

Measurement System **Analysis **F**or Automated **T**est Systems**



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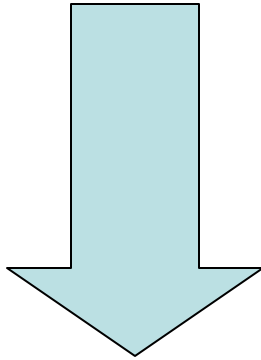
Rockwell Automation, Inc

Why ?



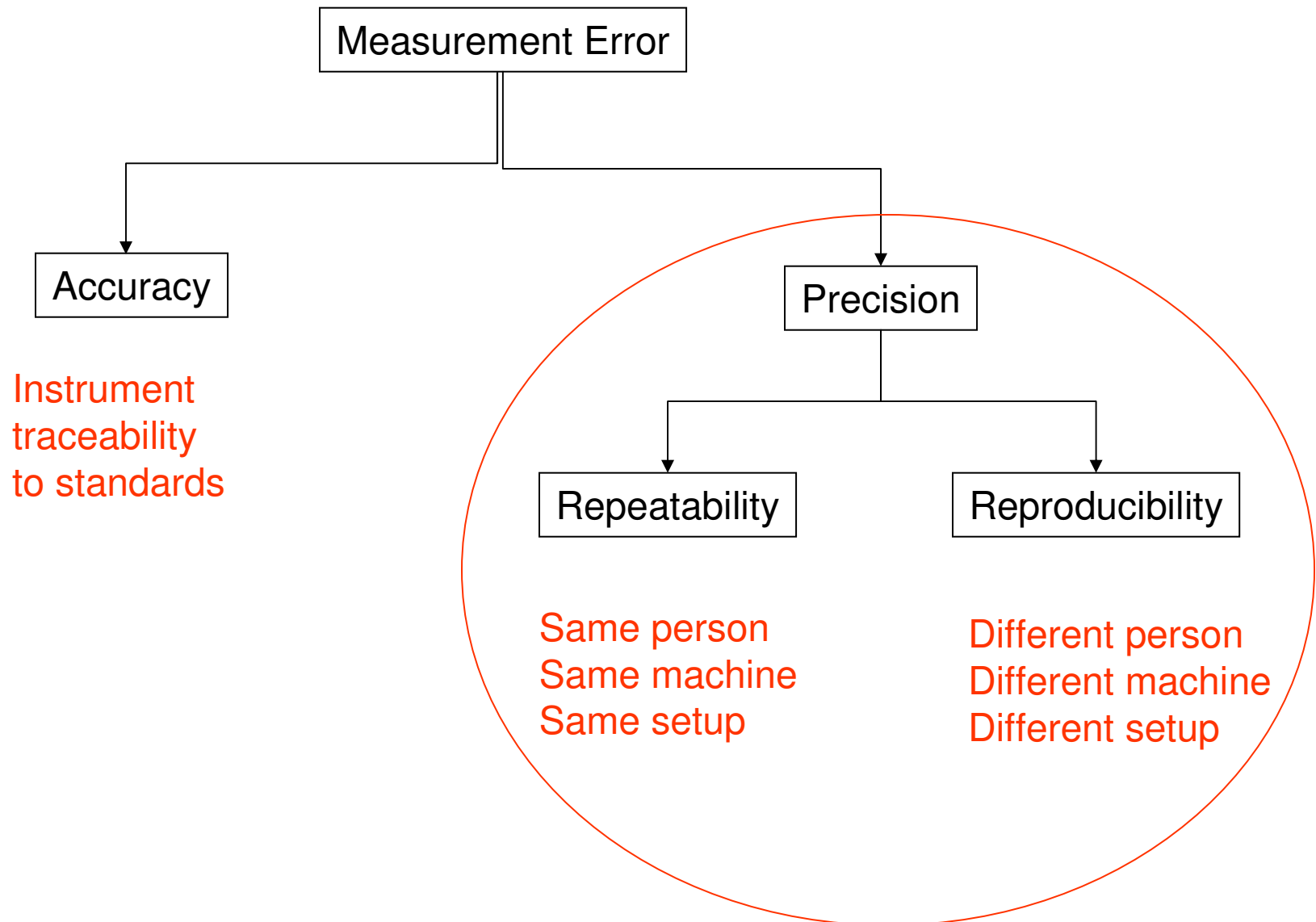
Measurement System Studies

How much of my tolerance is being used up by my measurement system?



Can I tell a good part from a bad part?

Measurement System Studies



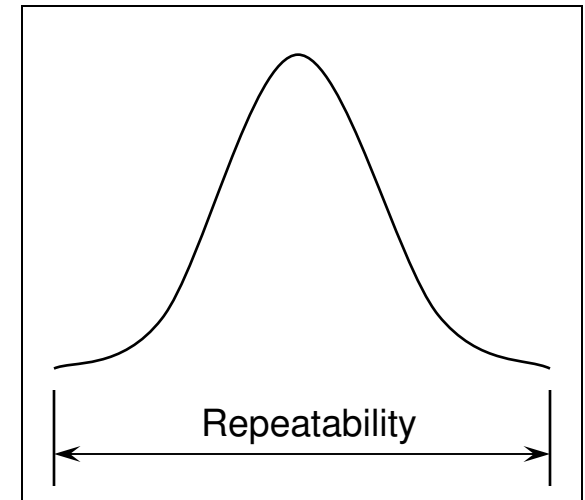
Measurement System Studies



Repeatability:

Repeatability is the spacing (dispersion) between measurements. Repeatability is the variation between the measurements obtained when an operator measures the same dimension (characteristic) several times under the following conditions:

- the same measuring instrument;
- on the same parts;
- in the same location on the part;
- under the same conditions of use;
- over a short period of time.



Repeatability is considered to be the inherent variation of the measurement system. The repeatability error comes from the instrument itself and the position of the part in relation to the instrument. Note that the measurements may show good repeatability without being accurate.

Measurement System Studies

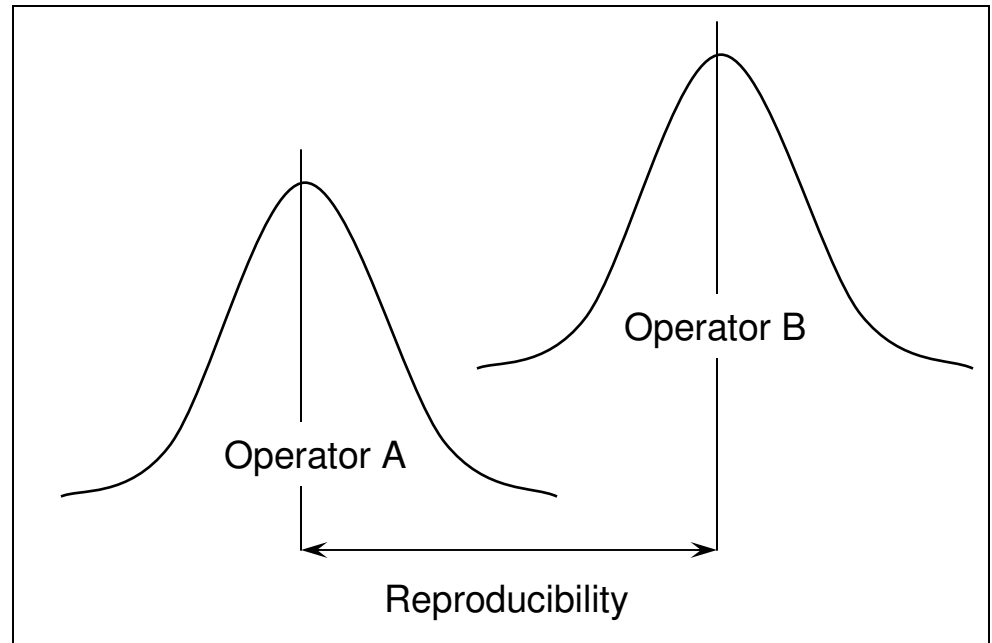
MEASUREMENT SYSTEM



Reproducibility:

Reproducibility is the variation between the mean measurements obtained by different operators who measure the same dimension (characteristic) on the same parts under the following conditions:

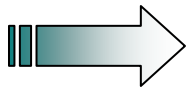
- the same measuring instrument;
- the same method;
- in the same location on the part;
- under the same conditions of use;
- over a short period of time.



Measurement System Studies

MEASUREMENT SYSTEM ANALYSIS: (Gauge R&R STUDY)

The objective of the measurement systems analysis is to obtain information concerning the scope and type of error that the measurement system produces when it interacts with its environment.



Important issues are at stake in a measurement systems analysis. An inadequate measurement system could have the following impact;

- concealing certain process variations;
- identifying the wrong causes of process variation;
- overvaluing or undervaluing process capability;
- accepting defective products;
- **rejecting conforming products;**
- **taking corrective action on false problems;**
- no corrective actions.

Measurement System Studies

Capability Study (CPK)

vs

Measurement Systems Study

Measured values

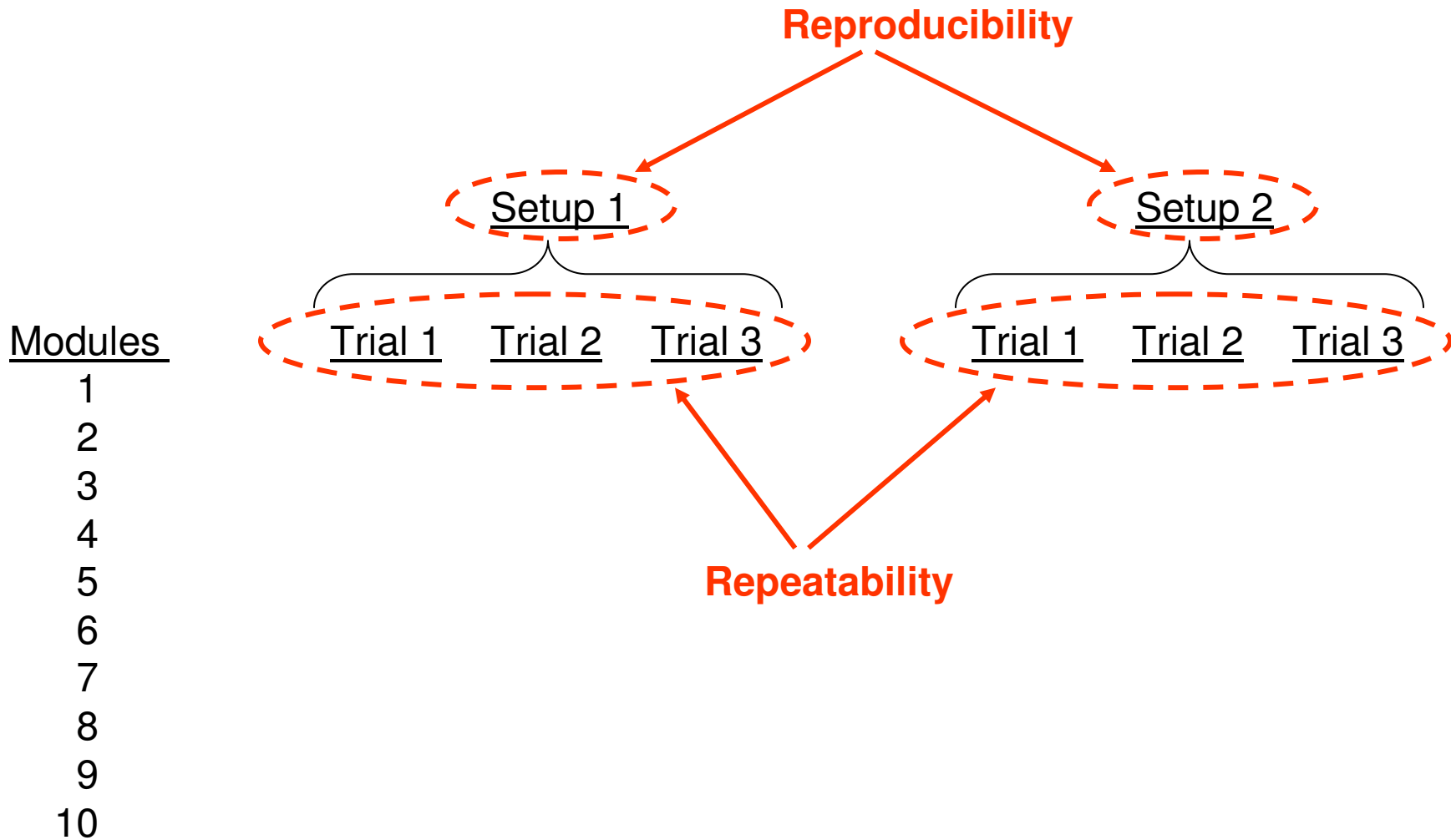
Required Tolerance Range

Differences In Measured Values

Required Tolerance Range

Measurement System Studies

3070 Tester Studies



Measurement System Studies

Simplified Explanation of Analysis

Differences in measurement
from repeats

Part
Tolerance

= % tolerance used by
repeatability

Differences in measurement
from reproduction
Of measurements

Part
Tolerance

= % tolerance used by
reproducibility

All measurement differences

Part
Tolerance

= % tolerance used by
measurement system
(total gauge R & R)

Measurement System Studies

Output Of Study

Variable Data Gauge R & R Results									Attribute Data Gauge R & R Results	
Repeatability				Reproducibility			Total Gauge R & R		Attribute Repeatability Results	Attribute Reproducibility Results
Rbar ₁	UCL _R	EV	% of Tolerance Used By Repeatability Error	Rbar ₂	AV	% of Tolerance Used By Reproducibility Error	R & R	% of Tolerance Used by Measurement Variation		
2.20	5.66	6.71	34%	0.30	0.00	0%	6.71	34%	Fail	Fail



- Less than 10% is ideal and will highlight the cell in green
- 11% to 29% is cautionary but may be acceptable depending on the criticalness of the check - will be yellow
- Greater than 29% is unacceptable and requires corrective action - will be red

SO?

- The Jumper 'Issue'
 - Threshold tests
- Fixture PMs
 - 75% of issues traced here
- Analog tolerance settings
- Capability Analysis tool

Questions

