Introduction: The 4-M Rule:

When the parts are rejected or the gages or instruments are giving dodgy answers the red flag goes up and panic usually ensues. Everyone involved defends their turf, talent or toys which is normal but rarely answers the question of what's gone wrong.
We are frequently asked for help in such situations and as is often the case, a fresh set of eyes looking at the problem can be of benefit. I thought it might be useful for readers to have a checklist of sorts so they can narrow their focus to get to the cause of the problem from a measurement point of view. Everyone wants an app for everything but they are not always forthcoming or workable. However, the 4-M rule can be used to keep you on track.

Source: https://www.qualitymag.com/articles/94874-solving-dimensional-problems

Manpower

Where some level of skill is required for the measurements, folks lacking it can be the most significant source of trouble. Digital displays mean anyone can 'read' the device but often they are looking for a value and see it even though the display is showing something different (observational bias). This happens when the first few numbers of the display are right but the last digit is misread. A simple eye test may reveal a hidden problem. Manipulative bias can often cause the unwary to bring up the reading they are looking for by unconsciously using the measuring device to deliver it when the skill level required is high. Manpower problems are often the key source for repeatability problems.

2. Machine

Measuring devices, whether a CMM or digital indictor, are usually worth a first look to solve a problem. Even though they may have passed their last calibration, they could still be the cause. This is due to the fact they just may not be precise enough for this application. Conversely, they may be suitable but the master they've been set to is not. In the latter case, it could be the master is the wrong shape, i.e. a flat faced master such as a gage block is setting equipment used to measure a diameter. This can cause poor linear response of the device. If the device physically contacts the work, a loose contact point can be the source of your repeatability problems. If the work being measured has a series of points for a datum but your setting master does not match them, it can cause problems.

The 4-M Rule:

This rule indicates the problem will be caused by one or more of the following:
Manpower: the people doing the measurements
Machine: the equipment being used is not appropriate for the measurements
Madhouse: the environment in which the work is being done is not suitable
Mess: the workpiece and/or its tolerances are not suitable for the precision expected

3. Madhouse

This refers to the environment in which the measurements are made. There's a reason the international standard temperature for dimensional metrology is 20 C or 68 F. If work is being measured outside of a controlled environment all bets are off if close tolerances have to be verified.
If you're measuring brass parts with steel masters and the temperature is not under control or accounted for, variations in results are guaranteed. Vibrations from machines adjacent to the inspection area can keep readings dancing around unseen or cause settings to change. A dirty environment can result in measurements being made over dirt.

4. Mess

This refers to the workpiece being measured not being suitable for precision manufacture or it's out of round or tapered or has not been deburred. Outside diameter measurements on thin walled tubing is but one example. Poorly defined or machined datum surfaces or other references not accurately determined are another cause of measurement problems. Surface finish on critical features has to be in keeping with dimensional requirements or problems will result.