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# From Chaos to Control: Driving Maintenance Effectiveness with Standardized Work Plans


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Reliable

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# Presentation Overview

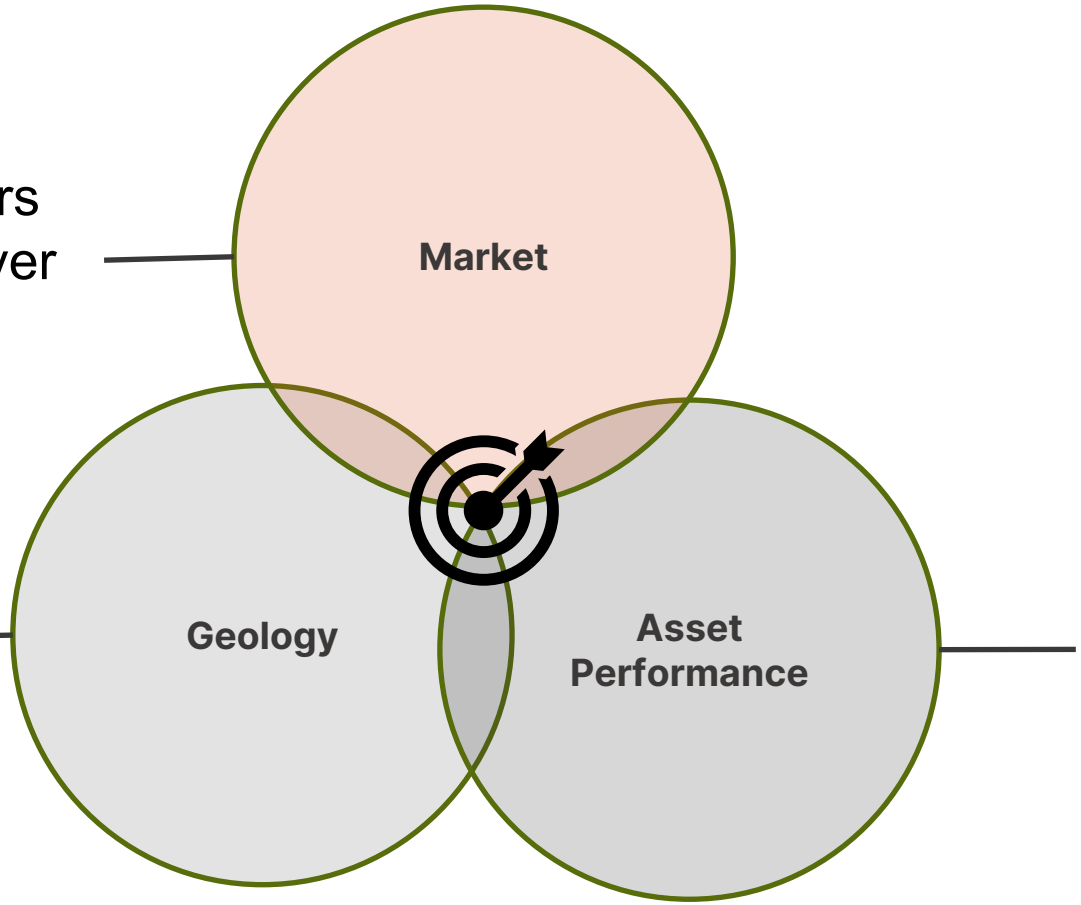
- Maintenance work is inherently repeatable — and standardization allows us to reliably capture that repeatability.
- Standardized job plans transform maintenance from a reactive art into a disciplined, improvable process.
- Field coaching and mentoring are how we reinforce precision execution at the point of work, not just on paper.
- Precision in Fastening, Lubrication, Alignment, and Balance (FLAB) is critical to asset reliability, safety, and efficiency.
- Coaching in the field strengthens tradespeople's skills, accelerates learning, and builds pride in craftsmanship.
- Our objective is simple: complete the work precisely, the first time, every time, and improve continuously.

**Goal:** 100% of Time/Usage-Directed and >80% of Condition Directed Work Performed to a Standard Plan.

# What Drives Value in the Mining Industry

We're price takers with no control over the market

If the geology is poor, we don't mine




Asset performance is the most controllable value driver in the mining industry

# Why it Matters - Jobs Planned from Standards – Worst to Best

| Industry | Lower Quartile (Poor Performers) | Average Performer | Upper Quartile (Best Performers) |
|---|---|---|---|
| Mining – HME (Haul Trucks, Shovels, Drills) | 10% | 30% | 60% |
| Mining – Fixed Plant Operations (Crushing, Conveyance, Milling) | 15% | 35% | 65% |
| Refinery (Oil & Gas) | 20% | 50% | 80% |
| Petrochemical Plants | 20% | 50% | 80% |
| Pulp & Paper Mills | 15% | 40% | 70% |
| Power Generation (Fossil, Nuclear, Hydro) | 25% | 55% | 85% |
| General Manufacturing (Discrete and Continuous) | 15% | 45% | 75% |

# Why it Matters - Wrench Time Performance – Worst to Best

| Industry | Lower Quartile (Poor Performers) | Average Performer | Upper Quartile (Best Performers) |
|---|---|---|---|
| Mining – HME (Haul Trucks, Shovels, Drills) | 20% | 35% | 50% |
| Mining – Fixed Plant Operations (Crushing, Conveyance, Milling) | 25% | 40% | 50% |
| Refinery (Oil & Gas) | 25% | 40% | 50% |
| Petrochemical Plants | 25% | 40% | 50% |
| Pulp & Paper Mills | 25% | 35% | 45% |
| Power Generation (Fossil, Nuclear, Hydro) | 30% | 40% | 50% |
| General Manufacturing (Discrete and Continuous) | 25% | 40% | 50% |

# Why it Matters - Planner to Craft Ratio – Worst to Best

| Industry | Lower Quartile (Poor Performers) | Average Performer | Upper Quartile (Best Performers) |
|---|---|---|---|
| Mining – HME (Haul Trucks, Shovels, Drills) | 8 | 12 | 20 |
| Mining – Fixed Plant Operations (Crushing, Conveyance, Milling) | 8 | 12 | 20 |
| Refinery (Oil & Gas) | 10 | 15 | 25 |
| Petrochemical Plants | 10 | 15 | 25 |
| Pulp & Paper Mills | 8 | 12 | 20 |
| Power Generation (Fossil, Nuclear, Hydro) | 10 | 15 | 25 |
| General Manufacturing (Discrete and Continuous) | 8 | 12 | 20 |

# Start with Life of Physical Asset Plans (LOPAP)

## Time-/Usage-Based Tasks Including:

- REPL – Replace
- RBLD – Rebuild
- STAT – Statutory Task
- LUBE – Lubrication
- CAL – Calibration
- ADJ – Adjustment
- INSP - Inspection
- CM – Condition Monitoring
- NDT – Non-destructive Testing

Note: ~ 100% to a standard plan

## Truncated Example

| Plan Element Name | Description | Interval (Norm) | Task Type |
|---|---|---|---|
| **Conveyor Frame Life** | Design life of conveyor structure and base frame | 25–40 years | REPL |
| Idler Replacement | Replace worn or seized idlers | 10,000–15,000 hrs | REPL |
| Pulley Lagging Replacement | Replace lagging on drive or tail pulleys | 12,000–18,000 hrs | REPL |
| Skirt Rubber Replacement | Replace skirt rubber to maintain material seal | 6,000–10,000 hrs | REPL |
| Belt Replacement | Replace conveyor belt due to wear or age | 15,000–20,000 hrs | REPL |
| Shaft Bearing Replacement | Replace sealed shaft bearings on time/usage basis | 12,000–15,000 hrs | REPL |
| Chute Deflector Rebuild | Rebuild internal deflector to maintain material direction and reduce blockage | 10,000–12,000 hrs | REBLD |
| Take-up Unit Rebuild | Rebuild screw or gravity-type belt take-up systems | 10,000–12,000 hrs | REBLD |
| Mount Pad Rebuild | Rebuild or replace elastomeric base mounts under drive systems | 12,000–15,000 hrs | REBLD |
| Gearbox Overhaul/Rebuild | Full internal rebuild of gear reducer | 30,000–50,000 hrs | REBLD |

# Define Your Top 80% CBM Jobs

| Standard Notification | Description | Corrective Maintenance Frequency (Upper Quartile) | Inspection/Condition Monitoring Trigger | Inspection/Condition Monitoring Frequency |
|---|---|---|---|---|
| Conveyor Belt Replacement | Replacing worn or damaged conveyor belts to maintain proper material transport and prevent breakdowns. | 8,000 - 12,000 hours | Visual inspection or belt slippage sensors showing belt wear | Every 2,000 hours |
| Drive Motor Replacement | Replacing the conveyor drive motor when signs of wear or failure are detected. | 15,000 - 20,000 hours | Vibration or temperature analysis showing motor | Continuous monitoring |
| Idler Roller Replacement | Replacing worn or damaged idler rollers to ensure smooth belt operation and prevent wear on the belt. | 10,000 - 12,000 hours | Vibration or acoustic analysis showing roller wear | Every 2,000 hours |
| Pulley Replacement | Replacing worn or damaged pulleys to maintain belt alignment and tension. | 12,000 - 15,000 hours | Vibration analysis or visual wear inspection | Every 2,500 hours |
| Belt Tension Adjustment | Adjusting belt tension to prevent slippage and ensure proper material transport. | 5,000 - 7,000 hours | Visual inspection or belt tracking system showing | Every 1,500 hours |
| Skirting Replacement | Replacing worn or damaged skirting to prevent material spillage and maintain proper material containment. | 7,500 - 10,000 hours | Visual inspection showing material spillage | Every 1,500 hours |
| Tracking System Adjustment | Adjusting the belt tracking system to maintain belt alignment and prevent wear on belt edges. | 5,000 - 7,000 hours | Visual inspection or belt tracking sensors showing | Every 1,500 hours |
| Conveyor Belt Splicing (Mechanical) | Repairing or splicing conveyor belts using mechanical fasteners to prevent belt failure. | 7,500 - 10,000 hours | Visual inspection showing belt damage or | Every 1,500 hours |
| Conveyor Belt Splicing (Vulcanized) | Repairing conveyor belts using vulcanization techniques to ensure long-lasting belt performance. | 10,000 - 12,000 hours | Visual inspection showing belt damage or wear | Every 2,000 hours |
| Drive Gearbox Replacement | Replacing worn or damaged gearboxes to ensure efficient power transmission to the conveyor belt. | 15,000 - 20,000 hours | Vibration or temperature analysis showing gearbox | Every 2,500 hours |
| Conveyor Frame Inspection and Realignment | Inspecting and realigning the conveyor frame to prevent belt misalignment and reduce wear. | 15,000 - 20,000 hours | Visual inspection showing misalignment | Every 2,500 hours |
| Conveyor Belt Cleaner Replacement | Replacing belt cleaners to ensure the belt is kept free of carryback material and to prevent blockages. | 5,000 - 7,000 hours | Visual inspection or material buildup on the belt | Every 1,500 hours |

**Truncated Example**

**Customize:**

- Frequency Norms
- Inspection Method
- Inspection/ Monitoring Frequency Norms

**Note:** The notification initiates maintenance work. Standardizing the taxonomy improves clarity.

# Start with Generic Standard Job Plans

- Start with the job's intent.
- Define the Job Risk/Hazard Analysis and Controls

**Note**: JRA/JHA this does not replace situational awareness

**JP-MOTOR-GEN-002**

**Job Plan: Conveyor Drive Motor Replacement**

**1. Job Intent**

Safely remove and replace a conveyor drive motor exhibiting signs of degradation. Follow FLAB-based precision maintenance to ensure correct mechanical installation and electrical integrity, reducing repeat failures and improving long-term system performance.

**2. Job Risk Assessment (JRA)**

The following hazards and suggested controls are typical for this job plan. They **do not replace the need for active situational awareness** and sound judgment by all personnel involved.

| Hazard | Control |
|---|---|
| **Electrical shock** | Lockout, tagout, test-for-dead, insulated tools |
| **Dropped object** | Use proper rigging, hoists rated for motor weight, tag lines |
| **Pinch/crush injury** | Hands clear during mounting/removal, coordinated lift |
| **Arc flash** | Proper PPE, arc-rated gloves, face shield, stand clear on energization |
| **Misalignment or strain** | Use calibrated tools, torque wrenches, alignment lasers |
| **Hot surface contact** | Let motor cool prior to removal, verify with IR gun |

# Task List – the Heart of the Job Plan – Don't Forget FLAB!

**3. Task Sequence – Precision Execution**

| Step | Task Description | Time (min) | Skill | FLAB Focus / Notes |
|---|---|---|---|---|
| **1** | Apply LOTO at MCC and feeder; verify zero voltage at terminals | 10 | Electrician | Use arc-rated gloves and test-for-dead protocol |
| **2** | Perform FLAB inspection for heat, looseness, grease trails | 15 | Mech Tech | Record any failure clues for RCA |
| **3** | Disconnect motor leads using insulated tools; label conductors | 20 | Electrician | Record torque and phase ID |
| **4** | Remove cable supports, flexible conduit, strain reliefs | 15 | Electrician | Save hardware if in reusable condition |
| **5** | Unbolt motor and rig for lifting using hoist or gantry | 20 | Mech Tech | Use spreader bar if required |
| **6** | Remove motor and place on padded surface | 10 | Mech Tech | Avoid shaft impact; tag for repair if needed |
| **7** | Clean and inspect base; verify flatness and shim as needed | 20 | Mech Tech | Shim if deviation > 0.05 mm |
| **8** | Position replacement motor and lightly snug bolts | 15 | Mech Tech | Confirm rotation direction, match base |
| **9** | **Align shafts using laser or dial indicators** | **40** | **Mech Tech** | **Offset ≤ 0.05 mm; angle ≤ 0.05 mm/mm** |
| **10** | Torque mounting bolts in crisscross pattern to spec | 10 | Mech Tech | Example: M20 bolts to 400 Nm |
| **11** | Install or re-install coupling; set gap and float | 15 | Mech Tech | Verify backlash and axial float |
| **12** | Confirm lubrication status; grease if required | 15 | Mech Tech | Use OEM grease; avoid overfilling |
| **13** | Reconnect motor leads and torque per spec | 15 | Electrician | Use torque wrench; confirm phasing |
| **14** | Bump test motor to confirm direction | 10 | Electrician | Stop immediately if reversed |
| **15** | Run at idle and full load; log current, temp, vibration | 30 | Electrician | Acceptable: <2.5 mm/s, <90°C |
| **16** | Complete documentation and CMMS closeout | 20 | QA / Planner | Include torque logs, alignment, photo |

**Notes:**

- This is a standard template to customize to specifics of asset, site, and operating environment.
- Complement with photos, video, flow charts, and other visual aids.

# BOMs and Required Tools Next

**4. Bill of Materials (BOM)**

| Item | Description | Qty | Notes |
|---|---|---|---|
| **Drive Motor** | OEM-specified, match nameplate specs | 1 | 100–200 HP typical, 1800 RPM |
| **Mounting Bolts** | M20 × 80 mm, Grade 8.8 or higher | 4–6 | Torque to 400 Nm |
| **Coupling** | Grid or gear-type | 1 | Match motor/gearbox shaft sizes |
| **Terminals/Lugs** | Compression type, Cu/Al rated | As needed | Sized to conductor |
| **Grease** | Mobil Polyrex EM or equivalent | 45–50 g max | Only if not pre-filled |
| **Shims** | SS 0.05–1.00 mm thickness | As needed | For soft foot correction |

Critical interface with MRO supply chain teams.

**5. Tools & Equipment**

*Note: Tool list is representative. Customize based on site-approved tools, voltage class, and alignment method.*

- Hoist or gantry rated for motor weight
- Insulated hand tools and torque wrenches (10–450 Nm)
- Laser alignment kit or dial indicator
- Multi-meter, clamp-on ammeter
- Infrared thermometer or thermal camera
- Grease gun and approved lubricant
- Vibration meter (optional baseline)
- PPE: arc-rated gloves, face shield, hard hat, safety glasses, boots

# Include Trades, Time, and Closeout Details

**6. Trade Resources & Time Allocation**

| Trade | Role | Est. Hours | Headcount |
|---|---|---|---|
| **Mechanical Technician** | Motor removal, alignment, installation | 5 hrs | 2 |
| **Electrician** | Disconnect/reconnect, bump test, measurements | 2 hrs | 1 |
| **QA / Planner** | Torque & alignment verification, CMMS entry | 1 hr | 1 |

**Total Estimated Labor Hours:** 13

**Estimated Elapsed Time (Clock Time):** ~6 hours

Time estimates are a good start. Revise through PDCA.

Closeout feedback is the basis for continuous improvement.

**7. QA & FLAB Verification Checklist**

- ☐ LOTO applied and zero energy verified
- ☐ Removed motor stored or tagged for analysis
- ☐ Mounting base cleaned and soft foot shimmed
- ☐ Shaft alignment verified and documented
- ☐ All fasteners torqued to specification
- ☐ Coupling gap, float, and torque checked
- ☐ Motor connections torqued; phasing and rotation verified
- ☐ Trial run completed with current, vibration, and temp readings logged
- ☐ CMMS updated with part number, torque log, alignment results, and photo

# Coaching Hints Enable Supervisors

| Step | Task Description | In-the-Field Coaching & Mentoring Tip |
|---|---|---|
| 1 | Apply LOTO at MCC and feeder, verify zero voltage at terminals | Emphasize independent verification. Confirm at source and load. Require showing meter reading before starting any work. |
| 2 | Perform FLAB inspection: check for overheating, looseness, lube trails | Reinforce recording observations systematically, even if no damage is found. Encourage asking "Why?" about each indicator. |
| 3 | Disconnect motor leads using insulated tools and label conductors | Stress labeling and torque recording. Show how correct labeling speeds troubleshooting later. |
| 4 | Remove cable support brackets, flexible conduit, and strain reliefs | Highlight preserving reusable hardware. Model organized removal and tagging. |
| 5 | Unbolt motor from base and rig for lift using sling and hoist | Demonstrate proper rigging inspection, use of spreader bars, and discussing load path before lifting. |
| 6 | Remove motor and place on padded surface | Show protective handling to prevent shaft and frame damage. Require checking shaft end condition after placement. |
| 7 | Clean mounting base and check for flatness, soft foot, or rust buildup | Teach use of feeler gauges for flatness and explain consequences of soft foot on motor life. |
| 8 | Position replacement motor and snug bolts | Confirm orientation, base match-up, and free shaft rotation before proceeding. Emphasize visual double-check. |

# Start with Generic Plans - Then Customize

**JP-MOTOR-GEN-002**

**Job Plan: Conveyor Drive Motor Replacement**

**(Weg W22 IE2 500 kW 4P 355S/B3, IC411 TEFC)**

**1. Job Intent**

Safely remove and replace a conveyor drive motor (Weg W
IC411 TEFC) exhibiting signs of degradation. Follow FLAB-I
correct mechanical installation and electrical integrity, red
term system performance.

**2. Job Risk Assessment (JRA)**

The following hazards and suggested controls are typical f
need for active situational awareness and sound judgmen

| Hazard | Control |
|---|---|
| **Electrical shock** | Lockout, tagout, test-for-dead, |
| **Dropped object** | Use proper rigging, hoists rate |
| **Pinch/crush injury** | Hands clear during mounting/removal, coordinated lift |
| **Arc flash** | Proper PPE, arc-rated gloves, face shield, stand clear on energization |
| **Misalignment or strain** | Use calibrated tools, torque wrenches, alignment lasers |
| **Hot surface contact** | Let motor cool prior to removal, verify with IR gun |

**3. Task Sequence – Precision Execution**

| Step | Task Description | FLAB Focus / Notes |
|---|---|---|
| 1 | Apply LOTO to MCC feeder and any motor auxiliaries. Test for zero voltage. | Ensure complete energy isolation before work |
| 2 | Conduct FLAB inspection of motor and mounting: signs of misalignment, looseness, wear | Check for discoloration, lube trails, witness marks |
| 3 | Disconnect motor leads. Use insulated tools. Label conductors. | Record wire phasing; torque target 25–30 Nm on reinstall |
| 4 | Remove cable supports and hardware. Retain or flag for replacement. | If reusing, record pre-removal torque values |
| 5 | Unbolt motor from base. Lift with hoist or gantry rated for 1,300–1,600 kg | Typical motor bolt: M24, torque 750 Nm |

**4. Bill of Materials (BOM)**

| Item | Description | Qty | Notes |
|---|---|---|---|
| **Drive Motor** | Weg W22 IE2 500 kW, 4P, 355S/B3, TEFC, IC411 | 1 | Match nameplate exactly |
| **Mounting Bolts** | M24 × 90 mm, Grade 10.9 | 4–6 | Torque to 750 Nm |
| **Coupling** | Grid/disc-type, match shaft spec | 1 | Confirm torque ratings, set float |
| **Terminals/Lugs** | Compression type, Cu/Al rated | As needed | Sized to conductor |
| **Grease** | Mobil Polyrex EM or equivalent | ~120 g | Only if not pre-filled |
| **Shims** | SS 0.05–1.00 mm thickness | As needed | For soft foot correction |

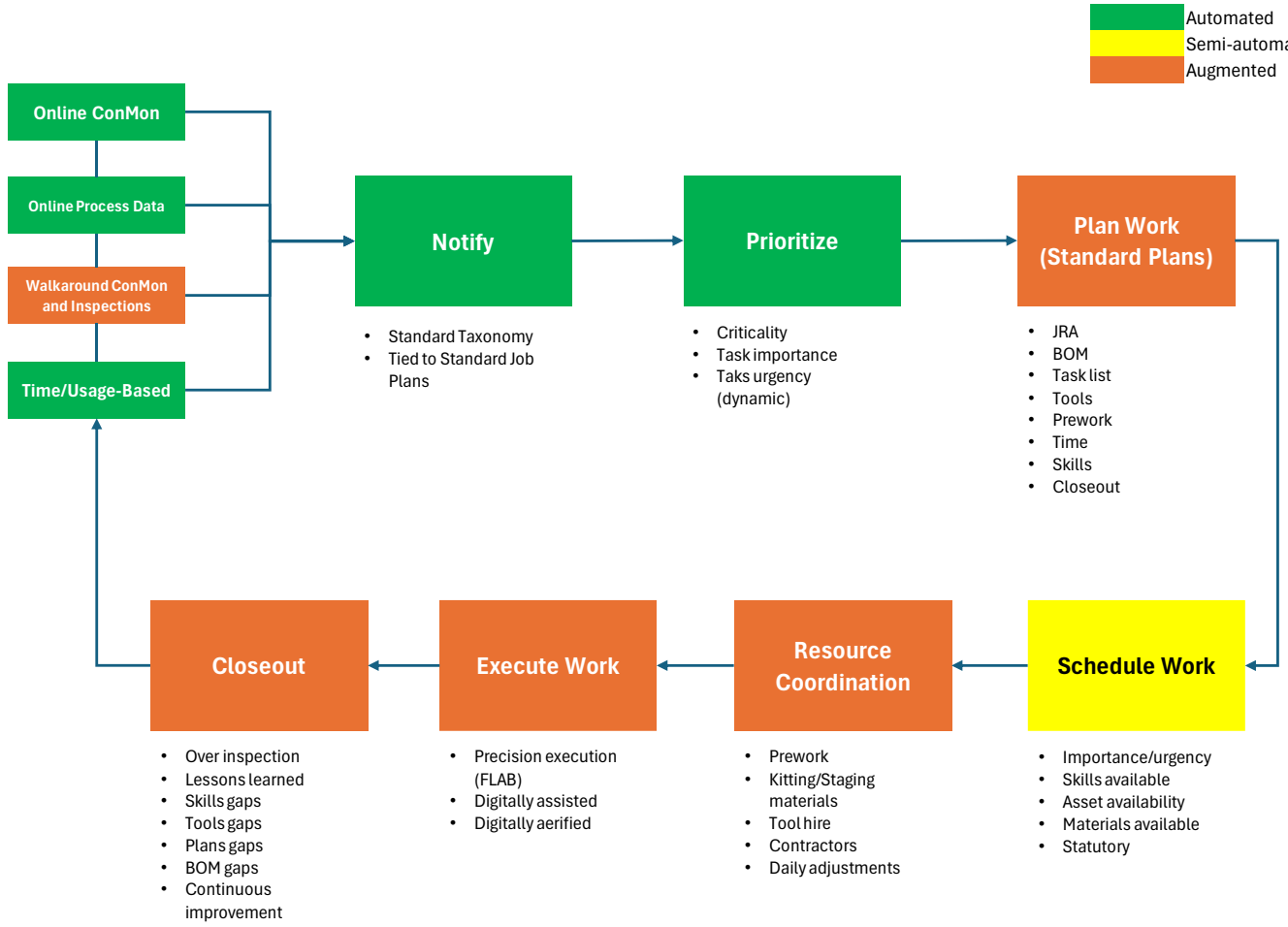
Bolt Size and Torque Values Adjusted

# Other Elements

**Appendix – Addition Items**

| Section | Why It's Universal |
|---|---|
| **Pre-Job Readiness Checklist** | Every job requires staged parts, tools, access, and permits to begin efficiently and safely. |
| **Required Qualifications and Certifications** | Ensures only competent, authorized personnel perform the work — critical for safety, compliance, and quality. |
| **Lessons Learned / Field Notes** | Captures insights from real-world execution that can improve future performance and prevent repeat issues. |
| **Actual vs. Planned Execution Log** | Enables planning accuracy improvement, variance tracking, and long-term productivity analysis. |
| **Spare Part Reorder Instruction** | Standard supply chain hygiene — any used part should trigger MRP restocking or BOM adjustment. |

# Standardization Enables Automation




Much of the maintenance work management process can be automated or semi-automated – especially with ML and AI.

# Conclusion

- Standardization leverages the repeatable nature of maintenance work, creating safer, more reliable, and more efficient operations.
- Field coaching ensures that execution quality matches plan quality, building the muscle memory that sustains world-class maintenance.
- Consistent closeout and feedback make today's lessons the foundation for tomorrow's improvements.
- Excellence in maintenance isn't achieved by chance — it's built deliberately, one job plan, one coaching moment at a time.

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