The University of Texas at El Paso

May 5, 2026

# TITUS OMS & SWITCH LINE TOOL KIT

Faculty Advisor: Pennathur, Arunkumar

# Team Introduction

## Gabriel Camargo

**Project Leader**

Major: Industrial, Manufactruring, and Systems Engineering

Experience: Research Assistant in Industrial and Systems Engineering.

## Andrea Sanchez

**3D Modeling Lead**

Major: Industrial, Manufacturing, and Systems Engineering

Experience: Research Assistant at Center for Transportation Infrastructure Systems

## Jose A. Gomez

**BOM /Analysis Lead**

Major: Industrial, Manufacturing, and Systems Engineering

## Alejandra Cisneros

**OMS Development Lead**

Major: Industrial, Manufacturing, and Systems Engineering

Experience: Account Management and Sales

# Agenda

# Industry Partner

***EATON***

Power management & electrical manufacturing

Facility

7800 Trade Center Ave, El Paso, TX

Operations

Electrical product assembly, wiring

# *Titus Project*

The Titus project focuses on enhancing the assembly process through the development of standardized work instructions and improved component data organization. Our approach integrates Operational Method Sheets (OMS) supported by 3D visualizations, along with bill of materials (BOMs) analysis, to improve process clarity, support assembler training, and increase overall efficiency.

# TITUS PROBLEM STATEMENT & OBJECTIVES

## Problem Statement

The Titus assembly process currently relies on work instructions and component information that are not fully visual, clear, or easy to follow. This matters because unclear instructions and BOM information can increase the risk of assembly errors, rework, inefficient part usage, and unnecessary costs in a manufacturing environment. There is an opportunity to improve the process by developing clearer OMS work instructions with 3D visuals and by organizing component data through a structured BOM analysis.

## Objectives:

1. Standardize work instructions using OMS with 3D visuals
2. Improve process clarity and assembler understanding
3. Ensure alignment with engineering specifications
4. Analyze BOM vs. Actual usage to improve cost and material efficiency

# What is an Operational Method Sheet (OMS)?

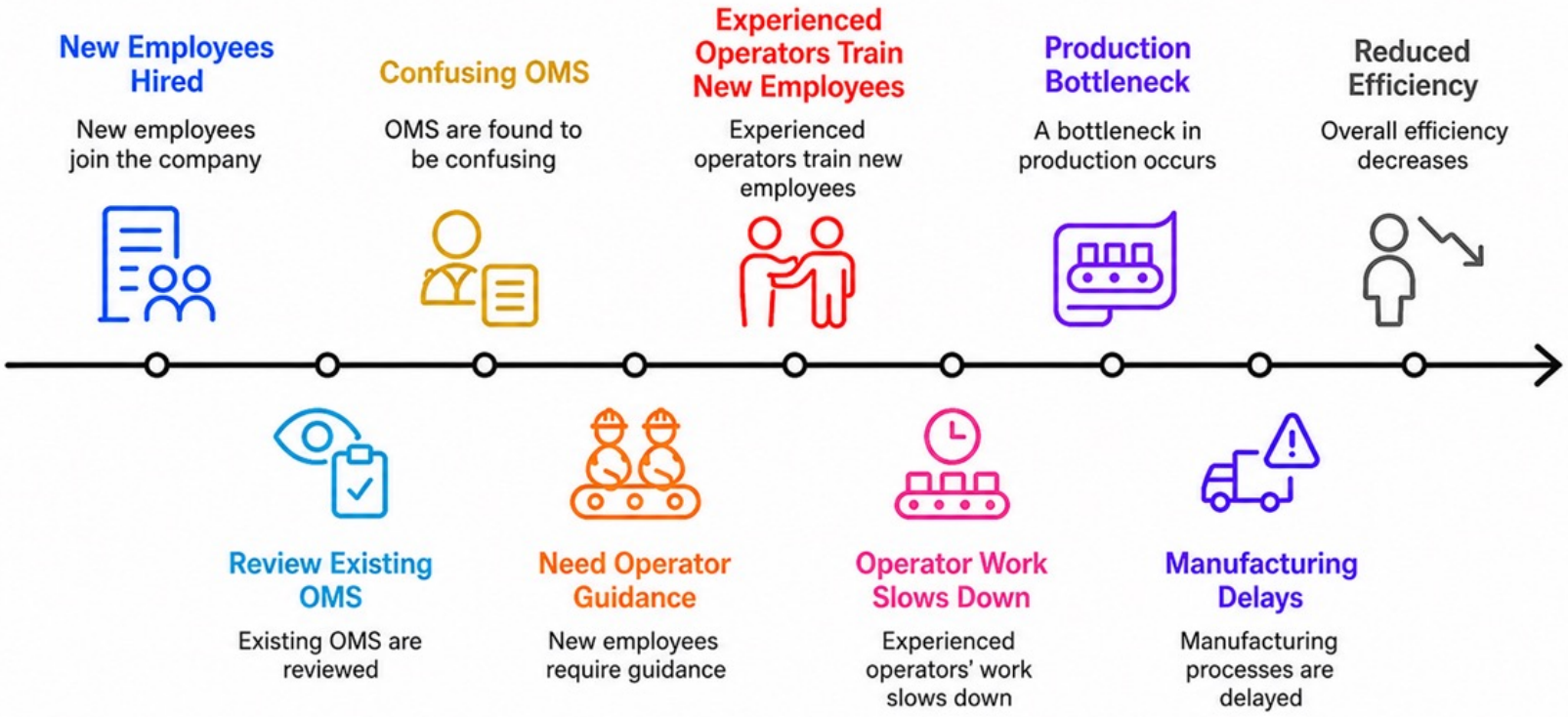
An Operational Method Sheet (OMS) is a standardized document that provides step-by-step instructions for performing a specific task or process on the production floor.

- Standardized instructions
- Step-by-step process
- Ensures consistency
- Reduces errors
- Improves efficiency
- Includes visuals & safety info

# Titus Requirements

| Requirement ID | Requirement |
|---|---|
| TI-REQ-01 | Develop clear OMS work instructions using the approved company template. |
| TI-REQ-02 | Create high-quality 3D models of parts, tools, fixtures, and assemblies. |
| TI-REQ-03 | Build step-by-step visual sequences that show each stage of the process. |
| TI-REQ-04 | Make sure all 3D illustrations match engineering drawings and approved specifications. |
| TI-REQ-05 | Insert 3D illustrations into the standardized work instruction format. |
| TI-REQ-06 | Review OMS drafts for clarity, accuracy, and ease of use. |
| TI-REQ-07 | Identify all components involved in the Titus structural assembly. |
| TI-REQ-08 | Obtain and review the complete BOM for the structural assembly. |
| TI-REQ-09 | Quantify component usage and compare planned versus actual quantities. |
| TI-REQ-10 | Create tables or charts summarizing component quantities and findings. |
| TI-REQ-11 | Prepare a final BOM analysis document with categorized components and quantities. |

# Titus Past State Process Flow



# Titus FMEA

| Risk Area | Failure Mode | Effect | S | O | D | RPN | Recommended Action |
|---|---|---|---|---|---|---|---|
| New Hire Training | New employees depend on experienced operators | Training bottleneck and production delays | 7 | 5 | 5 | **175** | Test OMS versions with operators and select the clearest format |
| OMS Instructions | Instructions are unclear | Operator confusion and slower training | 8 | 5 | 4 | **160** | Add clear 3D visuals and simple step-by-step instructions |
| Assembly Sequence | Steps are performed out of order | Rework and longer assembly time | 8 | 4 | 5 | **160** | Standardize numbered steps and clear visual sequence |
| BOM vs Actual Usage | BOM does not match actual usage | Material discrepancies and possible cost errors | 8 | 4 | 5 | **160** | Compare BOM to actual usage and document discrepancies |
| Quality Checks | Quality checkpoints are missing or unclear | Defects may continue through the process | 8 | 4 | 5 | **160** | Add checkpoints at critical assembly steps |

| Rating Scale | | | |
|---|---|---|---|
| S | Severity | 1 = Low | 10 = High |
| O | Occurrence | 1 = Rare | 10 = Frequent |
| D | Detection | 1 = Easy to detect | 10 = Hard to detect |
| RPN | Risk Priority Number | S × O × D | |

# *Possible Solutions*

## Standardization

- OMS with **3D visuals**
- **Consistent assembly steps**

## Data Alignment

- **BOM vs. actual analysis**
- Correct discrepancies

## Validation

- Develop OMS versions
- **Assembler testing and refinement**

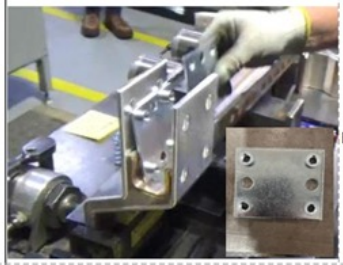
**Standardized, validated process with improved accuracy and efficiency**

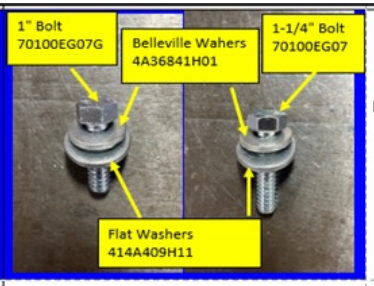
# Trade Study 1: Possible Solutions

| OMS Solutions Selection | | | | | | |
|---|---|---|---|---|---|---|
| **Possible Solution** | **Operator Feedback** | **Implementation Effort** | **Clarity Improvement** | **Cost Efficiency** | **Risk Reduction** | **Weighted Score** |
| Develop OMS work instructions with 3D visual guidance | 4 - Good; improves visual understanding | 3 - Moderate; requires 3D work | 5 - Excellent; very clear visuals | 3 - Acceptable; moderate cost | 4 - Good; reduces confusion | **4.00** |
| Standardize step-by-step assembly processes | 3 - Acceptable; easier to follow | 4 - Good; practical to implement | 4 - Good; organized steps | 5 - Excellent; low cost | 3 - Acceptable; reduces variation | **3.60** |
| Conduct BOM vs actual usage analysis to identify discrepancies | 2 - Fair; less direct operator impact | 3 - Moderate; requires data review | 2 - Fair; improves information accuracy | 4 - Good; can reduce waste | 4 - Good; identifies component issues | **2.75** |
| **Create Multiple OMS Versions and Test with Operators** | **5 - Excellent; based on real operator feedback** | **3 - Moderate; requires testing time** | **4 - Good; selected design improves clarity** | **4 - Good; prevents choosing weak format** | **5 - Excellent; validates usability before final use** | **4.35** |

| **Weight ->** | **30%** | **15%** | **25%** | **10%** | **20%** | **Total** |
|---|---|---|---|---|---|---|
| ***Rating Scale: 1 = Poor \| 2 = Fair \| 3 = Acceptable \| 4 = Good \| 5 = Excellent*** | | | | | | 100% |

# Titus OMS Past State

| | | |
|---|---|---|
| 5 |  | Build C-Phase<br>Place Stab 9257C71G03 for Bottom Riser in the top of the U-Bar location as shown for a RIGHT SIDE STANDARD Riser. For a LEFT SIDE NON-STANDARD Riser, the Stab would spin 180°.<br><br>NOTE: When building Risers for the RIGHT SIDE of the structure (per the Front View), the stabs will be in the STANDARD direction.<br>When building Risers for the LEFT SIDE of the structure, the stabs will be in the NON-STANDARD direction. |
| 6 |  | Build C-Phase<br>Place two 4-Hole Nutplates 2A97833G20 on the inside of the U-Bar at the Stab. The flat side of the nutplate should be against the Stab. |
| 7 |  | Build C-Phase<br>Place two 6-Hole Nutplates 2A97833G01 on the inside of the U-Bar at the last set of 3 holes at the bottom of the U-Bar. The flat side of the nutplate should be to the outside of the U-Bar. |

| | | |
|---|---|---|
| 8 |  | Build C-Phase<br>Build up the required bolt assemblies for C-Phase. You will need:<br><br>qty: 21 70100EG07J 1-1/4" long Bolts<br>qty: 1 70100EG07G 1" long Bolt<br>qty: 22 414A409H11 Flat Washers<br>qty: 22 4A36841H01 Belleville Washers |
| 9 |  | Build C-Phase<br>Using the cordless screwdriver, loosely start four 70100EG07J 1-1/4" long Bolt assemblies through the Stab and into the 4-Hole Nutplate on both sides of the fixture. |
| 10 |  | Build C-Phase<br>Place the Tap Plates 9251C04H01 into position as shown and, using the cordless screwdriver, loosely start three 70100EG07J 1-1/4" long Bolt assemblies through the Tap Plate holes and into the 6-Hole Nutplate on both sides of the fixture. |

# OMS V1

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Powering Business Worldwide

**ASSEMBLY METHOD SHEET**

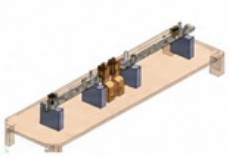
| | | | | | |
|---|---|---|---|---|---|
| Department: | Raptors | Title: | BusC phase | Doc # | ELP.LVA.01 |
| Work Center: | Falcon | | | Date: | 2/13/2025 |

(Part 1 Ligt base)

Part List

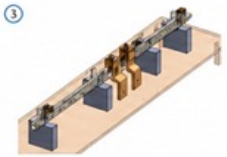
| Bent Plate L | Bent Plate R | Pre-Insulated Rod | Flat Connector Plate | HHCS M10x30 | Flat Washer M10 (SST) | Flat Washer M10 (Steel) |
|---|---|---|---|---|---|---|
| ② | ⑦ | ① | ⑤ | ⑨ | ⑥ | ③ |

Place the bottom section of **U-Bus** 251512208P07 onto the table.
Align parts so that the **end slotted bar** copper contacts touch and rest on the last flat copper, toward the bottom.



**Build Phase**
Place the 251512208P10 in the folgnden order using all the built-uin holes as shown and using HHCS M10X30 bolts to pre-build the light base subcomponents, from one end to the other.

NOTE: When building Phase from the BCA3 SIDE of the structure (as per the Carter View), you must refer to the STANDARD procedure.
When building from the BCA2 SIDE of the structure, the order will be on the INVERSED/OPPOSITE direction.



**Build Phase**
Place the sub-assembly 251512208P10 on the bottom of the plywood base. Make sure all of the copper contacts are seated on blocks.

| NOTES: | Critical to Safety | Critical to Quality | Critical to Quantity | Production:_____ | Quality:_____ | EHS:_____ | OPEX:_____ |
|---|---|---|---|---|---|---|---|

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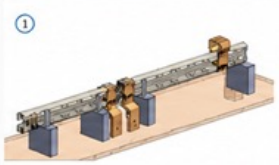
**ASSEMBLY METHOD SHEET**

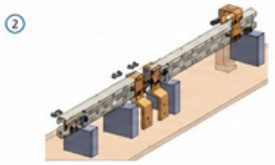
| | | | | | |
|---|---|---|---|---|---|
| Department: | Raptors | Title: | BusC phase | Doc #: | ELP.LVA.02 |
| Work Center: | Falcon | | | Date: | 2/13/2025 |

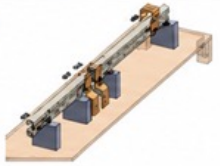
(Part 1 Ligt base Continuos)

Part List

| Pre-Insulated Rud | Performanace Insulator | Performanace Nut | Performanace Lock Washer | Performanace Hex Bolt | Flat Washer M10 (SST) | Flat Washer M10 (Steel) |
|---|---|---|---|---|---|---|
| ① | ③ | ④ | ⑤ | ⑥ | ⑧ | ⑨ |







| NOTES: | Critical to Safety | Critical to Quality | Critical to Quantity | Production:_____ | Quality:_____ | EHS:_____ | OPEX:_____ |
|---|---|---|---|---|---|---|---|

# OMS V2

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OPERATIONAL METHOD SHEET

Doc #

Department:

Title:

Date:

Work Center:

# Op | Tool / Fixture

**GENERAL SAFE PRACTICES:**

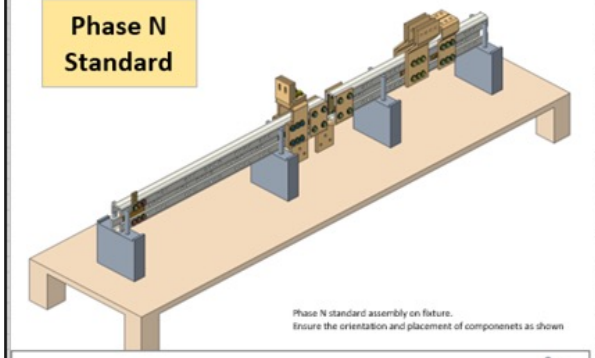
*Refer to area PPE Matrix for Required PPE - 8.11 Personal Protective Equipment Risk Assessment.

*Refer to area Risk Identification Packet and/or current area Work Station Risk Assessment.

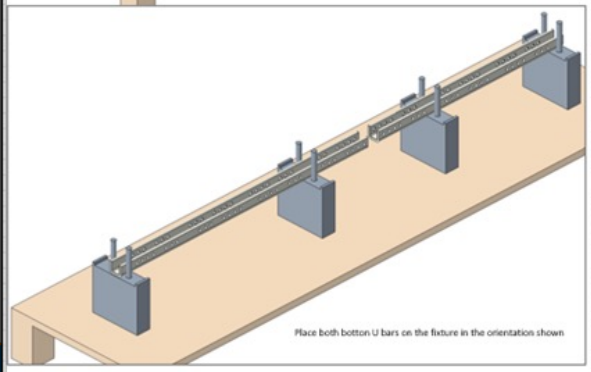
*No employee is permitted to lift any item or material

Parts List:

**Phase N Standard**



Phase N standard assembly on fixture.
Ensure the orientation and placement of componenets as shown



Place both botton U bars on the fixture in the orientation shown

| Part Number | Description | Quantity |
|---|---|---|
| | | |

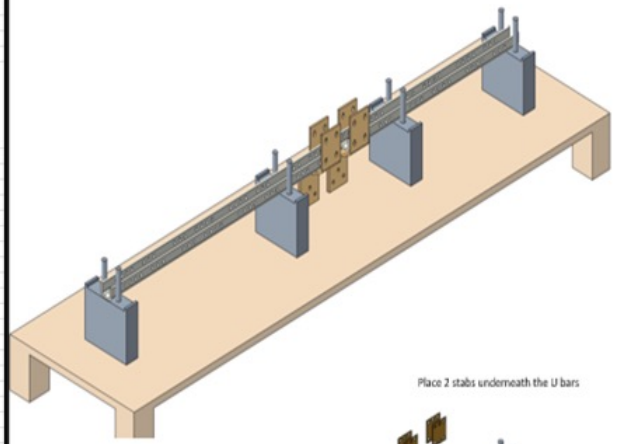
| Screw | Description | Torque value |
|---|---|---|
| | | |

| Part Number | Description | Quantity |
|---|---|---|
| | | |

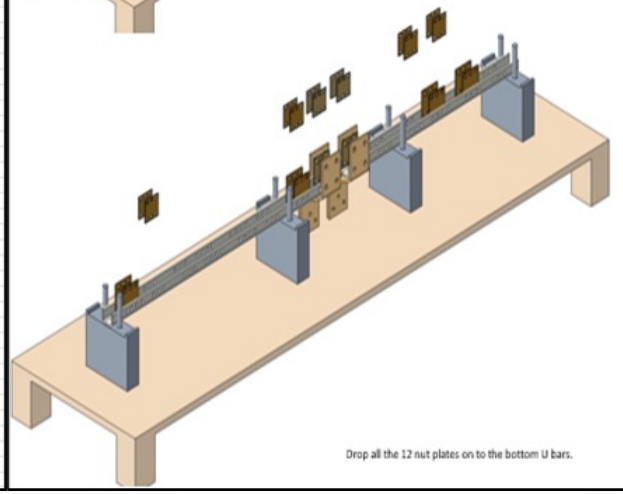
| Screw | Description | Torque value |
|---|---|---|
| | | |

| Part Number | Description | Quantity |
|---|---|---|
| | | |

| Screw | Description | Torque value |
|---|---|---|
| | | |



Place 2 stabs underneath the U bars



Drop all the 12 nut plates on to the bottom U bars.

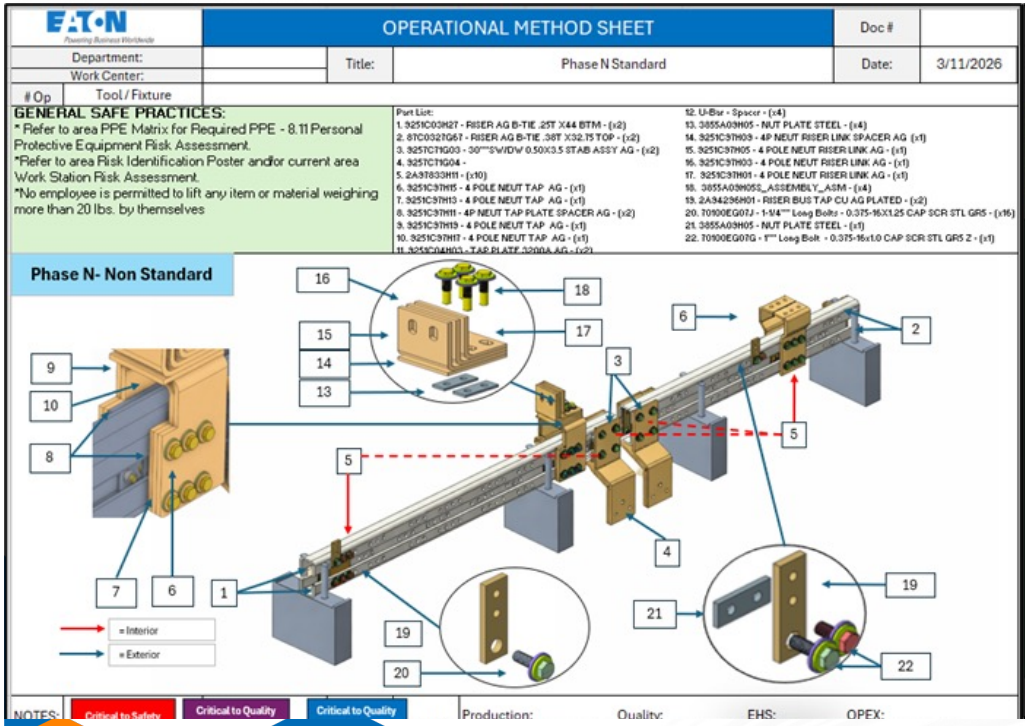
| Part Number | Description | Quantity |
|---|---|---|
| | | |

| Screw | Description | Torque value |
|---|---|---|
| | | |

| Part Number | Description | Quantity |
|---|---|---|
| | | |

| Screw | Description | Torque value |
|---|---|---|
| | | |

# OMS V3



EATON

OPERATIONAL METHOD SHEET

| | | | | | |
|---|---|---|---|---|---|
| Department: | | Title: | Phase N Standard | Doc # | |
| Work Center: | | | | Date: | 3/11/2026 |
| # Op | Tool / Fixture | | | | |

**GENERAL SAFE PRACTICES:**

* Refer to area PPE Matrix for Required PPE - 8.11 Personal Protective Equipment Risk Assessment.
*Refer to area Risk Identification Poster and/or current area Work Station Risk Assessment.
*No employee is permitted to lift any item or material weighing more than 20 lbs. by themselves

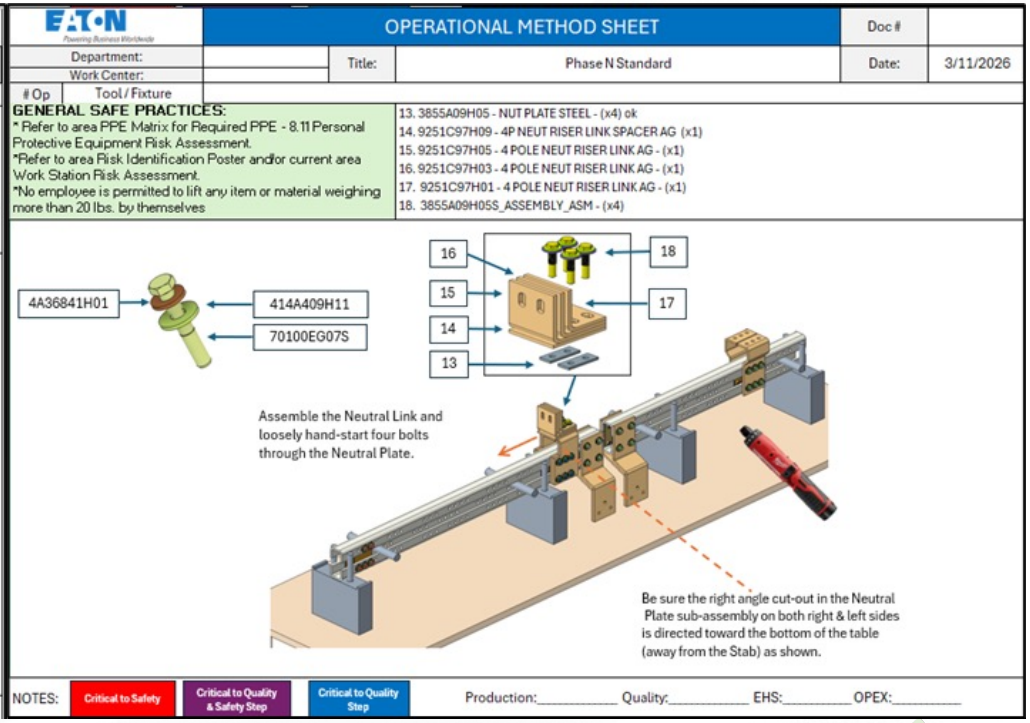
Part List:

1. 9251C03H27 - RISER AG B-TIE .25T X44 BTM - (x2)
2. 8TC0327G67 - RISER AG B-TIE .38T X32.75 TOP - (x2)
3. 9257C7TG03 - 30""SWDW 0.50X3.5 STAB ASSY AG - (x2)
4. 9257C7TG04 -
5. 2A97833H11 - (x10)
6. 9251C97H15 - 4 POLE NEUT TAP AG - (x1)
7. 9251C97H13 - 4 POLE NEUT TAP AG - (x1)
8. 9251C97H11 - 4P NEUT TAP PLATE SPACER AG - (x2)
9. 9251C97H19 - 4 POLE NEUT TAP AG - (x1)
10. 9251C97H17 - 4 POLE NEUT TAP AG - (x1)
11. 9253C04H03 - TAP PLATE 2200A AG - (x2)
12. U-Bar - Spacer - (x4)
13. 3855A03H05 - NUT PLATE STEEL - (x4)
14. 9251C97H09 - 4P NEUT RISER LINK SPACER AG (x1)
15. 9251C97H05 - 4 POLE NEUT RISER LINK AG - (x1)
16. 9251C97H03 - 4 POLE NEUT RISER LINK AG - (x1)
17. 9251C97H01 - 4 POLE NEUT RISER LINK AG - (x1)
18. 3855A09H05S_ASSEMBLY_ASM - (x4)
19. 2A94296H01 - RISER BUS TAP CU AG PLATED - (x2)
20. 70100EG07J - 1-1/4"" Long Bolts - 0.375-16X1.25 CAP SCR STL GR5 - (x16)
21. 3855A03H05 - NUT PLATE STEEL - (x1)
22. 70100EG07G - 1"" Long Bolt - 0.375-16x1.0 CAP SCR STL GR5 Z - (x1)

**Phase N- Non Standard**



NOTES: Critical to Safety | Critical to Quality | Critical to Quality | Production: | Quality: | EHS: | OPEX:



EATON

OPERATIONAL METHOD SHEET

| | | | | | |
|---|---|---|---|---|---|
| Department: | | Title: | Phase N Standard | Doc # | |
| Work Center: | | | | Date: | 3/11/2026 |
| # Op | Tool / Fixture | | | | |

**GENERAL SAFE PRACTICES:**

* Refer to area PPE Matrix for Required PPE - 8.11 Personal Protective Equipment Risk Assessment.
*Refer to area Risk Identification Poster and/or current area Work Station Risk Assessment.
*No employee is permitted to lift any item or material weighing more than 20 lbs. by themselves

13. 3855A09H05 - NUT PLATE STEEL - (x4) ok
14. 9251C97H09 - 4P NEUT RISER LINK SPACER AG (x1)
15. 9251C97H05 - 4 POLE NEUT RISER LINK AG - (x1)
16. 9251C97H03 - 4 POLE NEUT RISER LINK AG - (x1)
17. 9251C97H01 - 4 POLE NEUT RISER LINK AG - (x1)
18. 3855A09H05S_ASSEMBLY_ASM - (x4)



NOTES: Critical to Safety | Critical to Quality & Safety Step | Critical to Quality Step | Production:_____ Quality:_____ EHS:_____ OPEX:_____

# Trade Study 2: OMS Version Selection

| OMS Version Selection | | | | | | | |
|---|---|---|---|---|---|---|---|
| **OMS Version** | **Ease of Understanding** | **Visual Clarity** | **Part Identification** | **Color Coding / Organization** | **Component Quantity Info** | **Operator Usability** | **Weighted Score** |
| **OMS V1** | 2 - Fair; text-heavy, harder to follow | 2 - Fair; limited visual clarity | 2 - Fair; parts not clearly labeled | 1 - Poor; minimal color coding | 2 - Fair; quantity info not clear | 2 - Fair; less operator friendly | 1.85 |
| **OMS V2** | 3 - Acceptable; improved layout | 3 - Acceptable; better images | 3 - Acceptable; some part information | 2 - Fair; limited organization | 3 - Acceptable; quantity info improved | 3 - Acceptable; easier than V1 | 2.85 |
| **OMS V3** | **5 - Excellent; easiest to follow** | **5 - Excellent; clean visual layout** | **5 - Excellent; labeled part numbers** | **5 - Excellent; color-coded references** | **5 - Excellent; quantities included** | **5 - Excellent; best for operators** | **5.00** |
| **Weight ->** | **25%** | **20%** | **20%** | **15%** | **10%** | **10%** | **Total** 100% |

**Rating Scale: 1 = Poor | 2 = Fair | 3 = Acceptable | 4 = Good | 5 = Excellent**

# Outcomes

OMS implementation reduced overall cycle time by 12% and improved process consistency across operations.

| Average Cycle Time | |
|---|---|
| **Description of Task** | **Time** |
| Risers | 1:12:15 |
| Rotator | 0:37:31 |
| Laydown | 1:56:05 |
| **Crossbus** | **9:02:20** |
| Midline Mechanical | 3:17:20 |
| Copper Layout | 4:44:12 |
| Closeout | 1:27:42 |

| Summary | |
|---|---|
| Avg. Cycle Time | 3:11:04 |
| Takt Time | 3:35 |

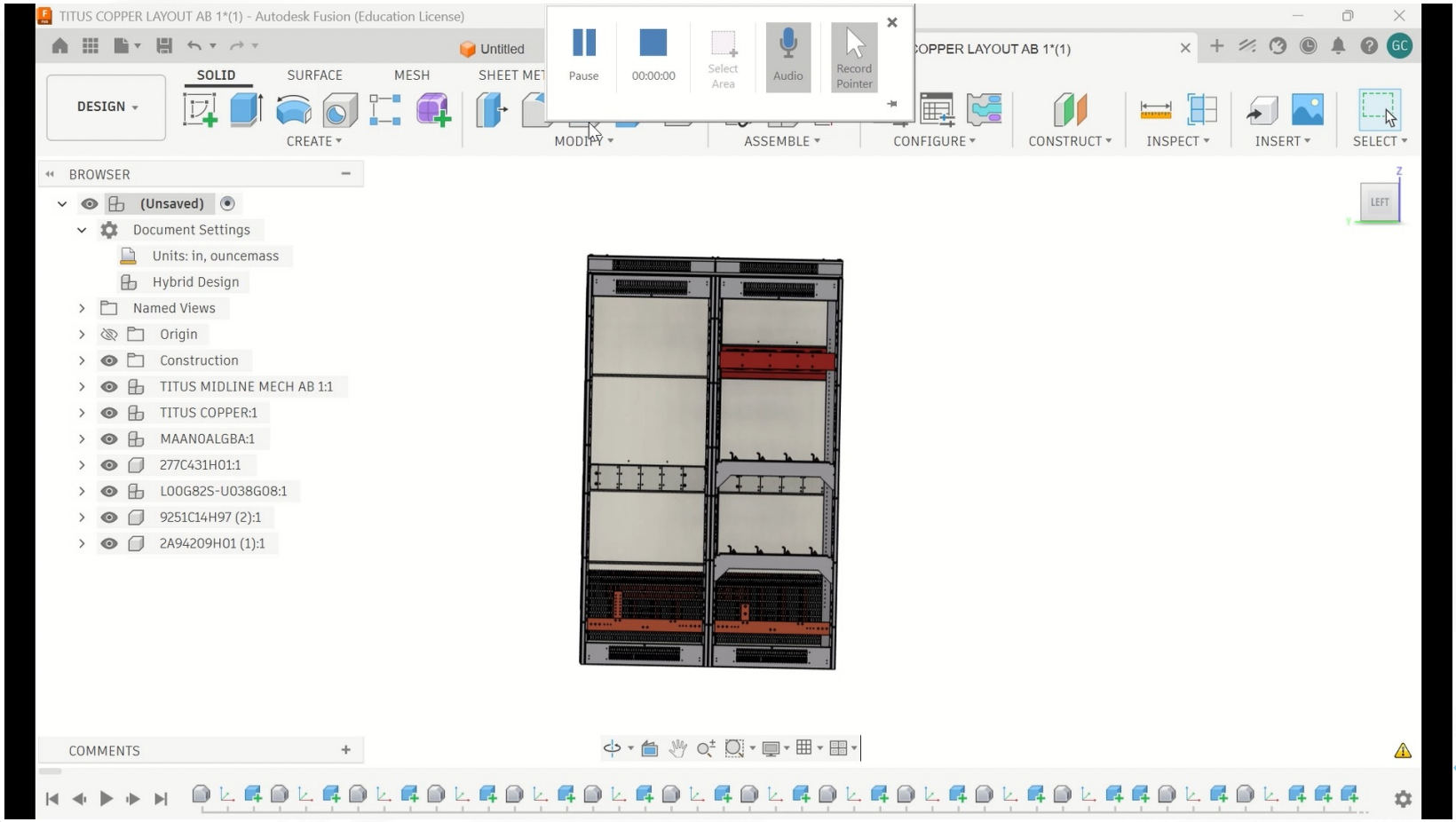
**22-minute reduction in average cycle time**

| Average Cycle Time | |
|---|---|
| **Description of Task** | **Time** |
| **Risers** | **1:09:56** |
| Rotator | 0:36:46 |
| Laydown | 1:56:05 |
| **Crossbus** | **7:16:51** |
| **Midline Mechanical** | **2:29:21** |
| Copper Layout | 4:44:12 |
| Closeout | 1:27:42 |

| Summary | |
|---|---|
| Avg. Cycle Time | 2:48:42 |
| Takt Time | 3:35 |

OMS implementation reduced cycle time and improved process consistency, with the most significant impact in Crossbus operations.

# OMS Process


TITUS COPPER LAYOUT AB 1*(1) - Autodesk Fusion (Education License)
Untitled
Pause
00:00:00
Select Area
Audio
Record Pointer
DESIGN
SOLID
SURFACE
MESH
SHEET METAL
CREATE
MODIFY
ASSEMBLE
CONFIGURE
CONSTRUCT
INSPECT
INSERT
SELECT
BROWSER
(Unsaved)
Document Settings
Units: in, ouncemass
Hybrid Design
Named Views
Origin
Construction
TITUS MIDLINE MECH AB 1:1
TITUS COPPER:1
MAAN0ALGBA:1
277C431H01:1
L00G82S-U038G08:1
9251C14H97 (2):1
2A94209H01 (1):1
LEFT
COMMENTS

# OMS Process

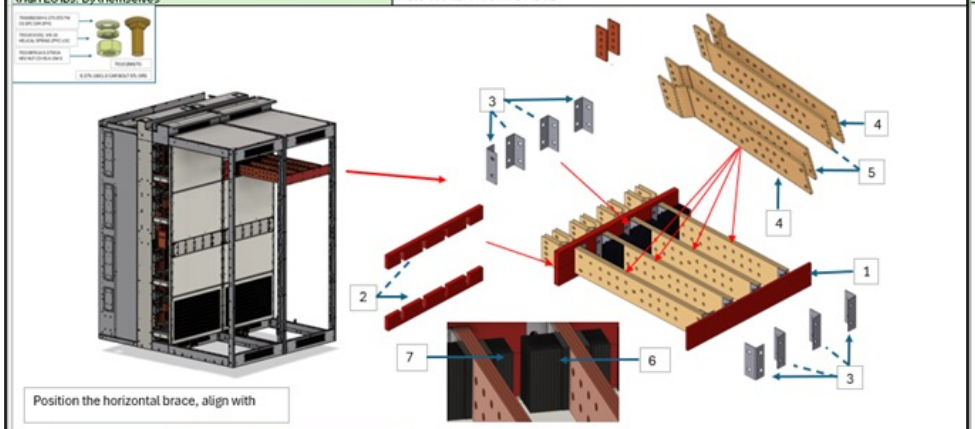
EATON

| OPERATIONAL METHOD SHEET | | | Doc # | |
|---|---|---|---|---|
| Department: | | Title: | Date: | 4/1/2026 |
| Work Center: | | Copper Layout | | |
| # Op | Tool / Fixture | | | |

**GENERAL SAFE PRACTICES:**

* Refer to area PPE Matrix for Required PPE – 8.11 Personal Protective Equipment Risk Assessment.
*Refer to area Risk Identification Poster and/or current area Work Station Risk Assessment.
*No employee is permitted to lift any item or material weighing more than 20 lbs. by themselves

Parts List:
1.L00GNVZ-D651H02 - BRACE
2. L00GNVZ-D651H01 - GLASSPOLY BRACE 1.00 THK - (x2)
3. 9256C90H01 - 4000A LOAD TAKEOFF RUNBACK BKT - (x8)
4. L00GNVZ-U152H01 - 0.250X4.500X36.770 AG BUS BAR
5. L00GNVZ-U152H03 - 0.250X4.500X36.570 AG BUS BAR
6. 208-335-01 - AWS RTO HS #1
7. 208-335-02 - AWS RTO HS #2




Position the horizontal brace, align with

NOTES: Critical to Safety | Critical to Quality & Safety Step | Critical to Quality Step

Production:_____ Quality:_____ EHS:_____ OPEX:_____

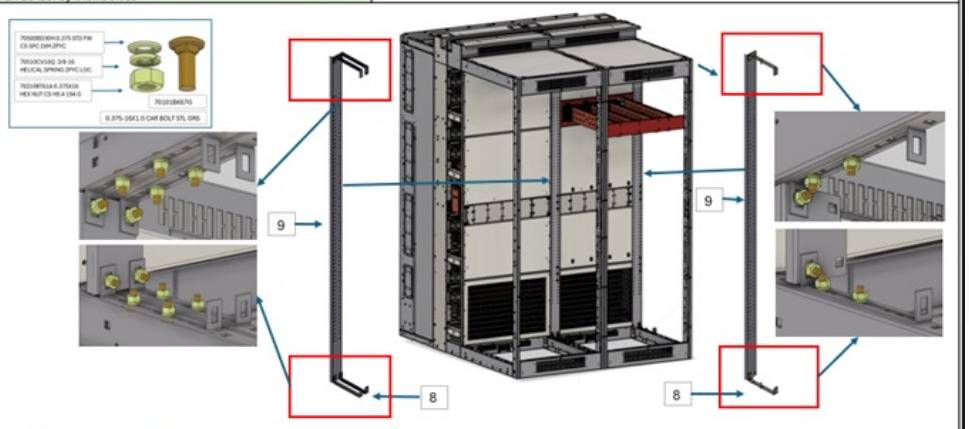
EATON

| OPERATIONAL METHOD SHEET | | | Doc # | |
|---|---|---|---|---|
| Department: | | Title: | Date: | 4/1/2026 |
| Work Center: | | Copper Layout | | |
| # Op | Tool / Fixture | | | |

**GENERAL SAFE PRACTICES:**

* Refer to area PPE Matrix for Required PPE – 8.11 Personal Protective Equipment Risk Assessment.
*Refer to area Risk Identification Poster and/or current area Work Station Risk Assessment.
*No employee is permitted to lift any item or material weighing more than 20 lbs. by themselves

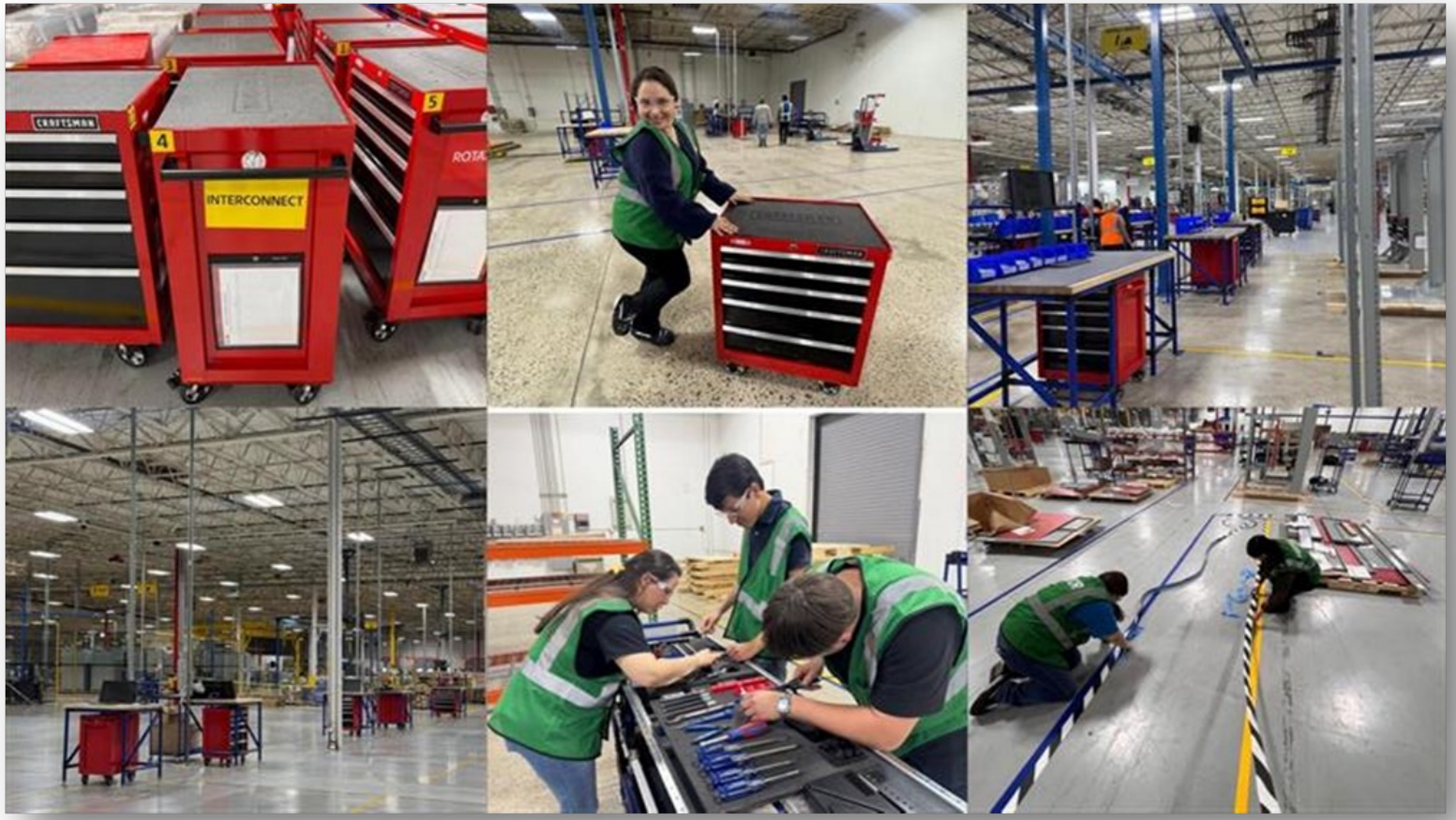
Parts List:
8. 114B718H01 - BRACKET, END COVER ABBXFMR - (x6)
9. L00G82S-D697H01- 0.119 VERT AMZN SIDE CABLE SUP - (x2)
70101BK67G- 0.375-16X1.0 CAR BOLT STL GR5 - (x16)
70210BT61A- 0.375X16 HEX NUT CS HS A 194 G - (x16)
70510CV10Q- 3/8-16 HELICAL SPRING ZPYC LOC - (x16)
70500BD30H- 0.375 STD FW CS SPC DIM ZPYC - (x16)




NOTES: Critical to Safety | Critical to Quality & Safety Step | Critical to Quality Step

Production:_____ Quality:_____ EHS:_____ OPEX:_____

# Switch Line Project



# *Switch Line Project*

The Switch Line project focuses on improving assembly efficiency through the optimization and standardization of tool kits across production stations. By applying Lean principles and 5S methodology, the project aims to enhance tool organization, reduction of unnecessary motion, and support a more streamlined and consistent workflow.

# SWITCH LINE PROBLEM STATEMENT & OBJECTIVES

## Problem Statement

The current Switch Line operates with non-standardized tool kits, leading to increased search time, unnecessary motion, process variability, and potential downtime. These inefficiencies reduce productivity and limit overall operational performance, creating a need for tool kit standardization and optimization.

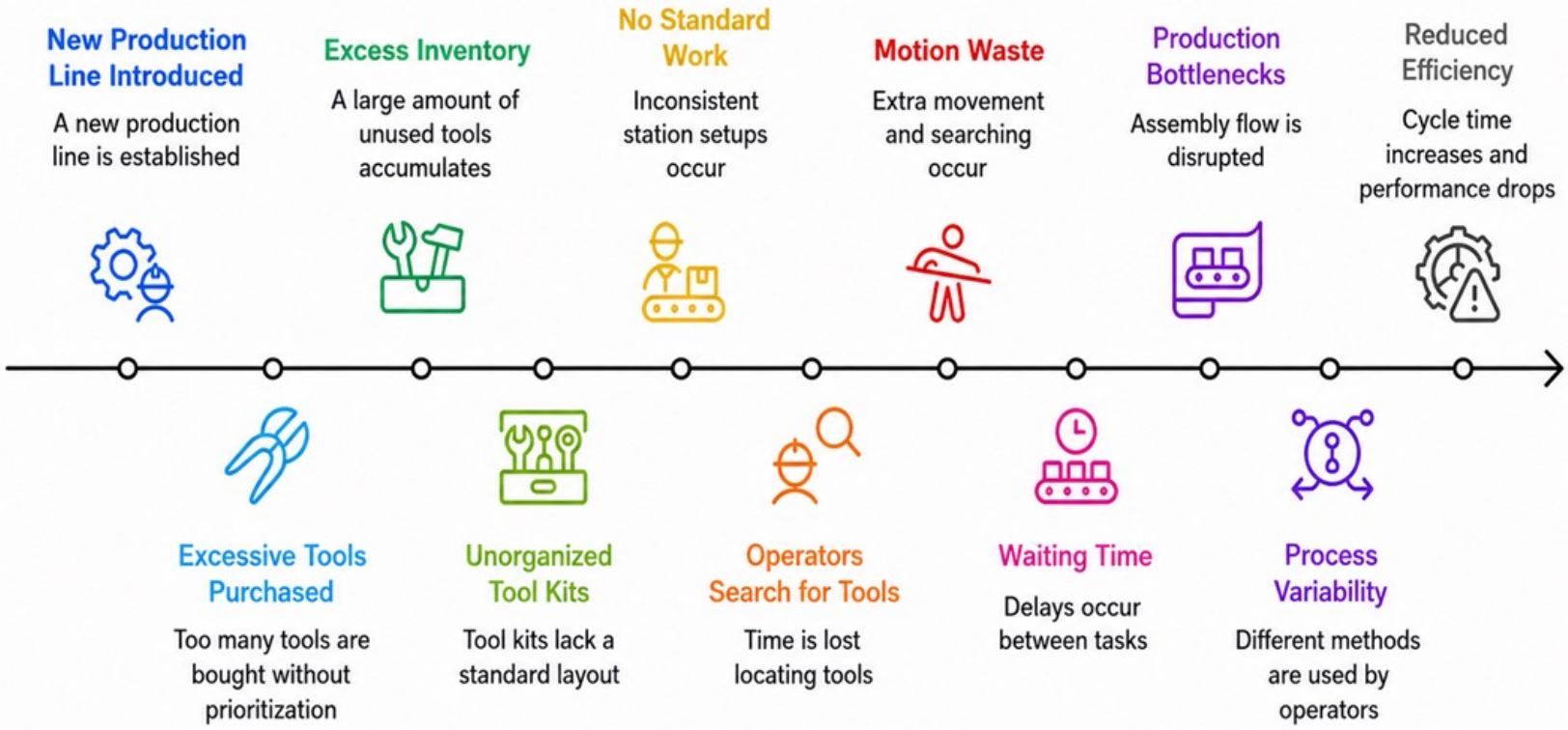
## Objectives:

1. Standardize tool kits across all assembly stations
2. Optimize tool organization using Lean and 5S principles
3. Reduce unnecessary motion and time spent searching for tools
4. Validate tool requirements with production operators
5. Improve workflow efficiency and consistency across the line

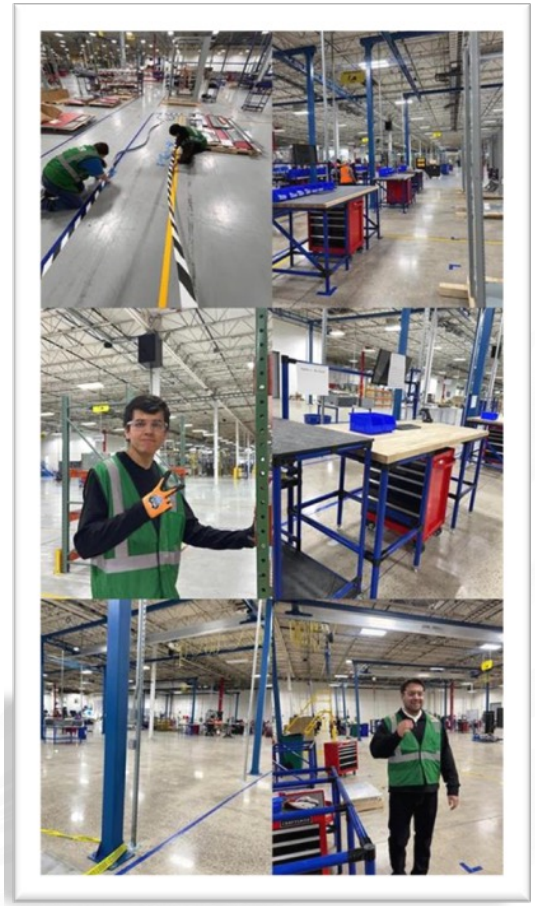
# Switch Line Requirements

| Requirement ID | Requirement |
|---|---|
| SW-REQ-01 | Review and analyze the current Switch Line tool list. |
| SW-REQ-02 | Identify the required tools for each production station. |
| SW-REQ-03 | Validate tool requirements with production staff and manufacturing engineers. |
| SW-REQ-04 | Organize the tool kits by workstation and toolbox drawer. |
| SW-REQ-05 | Standardize tool kits across the Switch Line to improve consistency. |
| SW-REQ-06 | Optimize tool placement to reduce tool searching time and improve workflow. |
| SW-REQ-07 | Ensure the tool kit arrangement follows safety and quality standards. |
| SW-REQ-08 | Create clear documentation for implementation and future maintenance. |
| SW-REQ-09 | Present the final optimized tool kit layout for approval and deployment. |

# Switch Line Past State Process Flow



# Switch Line Past State



# *Possible Solutions*

| Standardization | Organization | Optimization |
| --- | --- | --- |
| • **Standardize tool kits** per station<br>• Consistent tool setup across the line | • Apply **5S principles** for tool arrangement<br>• Improve **visibility and accessibility** | • Align tools with assembler needs<br>• Reduce **search time and motion** |

**Standardized and organized tool system to improve efficiency and reduce motion waste.**

# *Trade Study 1: Possible Solutions*

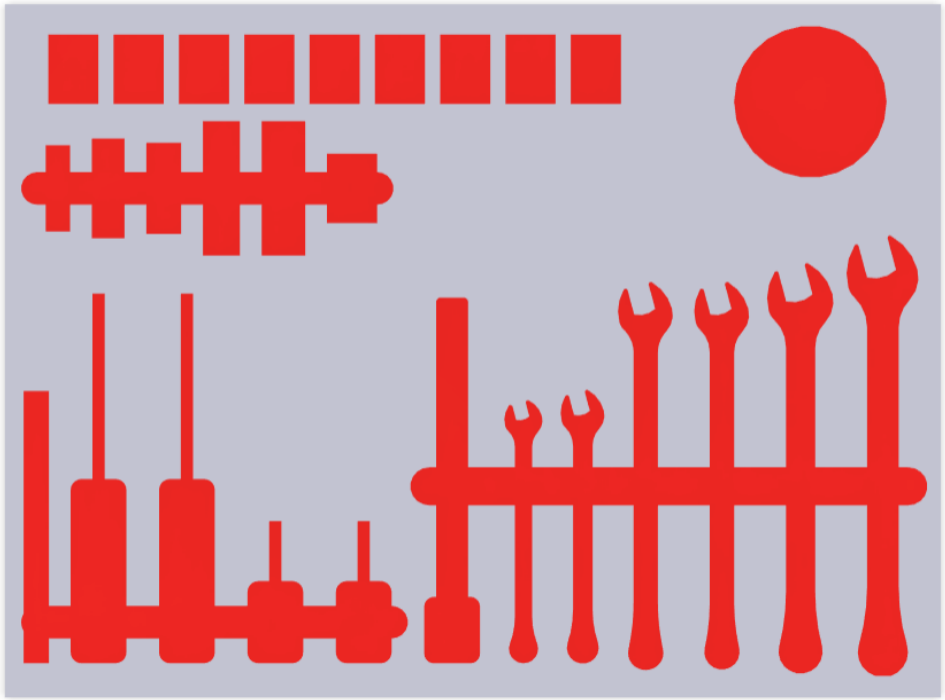
| Switch Line Solutions Trade Study | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Possible Solution** | **Process Impact** | **Implementation Effort** | **Cost Efficiency** | **Standardization Benefit** | **Waste Reduction** | **Ease of Maintenance** | **Weighted Score** |
| **Standardization** | 4 - Good; consistent tool kits across stations | 4 - Good; practical to implement | 5 - Excellent; low cost approach | 5 - Excellent; strong consistency across line | 4 - Good; reduces variation and search time | 4 - Good; easy to audit and maintain | 4.30 |
| **Organization** | **5 - Excellent; improves tool visibility and accessibility** | **4 - Good; requires drawer layout work** | **4 - Good; moderate material effort** | **4 - Good; supports standard placement** | **5 - Excellent; reduces motion and searching** | **4 - Good; easier to keep tools in place** | **4.45** |
| **Optimization** | 5 - Excellent; aligns tools with assembly needs | 3 - Moderate; requires usage analysis | 4 - Good; prevents unnecessary tool setup | 4 - Good; improves station layout | 5 - Excellent; reduces search time and motion | 3 - Moderate; needs updates as process changes | 4.20 |
| **Weight ->** | **25%** | **15%** | **10%** | **20%** | **20%** | **10%** | **Total** |
| | | | | | | | **100%** |

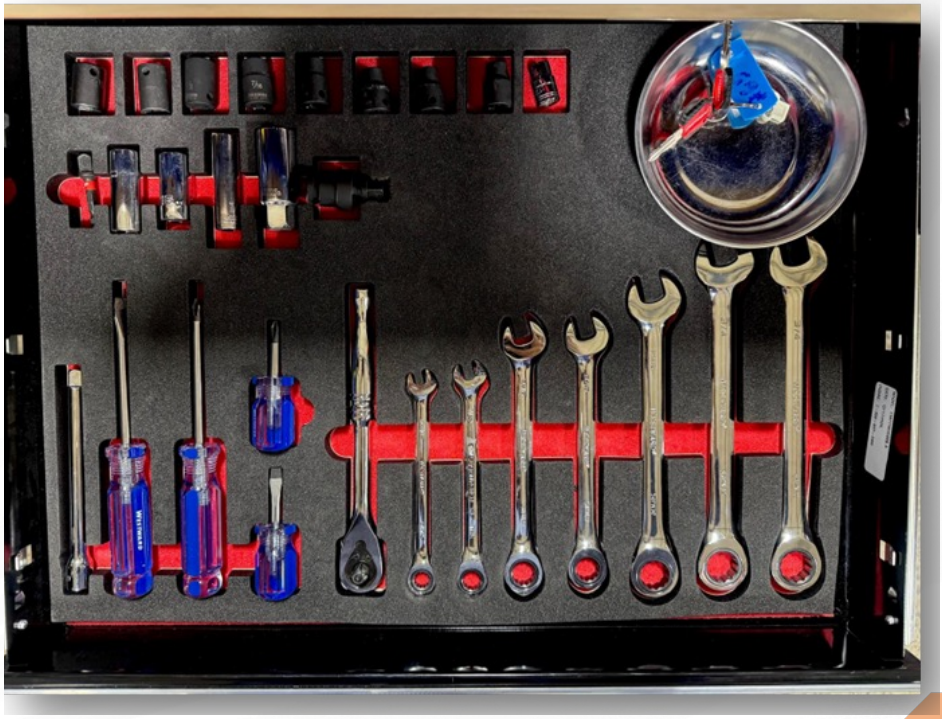
*Rating Scale: 1 = Poor | 2 = Fair | 3 = Acceptable | 4 = Good | 5 = Excellent*

# Trade Study 2: Material Selection

| Switch Line Tool Insert Material Trade Study | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Material Option** | **Laser Cut Quality** | **Heat / Melting Resistance** | **Tool Fit & Retention** | **Durability** | **Cost Efficiency** | **Ease of Replacement** | **Weighted Score** |
| **High-Density EVA Foam** | **5 - Excellent; clean cut with proper settings** | **4 - Good; low melting risk with controlled laser settings** | **5 - Excellent; cushions and holds tools securely** | **4 - Good; durable for repeated tool use** | **4 - Good; affordable for multiple drawers** | **5 - Excellent; easy to recut and replace** | **4.55** |
| Polyethylene Tool Foam | 3 - Acceptable; may leave rough edges | 2 - Fair; higher melting risk during laser cutting | 5 - Excellent; strong tool retention | 4 - Good; durable tool-control material | 3 - Acceptable; moderate cost | 4 - Good; replaceable but settings matter | **3.50** |
| Neoprene Foam Rubber | 3 - Acceptable; can cut but may smell or mark | 3 - Acceptable; better heat resistance than basic foam | 4 - Good; flexible grip for tools | 4 - Good; resists wear | 3 - Acceptable; moderate cost | 4 - Good; relatively easy to replace | **3.45** |
| Baltic Birch Plywood | 5 - Excellent; very clean laser cut | 5 - Excellent; no melting during laser cutting | 3 - Acceptable; rigid and less forgiving for tools | 5 - Excellent; very durable | 4 - Good; reasonable material cost | 3 - Acceptable; harder to modify after cutting | **4.30** |
| Acrylic Sheet | 5 - Excellent; clean polished laser edges | 4 - Good; cuts well but can mark or crack | 2 - Fair; rigid and does not grip tools well | 4 - Good; durable but brittle if impacted | 2 - Fair; higher cost | 2 - Fair; less flexible to replace | **3.45** |
| **Weight ->** | **25%** | **20%** | **25%** | **15%** | **10%** | **5%** | **Total** |
| *Rating Scale: 1 = Poor \| 2 = Fair \| 3 = Acceptable \| 4 = Good \| 5 = Excellent* | | | | | | | **100%** |

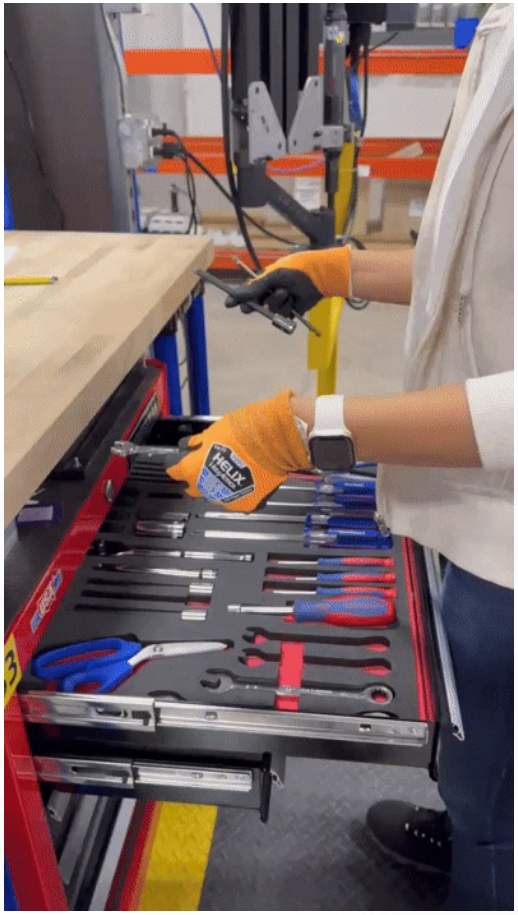
# VISUAL POKA-YOKE





## Bus Station

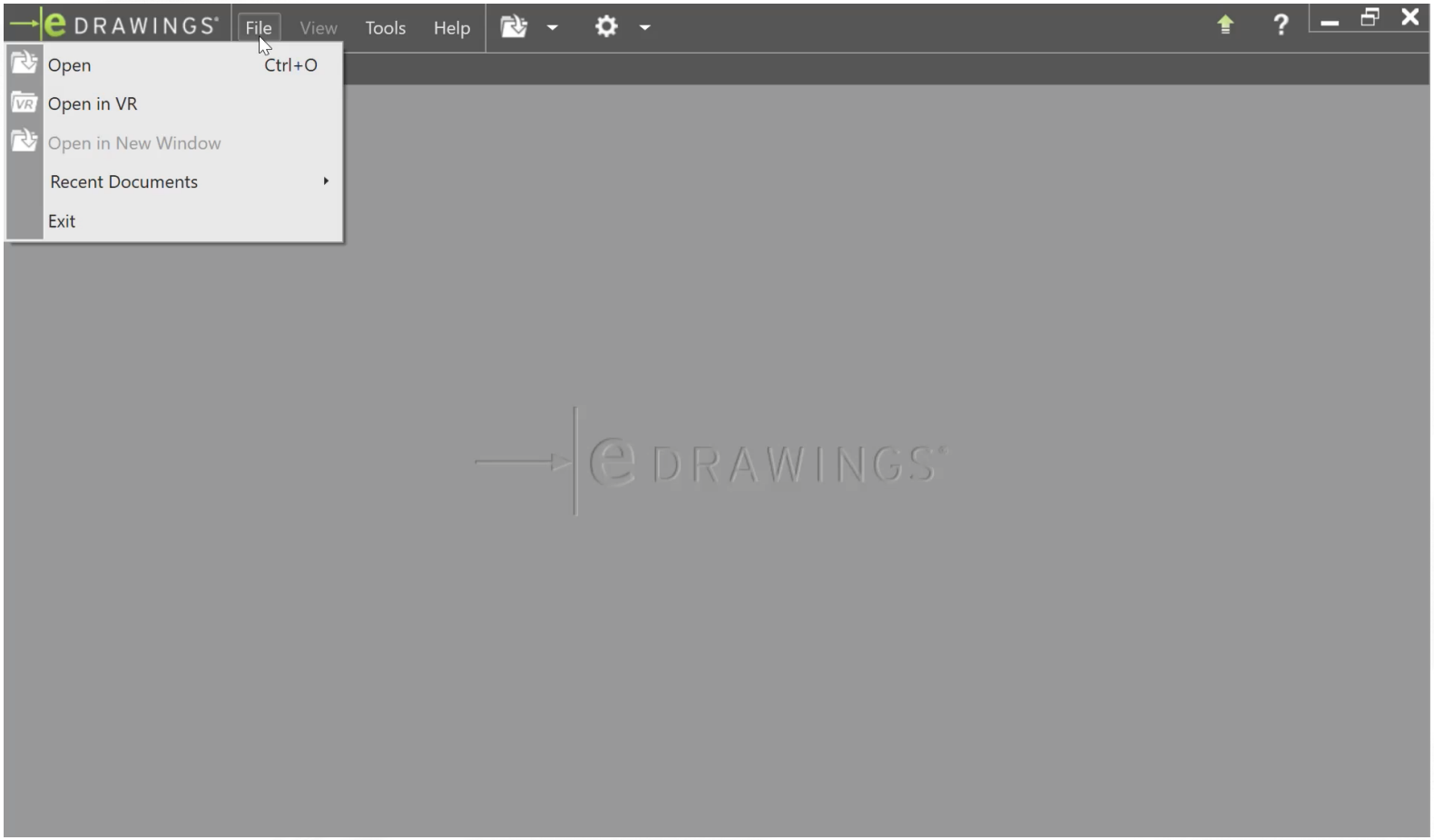
## Chassis



# Outcomes

| |
|---|
| Standardized tool kits across Switch Line stations |
| Reduced tool search time and unnecessary motion |
| Improved workplace organization using 5S principles |
| Implemented visual control through foam tool layouts (visual Poka-Yoke) |
| Increased process consistency and operator efficiency |
| Enhanced training and ease of tool identification |
| Reduced risk of missing or misplaced tools |

# Proposed Future Work



# CONCLUSIONS

**TITUS**

- Standardized OMS with 3D visuals improved process clarity and consistency
- Reduced operator confusion and training time
- Improved alignment with engineering specifications
- BOM analysis identified discrepancies and improved material accuracy
- Project objectives were successfully achieved

**SWITCH**

- Standardized tool kits across stations reduced variability
- 5S implementation minimized search time and unnecessary motion
- Visual Poka-Yoke improved tool control and error detection
- Improved operator efficiency and workflow consistency
- Provided a scalable standard for future implementation

# LESSONS LEARNED

Applied Lean Manufacturing, 5S, and visual management in real environment

Developed OMS using 3D visualization tools

Learned importance of operator validation and feedback

Strengthened teamwork and project coordination skills

Gained real-world manufacturing and process improvement experience

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Sr. Manufacturing Engineer

**Jesus H. Gomez Chavez**

Sr. Manufacturing Engineer

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# THANK YOU

Questions?


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