Sample 8D · Loose bolted joint

AI-assisted working draft: all content, causes, actions, evidence and approvals must be professionally verified before use. This document is not an automatic approval.

Base data

Customer
Sample OEM Ltd. (fictional)

Supplier
Musterwerk Components Ltd. (fictional)

Part / part number
Bracket NW-2084, M6 bolted joint

Complaint number
RE-2026-0148

Defect
Loose bolted joints on 8 of 200 brackets; required tightening torque 12 ± 1 Nm.

Complaint date
2026-11-02

D1 – Establish the team

Team / functions
Quality lead; production, process engineering, logistics, purchasing and the customer's supplier quality engineer.

Roles and responsibilities
Quality coordinates analysis and customer communication. Production secures stock. Engineering checks the driver program and process FMEA. Logistics tracks stock in transit. Purchasing and supplier quality align requirements and evidence.

D2 – Describe the problem

Problem description
Customer incoming inspection found loose joints on 8 of 200 brackets from batch 2639. Torque was 8 Nm instead of 12 ± 1 Nm.

Detection
Detected on 2 November 2026 during incoming torque inspection. Detection location is not the origin; the technical cause is investigated in D4.

Scope / boundaries
Batch 2639, one customer plant and the associated fastening station are affected. Other batches and variants are bounded using program and torque records.

D3 – Containment actions

1. Block and identify stock at supplier, in transit and at customer.

Owner: Logistics / sample · Due date: 2026-11-02 · Status: Completed
Evidence / effectiveness: Sample evidence: 1,200 parts clearly blocked and stock list confirmed.

2. Sort suspect batch using torque inspection and introduce a clean point.

Owner: Quality / sample · Due date: 2026-11-03 · Status: Completed
Evidence / effectiveness: Sample evidence: 52 additional loose joints rejected; clean point documented from batch 2640.

Risk assessment

A loose joint may lead to component separation. Until corrective action is effective, 100% torque inspection and clear clean-point identification are required.

D4 – Root cause analysis

Structured method

Separate 5 Whys chains for occurrence and non-detection; 6M Ishikawa for alternatives; reproduction and good/bad comparison as evidence.

Occurrence cause · 5 Whys chain

1. Why: The joint is loose because tightening torque was too low.

Status: Evidence-supported
Evidence / data: Sample evidence: station delivered 8 Nm in the comparison test; at 12 Nm no loose joint occurred.

2. Why: Torque was too low because the driver used another variant's program.

Status: Evidence-supported
Evidence / data: Sample evidence: station log shows program B at 8 Nm instead of program A at 12 Nm.

3. Why: The wrong program remained active because manual program selection was not changed during the variant changeover.

Status: Evidence-supported
Evidence / data: Sample evidence: repeating the changeover from B to A without switching reproduces the defect.

4. Why: The changeover was not safeguarded because part identification was not linked to the driver program.

Status: Evidence-supported
Evidence / data: Sample evidence: station accepts variant A with program B; no interlock signal.

5. Why: The safeguard was missing because variant mix-up was not considered in the process FMEA and station approval.

Status: Evidence-supported
Evidence / data: Sample evidence: approval documents contain no test of the wrong-program / correct-part combination.

Non-detection cause · 5 Whys chain

1. Why: The defect escaped because final inspection checked the bolted joint visually only.

Status: Evidence-supported
Evidence / data: Sample evidence: eight loose joints pass the repeated visual inspection.

2. Why: Visual inspection found nothing because insufficient torque has no visible indication.

Status: Evidence-supported
Evidence / data: Sample evidence: good and defective parts look alike; torque records differ.

3. Why: There was no alarm because inspection logic checked cycle completion, not variant-specific torque.

Status: Evidence-supported
Evidence / data: Sample evidence: an 8 Nm cycle receives an OK signal for variant A.

4. Why: Inspection logic was insufficient because the control plan did not require checking the program-to-part assignment.

Status: Evidence-supported
Evidence / data: Sample evidence: inspection plan specifies cycle OK and visual inspection only.

5. Why: The gap persisted because inspection effectiveness was not validated using deliberately defective parts.

Status: Evidence-supported
Evidence / data: Sample evidence: inspection approval contains no challenge test with incorrect torque.

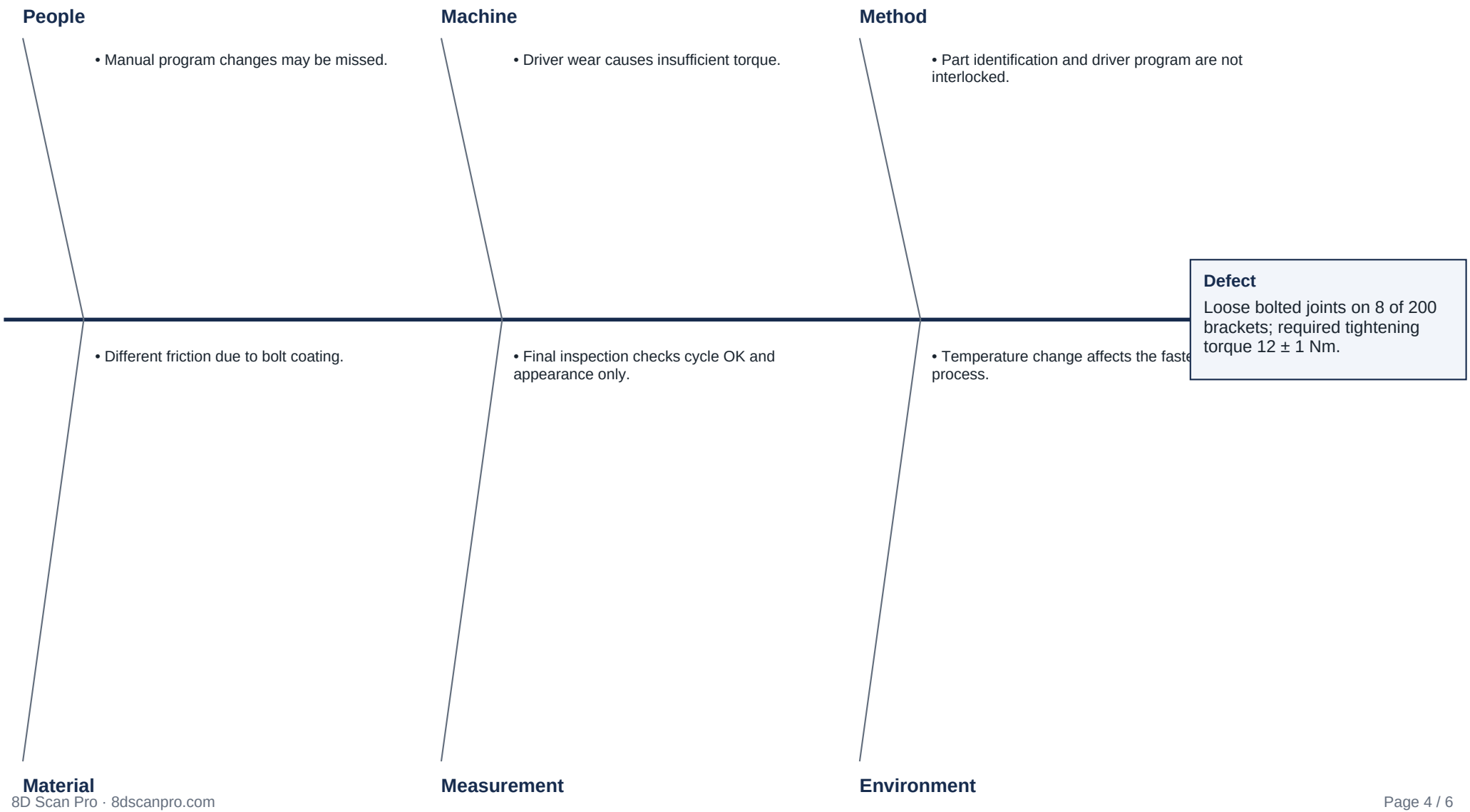
Alternative causes and exclusion tests

Driver wear and ambient temperature were excluded within the investigated range using reference measurements. Coating friction remains an open hypothesis and is checked with comparison lots.

Remaining uncertainty

The coating hypothesis remains unproven. Effectiveness of the technical linkage must be confirmed across several batches in D6.

D4 · Ishikawa / 6M fishbone diagram



D4 · Ishikawa causes – status and evidence

1. Manual program changes may be missed.

Status: Evidence-supported
Evidence / data: Sample evidence: changeover without switching was repeated.

2. Driver wear causes insufficient torque.

Status: Excluded
Evidence / data: Sample evidence: reference measurements with the correct program are within 12 ± 1 Nm.

3. Part identification and driver program are not interlocked.

Status: Evidence-supported
Evidence / data: Sample evidence: variant A can be produced using the 8 Nm program.

4. Different friction due to bolt coating.

Status: Hypothesis – open
Evidence / data: Open – to be completed by the team

5. Final inspection checks cycle OK and appearance only.

Status: Evidence-supported
Evidence / data: Sample evidence: defective 8 Nm parts pass the repeated inspection.

6. Temperature change affects the fastening process.

Status: Excluded
Evidence / data: Sample evidence: good and defective parts made at the same temperature; comparison shows no effect within the investigated range.

D5 – Define corrective actions

1. Link part barcode to the variant-specific driver program and block incorrect combinations.

Linked D4 causes:
Not linked to a cause yet

Owner: Process engineering / sample · Due date: 2026-11-10 · Status: Completed
Evidence / effectiveness: Sample evidence: incorrect program triggers an interlock in the challenge test.

2. Add variant-specific torque limits and defective-part challenge test to the control plan.

Linked D4 causes:
Not linked to a cause yet

Owner: Quality / sample · Due date: 2026-11-12 · Status: In progress
Evidence / effectiveness: Sample evidence: revised control plan approved; repeated validation scheduled.

Selection rationale
The technical interlock prevents the reproduced occurrence cause. The revised control plan also addresses non-detection; retraining alone is not considered sufficient.

D6 – Implement corrective actions and verify effectiveness

1. Validate linkage with correct and incorrect program/part combinations.

Owner: Engineering / sample · Due date: 2026-11-14 · Status: Completed
Evidence / effectiveness: Sample evidence: 30 incorrect combinations blocked and 30 correct combinations completed without error.

Effectiveness verification

Sample effectiveness evidence: 5,000 consecutive parts across three batches without loose joints; all torque records within 12 ± 1 Nm. Further monitoring in the layered audit.

D7 – Prevent recurrence

1. Update process FMEA, station approval and variant-changeover standard.

Owner: Quality & engineering / sample · Due date: 2026-11-15 · Status: Completed
Evidence / effectiveness: Sample evidence: variant mix-up and challenge test are included in FMEA and approval checklist.

Systemic changes

Program-to-part linkage is evaluated as a standard for comparable stations. Lessons learned feed into the design guideline and purchasing of new fastening stations.

D8 – Recognize the team and close

Recognition

The cross-functional team is recognized for reproducible analysis and rapid technical safeguarding.

Lessons learned

Variant changeovers must not rely solely on manual program selection. Inspection systems must be validated with deliberately defective parts.

Closure criteria / approval

Sample closure: containment, cause evidence, technical correction and D6 effectiveness are documented; quality management and customer receive the report for final approval.