" gnbr="ZZX88-7235-49" key="ZZX88-7235-49-2" sheetnbr="2">
</sheet>
</graphic>
```

# Legacy Mapping

**SGML**

```
<step1><para></para>
<note>
<para><randlist>
<item>Warning horn will sound
after approximately 45 seconds of
intermittent
operation, both gauges will read in
green, and then horn will cease
operation.</item>
<item>Compressed air shall be dry
and unlubricated.</item>
</randlist></para>
</note>
</step1>
<step1><para label="3" assocfig=
"cbg0000557.tif">(A) Place vacuum
pump module on floor between
crew door and Main Landing Gear
```

**XML**

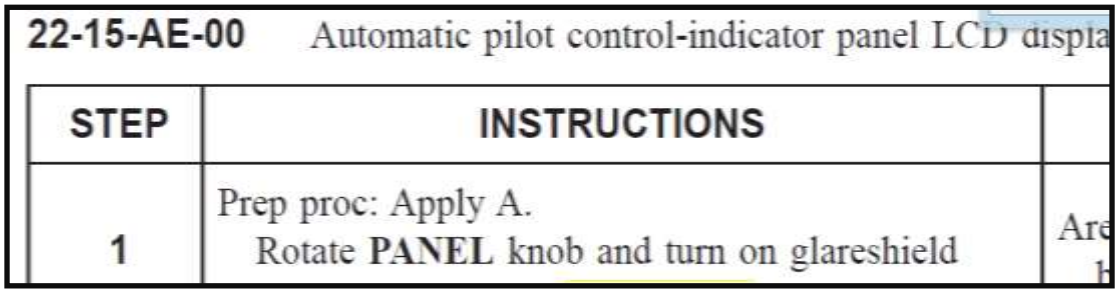
```
<step1>
<note>
<para>
<randlist prefix="pf51">
<item>Warning horn will sound after
approximately 45 seconds of
intermittent operation, both gauges
will read in green, and then horn will
cease operation.</item>
<item>Compressed air shall be dry
and unlubricated.</item>
</randlist>
</para>
</note>
</step1>
<step1>
<para><verbatim>3</verbatim>(A)
Place vacuum pump module on
```

**A Step with only a note and no paragraph**

# Legacy Mapping

**Issue:** <brk> in SGML causes space issues in converted XML.

PDF



22-15-AE-00 Automatic pilot control-indicator panel LCD displa

| STEP | INSTRUCTIONS | |
|---|---|---|
| 1 | Prep proc: Apply A.<br>Rotate **PANEL** knob and turn on glareshield | Are |

SGML

```
<para ID="H22-15-AE-00.1" LABEL="1">Prep
proc: Apply A.<brk>Rotate <emphasis EMPH=
"BOLD">PANEL</emphasis> knob and turn on
glareshield <emphasis EMPH="BOLD">PANEL
```

XML

```
<isostep id="h1">
<action>Prep proc: Apply A.Rotate PANEL knob
<question>
```

# Content Reuse Analysis

76\76-20-01-220-801.xml line: 29

**We identify locations of all parts of the engine as if installed in an aircraft, viewed from the rear. All radial locations are numbe**
**is always at the top (12 o'clock position) on the centerline.**

We identify {the} locations of all parts of the engine as if installed in an aircraft, viewed from the rear. All radial locations are numbered co
always at the top (12 o'clock {o'clock)} position) on the centerline.

<Exact matches>

76\76-20-01-220-803.xml line: 27
73\73-12-01-220-802.xml line: 40
73\73-12-01-220-803.xml line: 37
73\73-27-01-830-801.xml line: 31

02-1 INTERIOR CLEANING.¶
The use of personal protective equipment is mandatory to perform this procedure. The applicable Material Safety Data Sheet (MSDS) will identify special protection information.
~~Failure to comply may cause injury to personnel.~~¶
~~All~~¶
~~The use of personal protective equipment is mandatory to perform this procedure. The applicable Material Safety Data Sheet (MSDS) will identify special protection information.~~
Failure to comply may cause injury to personnel.¶
1 Review "Section 1 (General Information)" of this TO for system general warnings, cautions, and notes.¶
2 Review task "General Maintenance Input Conditions" page for task specific safety conditions
Short Aerial Delivery System (ADS) connecting link assembly shall be installed.¶
3 Install aerial delivery system connecting links on cargo ramp (52-32-11, task 3-1).¶
4 Open cargo ramp and cargo door (52-30-02, task 02-1).¶
Soundproof batting material contaminated with liquids will be removed, cleaned, dried, and reinstalled or replaced as necessary.¶
Avoid contact of cleaning solution with moisture absorbent material. Failure to comply may cause damage to equipment.¶

72\72-00\72-00-01-610-805.xml line: 325

**MIL-DTL-27686 or MIL-DTL-85470 fuel system icing inhibitor is**
**concentration for JP-5 is 0.15% and 0.20% by volume. During**
**static additive or equivalent is permitted to bring fuel up to 30**
**20 ppm (270 ppm total additive) of elemental boron.**

MIL-DTL-27686 or MIL-DTL-85470 fuel system icing inhibitor is rec
for JP-5 is 0.15% and 0.20% by volume. During refueling, minimun
permitted to bring fuel up {upto} to 300 conductive units but not to
elemental boron.

MIL-DTL-27686 or MIL-DTL-85470 fuel system icing inhibitor is rec
for JP-5 is 0.15% and 0.20% by volume. During refueling, minimun
permitted to bring fuel ~~up to~~ upto 300 conductive units but not to ex
elemental boron.

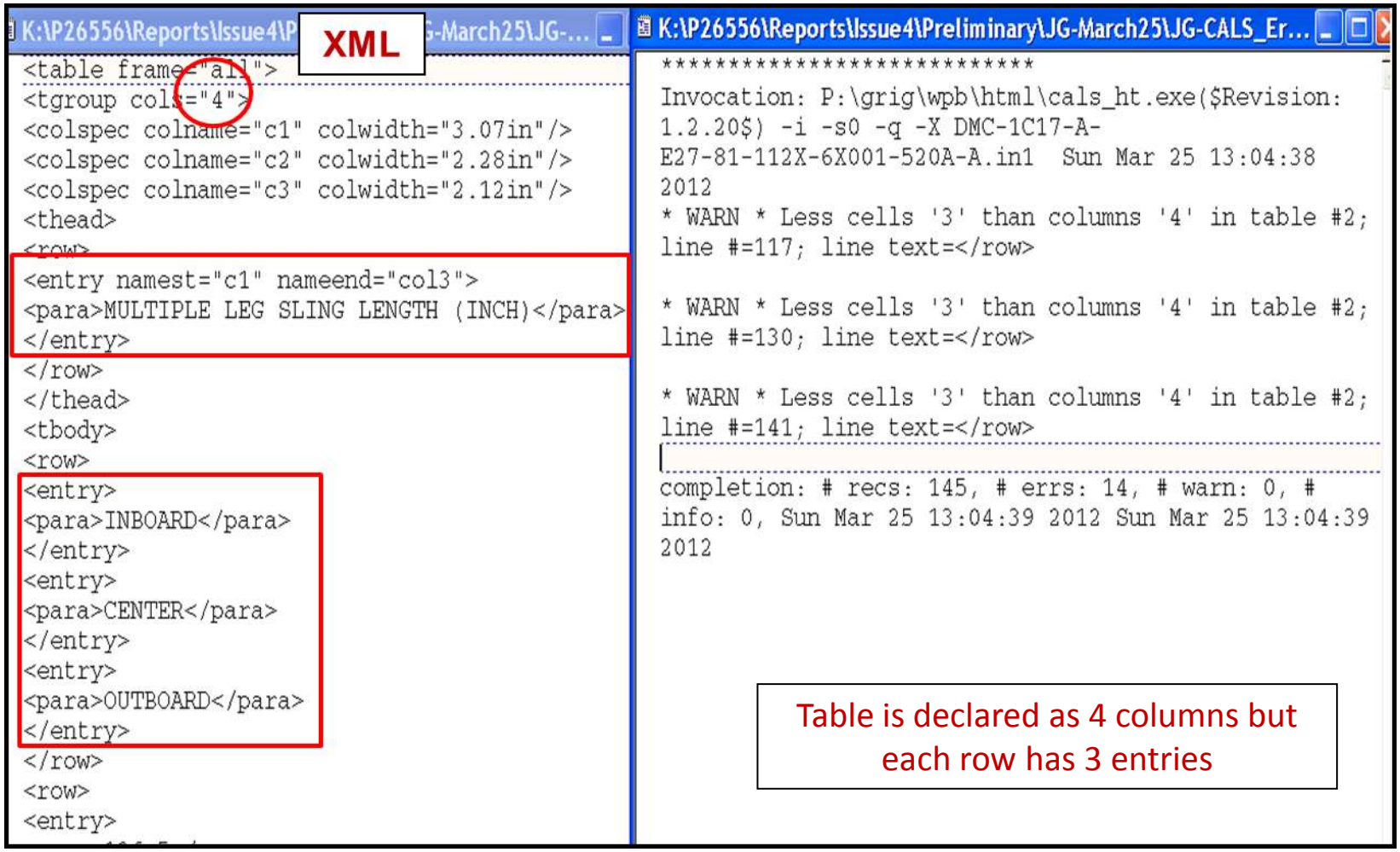
72\72-00\72-00-01-610-801.xml line: 163
72\72-00\72-00-01-610-803.xml line: 148

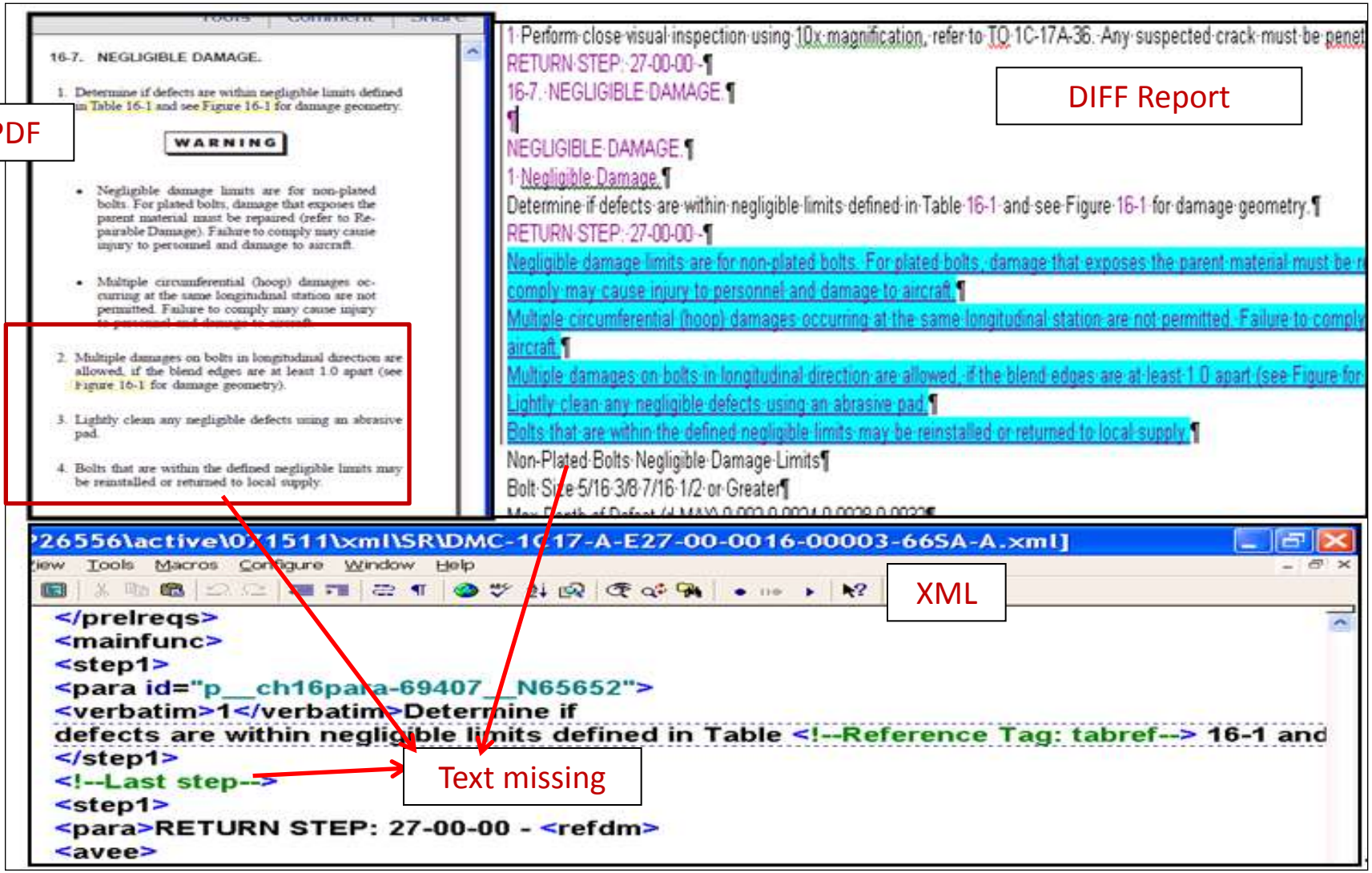
# Content Reuse Analysis

```
<llitem>
  <para>
    The fuel filter is contained in a stainless steel bowl that is
    threaded into the pump housing. The filter is located between the
    boost pump and the gear pump to protect the gear pump from any fuel
    tank contaminants. The fuel filter element is 30 micron.
  </para>
</llitem>
<llitem>
  <para>

    The fuel filter bypass valve is part of the fuel pump. It allows
    fuel to continue to flow into the gear pump if the differential
    pressure between the filter inlet and outlet passages reaches 10
    psid. A mechanical pop-out delta P indicator warns of a filter
    bypass before the bypass occurs.

  </para>
</llitem>
<llitem>
  <para>
    Electronic control unit provides several functions. One principle
    function is to provide limiting for the critical parameters: N1,
    N2, and ITT. The ECU controls N1 at high power and N2 at low power.
    The ECU is also
    <?Pub Caret?>
    responsible for thrust and acceleration scheduling.
  </para>
</llitem>
<llitem>
  <para>
    The engine has a fixed flow, stationary fuel nozzle for improved
    altitude re-start reliability. This nozzle provides approximately 9
```

```
<llitem>
  <para>
    The fuel filter is contained in a stainless steel bowl that is
    threaded into the pump housing. The filter is located between the
    boost pump and the gear pump to protect the gear pump from any fuel
    tank contaminants. The fuel filter element is 30 micron.
  </para>
</llitem>
<llitem>
  <para>
    The fuel filter electrical indicator (delta P switch) is installed
    on the fuel pump. It allows fuel to continue to flow into the gear
    pump if the differential pressure between the filter inlet and
    outlet passages reaches 10 psid. When 4.5 psid is present, an
    annuciator light in the cockpit will illuminate, indicating
    impending bypass. The lamp will remain illuminated until
    differential pressure drops below 1.5 psid.
  </para>
</llitem>
<llitem>
  <para>
    Electronic control unit provides several functions. One principle
    function is to provide limiting for the critical parameters: N1,
    N2, and ITT. The ECU controls N1 at high power and N2 at low power.
    The ECU is also responsible for thrust and acceleration scheduling.
    <?Pub Caret?>

  </para>
</llitem>
<llitem>
  <para>
    The engine has a fixed flow, stationary fuel nozzle for improved
    altitude re-start reliability. This nozzle provides approximately 9
```

# Tagging Accuracy




PDF
16-7. NEGLIGIBLE DAMAGE.
1. Determine if defects are within negligible limits defined in Table 16-1 and see Figure 16-1 for damage geometry.
WARNING
• Negligible damage limits are for non-plated bolts. For plated bolts, damage that exposes the parent material must be repaired (refer to Repairable Damage). Failure to comply may cause injury to personnel and damage to aircraft.
• Multiple circumferential (hoop) damages occurring at the same longitudinal station are not permitted. Failure to comply may cause injury to personnel and damage to aircraft.
2. Multiple damages on bolts in longitudinal direction are allowed, if the blend edges are at least 1.0 apart (see Figure 16-1 for damage geometry).
3. Lightly clean any negligible defects using an abrasive pad.
4. Bolts that are within the defined negligible limits may be reinstalled or returned to local supply.
DIFF Report
1 Perform close visual inspection using 10x magnification, refer to TO 1C-17A-36. Any suspected crack must be penet
RETURN STEP: 27-00-00 -¶
16-7. NEGLIGIBLE DAMAGE.¶
¶
NEGLIGIBLE DAMAGE.¶
1 Negligible Damage.¶
Determine if defects are within negligible limits defined in Table 16-1 and see Figure 16-1 for damage geometry.¶
RETURN STEP: 27-00-00 -¶
Negligible damage limits are for non-plated bolts. For plated bolts, damage that exposes the parent material must be r
comply may cause injury to personnel and damage to aircraft.¶
Multiple circumferential (hoop) damages occurring at the same longitudinal station are not permitted. Failure to comply
aircraft.¶
Multiple damages on bolts in longitudinal direction are allowed, if the blend edges are at least 1.0 apart (see Figure for
Lightly clean any negligible defects using an abrasive pad.¶
Bolts that are within the defined negligible limits may be reinstalled or returned to local supply.¶
Non-Plated Bolts Negligible Damage Limits¶
Bolt Size 5/16 3/8 7/16 1/2 or Greater¶
26556\active\071511\xml\SR\DMC-1617-A-E27-00-0016-00003-66SA-A.xml]
View Tools Macros Configure Window Help
XML
</prelreqs>
<mainfunc>
<step1>
<para id="p__ch16para-69407__N65652">
<verbatim>1</verbatim>Determine if
defects are within negligible limits defined in Table <!--Reference Tag: tabref--> 16-1 and
</step1>
<!--Last step-->
<step1>
<para>RETURN STEP: 27-00-00 - <refdm>
<avee>
Text missing

# Thank you

# Questions?

Naveh Greenberg
Director, Defense Development
Data Conversion Laboratory
+1.718.307.5738
ngreenberg@dclab.com

https://www.linkedin.com/company/dclab/

@DCLaboratory