# Sample · Ishikawa · Loose bolted joint

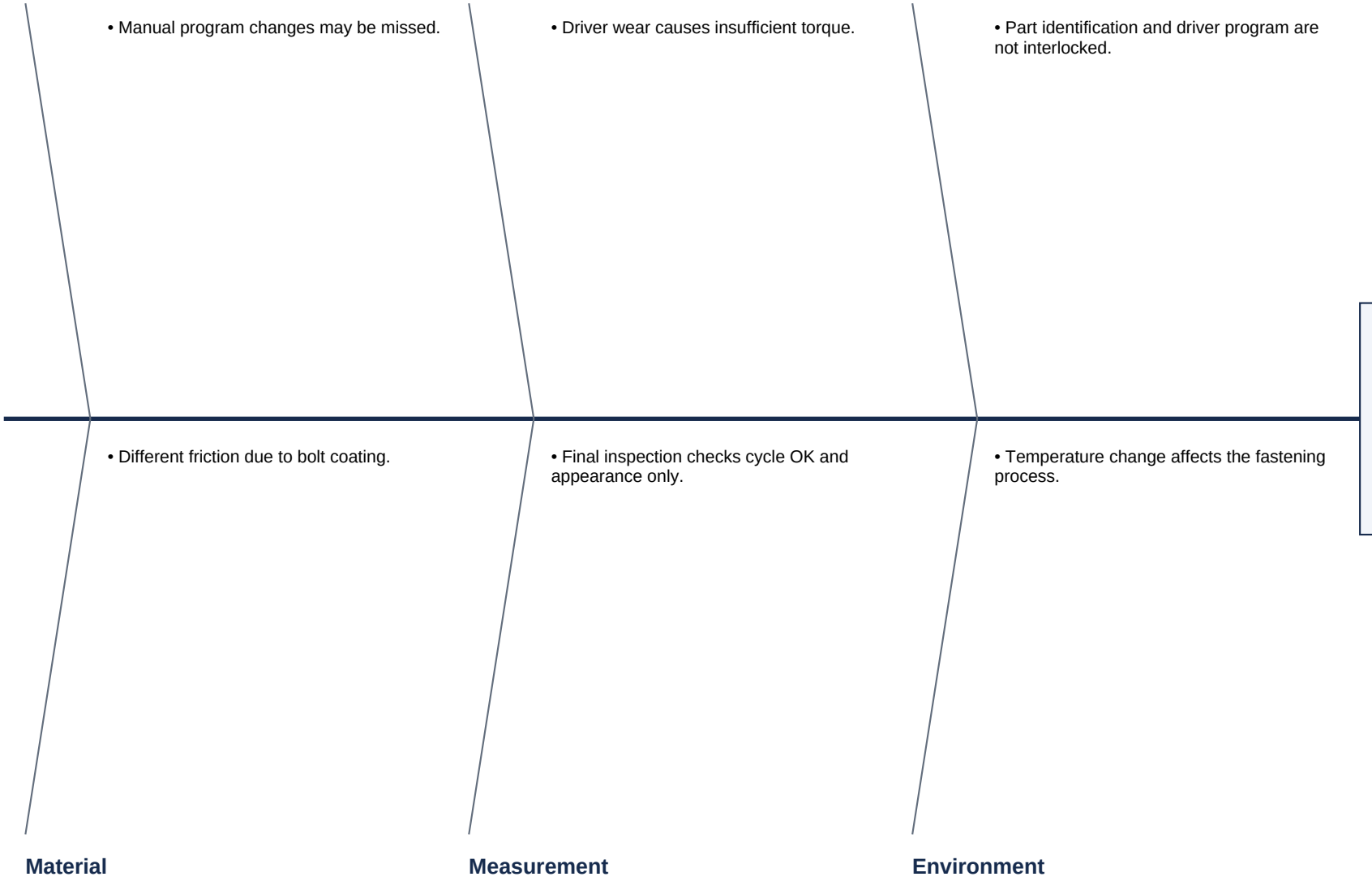
**Problem statement**

Fictional sample case: customer incoming inspection finds loose bolted joints on 8 of 200 brackets. Required tightening torque: 12 ± 1 Nm. All details and evidence are invented for illustration only.

*Working analysis: hypotheses are not proven causes. Status and evidence are supplied by the user.*

# Ishikawa analysis

15/11/2026



## People

### 1. Manual program changes may be missed.

Status: Evidence-supported
Evidence: Sample evidence: changeover without switching was repeated.
Verification / next steps: Review operating sequence; consider technical safeguards rather than training alone.

## Machine

### 1. Driver wear causes insufficient torque.

Status: Excluded
Evidence: Sample evidence: reference measurements with the correct program are within 12 ± 1 Nm.
Verification / next steps: Excluded for the investigated condition; continue monitoring after maintenance.

## Method

### 1. Part identification and driver program are not interlocked.

Status: Evidence-supported
Evidence: Sample evidence: variant A can be produced using the 8 Nm program.
Verification / next steps: Test barcode-to-program linkage and demonstrate effectiveness in D6.

## Material

### 1. Different friction due to bolt coating.

Status: Hypothesis
Evidence: Open
Verification / next steps: Compare coating lots; measure friction and preload. Unproven hypothesis so far.

## Measurement

### 1. Final inspection checks cycle OK and appearance only.

Status: Evidence-supported
Evidence: Sample evidence: defective 8 Nm parts pass the repeated inspection.
Verification / next steps: Add variant-specific torque limits and a challenge test.

## Environment

### 1. Temperature change affects the fastening process.

Status: Excluded
Evidence: Sample evidence: good and defective parts made at the same temperature; comparison shows no effect within the investigated range.
Verification / next steps: Excluded within the investigated temperature range; other conditions not assessed.