
DMAIC

**Análisis del sistema de
medición (MSA)**

AUTOPISTA

Análisis del sistema de medición (MSA)



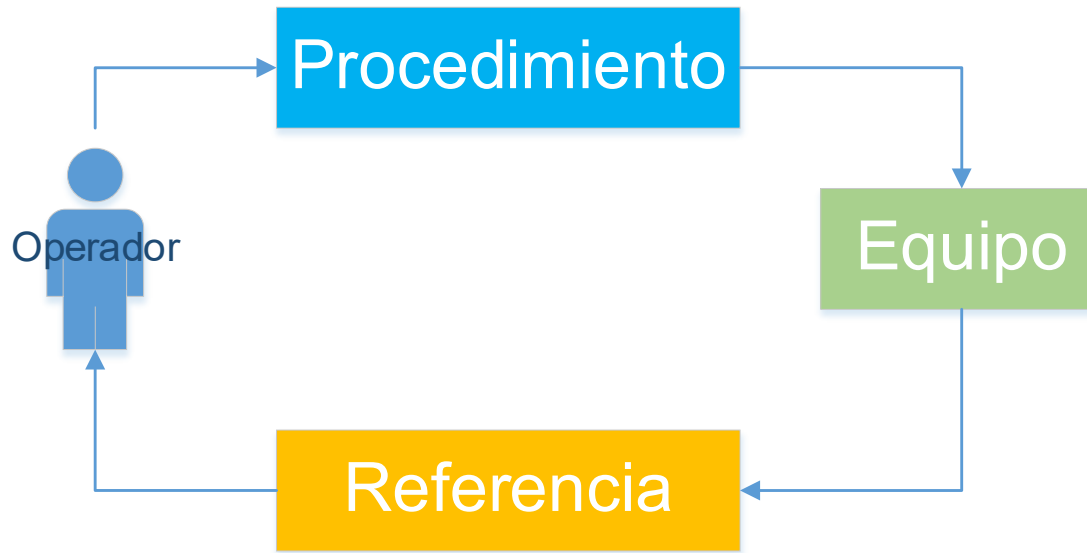
- Objetivo
 - Medir el nivel actual de exactitud del sistema de medición.
 - Saber si una medición es repetitiva y reproducible.

- Aplicaciones
 - Identificar errores de medición.
 - Mejorar SOP (proceso de operación).

Análisis del sistema de medición (MSA)

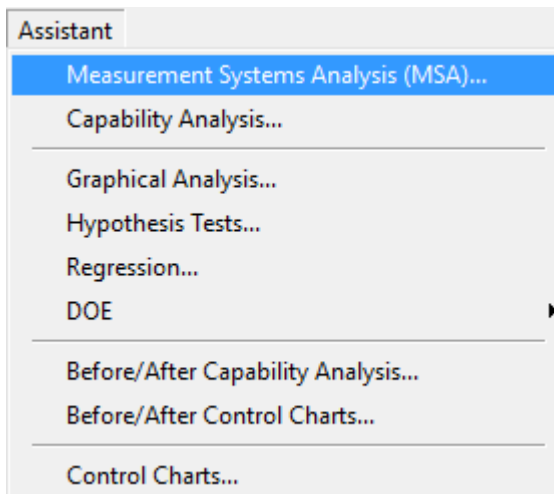


- MSA es un procedimiento matemático para cuantificar la variación inducida en un proceso o producto por medio del acto de medir.

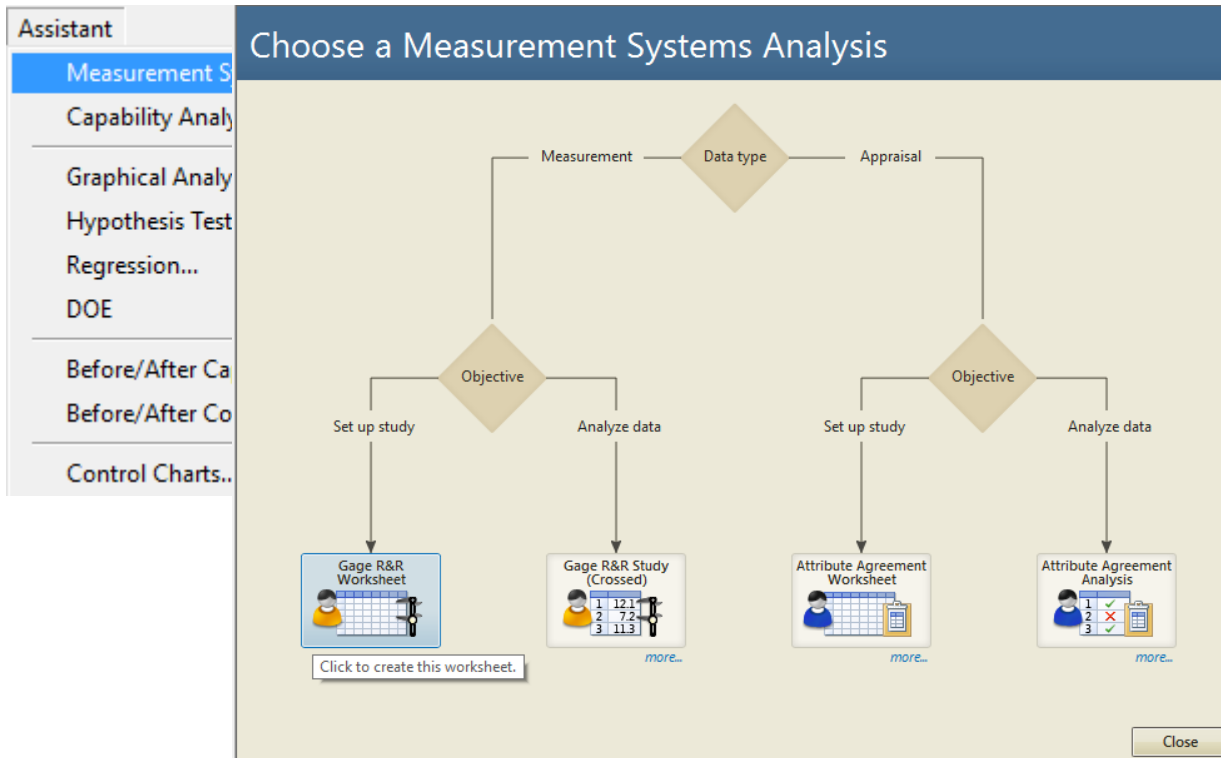


- Cualquier acto de medición tiene que contar con un procedimiento para garantizar la repetición y reproducción.

MSA – Generación de datos



MSA – Generación de datos



MSA – Generación de datos



Assistant

Measurement S

Capability Analy

Graphical Analy

Hypothesis Test

Regression...

DOE

Before/After Ca

Before/After Co

Control Charts..

Choose a Measurement

Create Gage R&R Worksheet

Operators and replicates

Number of operators: 2

Number of replicates: 2

(Number of times operators measure each part)

Enter your own operator names or use the defaults.

	Operator Name
1	A
2	B

Parts

Number of parts: 10

Enter your own part names or use the defaults.

	Part Name
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10

Click to create this worksheet.

Measurements

Objective

Set up study

Analyze

Gage R&R Worksheet

Gage R&R (Cross)

OK

Cancel

MSA – Generación de datos



Assistant

- Measurement S
- Capability Analy
- Graphical Analy
- Hypothesis Test
- Regression...
- DOE

Choose a Measurement

Measurements

Create Gage R&R Worksheet

Operators and replicates

Number of operators:

Number of replicates:

(Number of times operators measure each part)

Enter your own operator names or use the defaults.

Operator Name	
1	A
2	B

↓	C1	C2-T	C3-T	C4
	RunOrder	Operators	Parts	Measurements
1	1	A	3	
2	2	A	1	
3	3	A	7	
4	4	A	4	
5	5	A	8	
6	6	A	9	
7	7	A	5	
8	8	A	2	
9	9	A	10	
10	10	A	6	
11	11	B	9	
12	12	B	2	
13	13	B	8	
14	14	B	10	
15	15	B	7	

Number of parts:

Enter your own part names or use the defaults.

Part Name	
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10

MSA – Generación de datos



Assistant

- Measurement S
- Capability Analy
- Graphical Analy
- Hypothesis Test
- Regression...
- DOE

Choose a Measurement

Measuremer

Create Gage R&R Worksheet

Operators and replicates

Number of operators:

Number of replicates:

(Number of times operators measure each part)

Enter your own operator names or use the defaults.

Operator Name	
1	A
2	B

Enter your own part names or use the defaults.

Part Name	
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10

↓	C1	C2-T	C3-T	C4
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5	5	A	8	
6	6	A	9	
7	7	A	5	
8	8	A	2	
9	9	A	10	
10	10	A	6	
11	11	B	9	

Operadores

($\geq 2x$)

x

No. de piezas

($\geq 5x$)

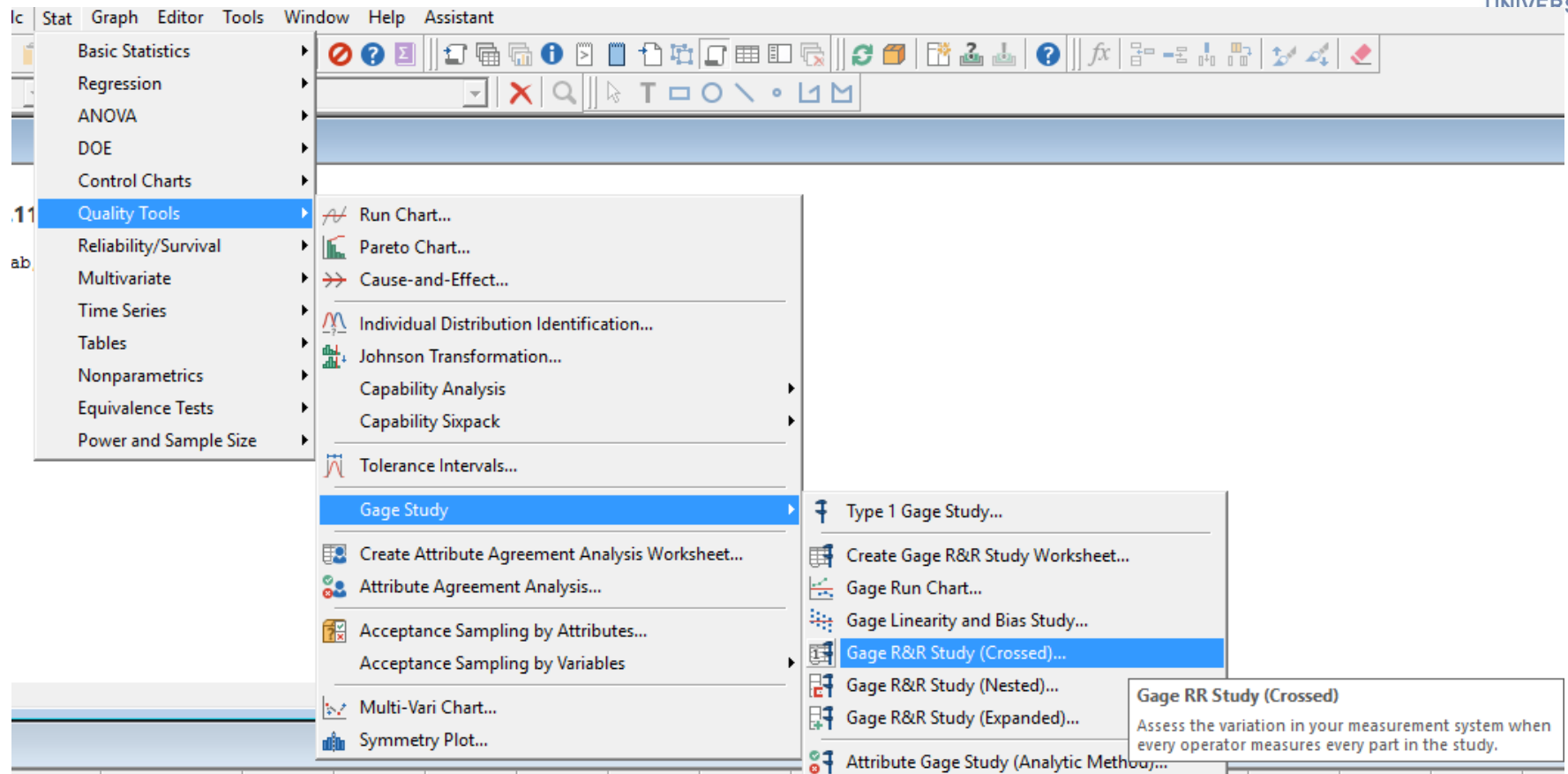
x

Repeticiones

($\geq 2x$)

≥ 30

MSA – Análisis



The screenshot shows the Minitab software interface with the 'Quality Tools' menu open. The 'Gage Study' option is selected, and the 'Gage R&R Study (Crossed)...' option is highlighted. A tooltip for 'Gage RR Study (Crossed)' is visible, providing a description of the study type.

- Stat
- Graph
- Editor
- Tools
- Window
- Help
- Assistant

- Basic Statistics
- Regression
- ANOVA
- DOE
- Control Charts
- Quality Tools**
 - Run Chart...
 - Pareto Chart...
 - Cause-and-Effect...
 - Individual Distribution Identification...
 - Johnson Transformation...
 - Capability Analysis
 - Capability Sixpack
 - Tolerance Intervals...
 - Gage Study**
 - Type 1 Gage Study...
 - Create Gage R&R Study Worksheet...
 - Gage Run Chart...
 - Gage Linearity and Bias Study...
 - Gage R&R Study (Crossed)...**
 - Gage R&R Study (Nested)...
 - Gage R&R Study (Expanded)...
 - Attribute Gage Study (Analytic Method)...
 - Create Attribute Agreement Analysis Worksheet...
 - Attribute Agreement Analysis...
 - Acceptance Sampling by Attributes...
 - Acceptance Sampling by Variables
 - Multi-Vari Chart...
 - Symmetry Plot...
- Reliability/Survival
- Multivariate
- Time Series
- Tables
- Nonparametrics
- Equivalence Tests
- Power and Sample Size

MSA – Análisis



The screenshot displays the Minitab software interface. The menu bar includes 'Stat', 'Graph', 'Editor', 'Tools', 'Window', 'Help', and 'Assistant'. The 'Stat' menu is open, showing options like 'Basic Statistics', 'Regression', 'ANOVA', 'DOE', 'Control Charts', 'Quality Tools', 'Reliability/Survival', 'Multivariate', 'Time Series', 'Tables', 'Nonparametrics', 'Equivalence Tests', and 'Power and Sample Size'. The 'Quality Tools' menu is expanded, showing 'Run Chart...', 'Pareto Chart...', 'Cause-and-Effect...', 'Individual Distribution Identification...', 'Johnson Transformation...', 'Capability Analysis', 'Capability Sixpack', 'Tolerance Intervals...', and 'Gage Study'. The 'Gage Study' sub-menu is open, listing 'Type 1 Gage Study...', 'Create Gage R&R Study Worksheet...', 'Gage Run Chart...', 'Gage Linearity and Bias Study...', 'Gage R&R Study (Crossed)...', 'Gage R&R Study (Nested)...', 'Gage R&R Study (Expanded)...', and 'Attribute Gage Study (Analytic Method)'. The 'Gage R&R Study (Crossed)' dialog box is open, showing fields for 'Part numbers' (No. de parte), 'Operators' (Operador), and 'Measurement data' (Longitud [mm]). The 'Method of Analysis' section has 'ANOVA' selected. Buttons for 'Gage Info...', 'Options...', 'Conf Int...', 'Storage...', 'OK', 'Cancel', 'Select', and 'Help' are visible.

Gage R&R Study (Crossed)

Part numbers: 'No. de parte'

Operators: 'Operador'

Measurement data: 'Longitud [mm]'

Method of Analysis

ANOVA

Xbar and R

Buttons: Gage Info..., Options..., Conf Int..., Storage..., OK, Cancel, Select, Help

Gage RR Study (Crossed)

Assess the variation in your measurement system when every operator measures every part in the study.

MSA – Análisis



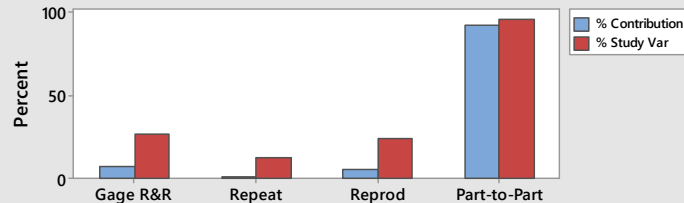
- Stat
- Graph
- Editor
- Tools
- Win
- Basic Statistics
- Regression
- ANOVA
- DOE
- Control Charts
- Quality Tools**
- Reliability/Survival
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Gage R&R (ANOVA) Report for Longitud [mm]

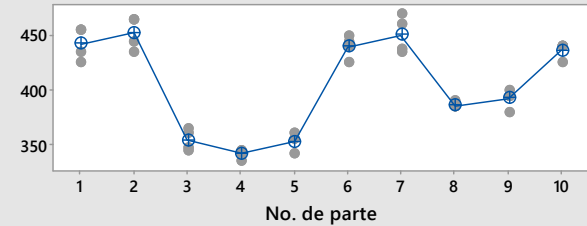
Gage name:
Date of study:

Reported by:
Tolerance:
Misc:

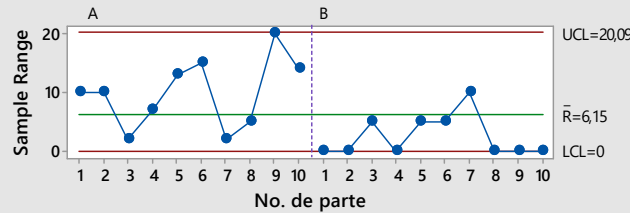
Components of Variation



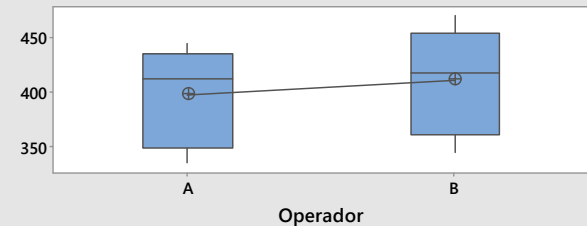
Longitud [mm] by No. de parte



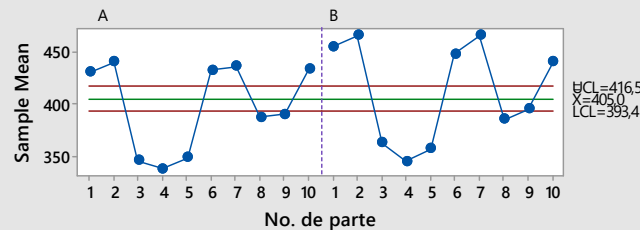
R Chart by Operator



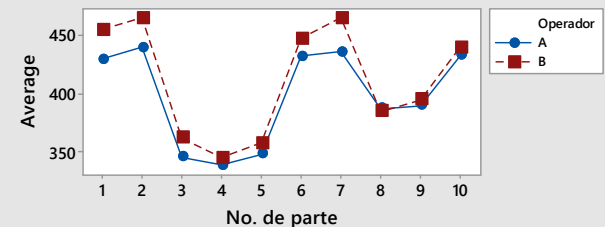
Longitud [mm] by Operator



Xbar Chart by Operator



No. de parte * Operator Interaction



Gage R&R Study (Crossed)

Part numl

Operator

Measur

Method o

ANOV

Xbar

Select

Help

Gage R&R

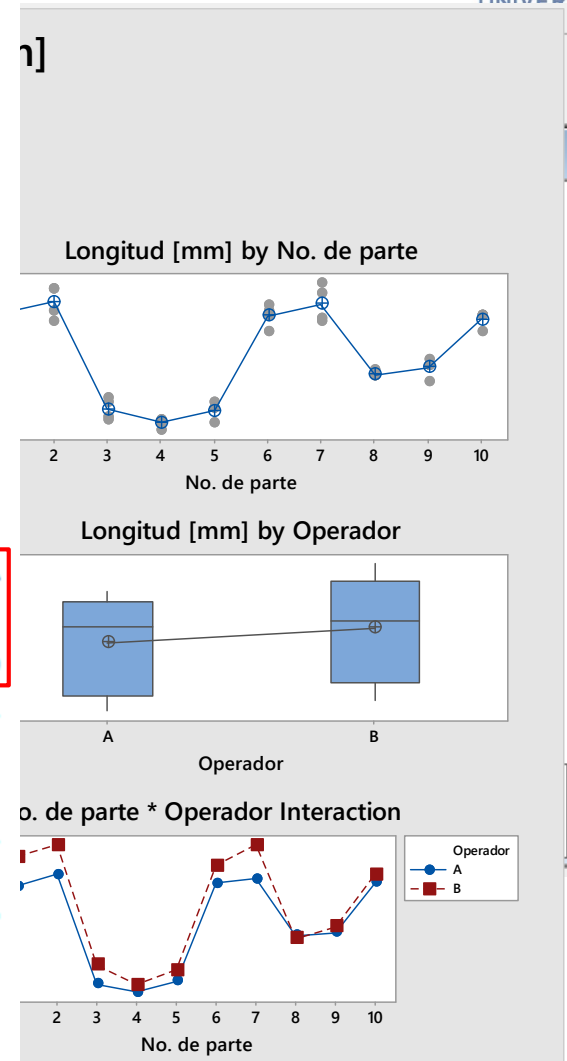
Source	VarComp	%Contribution (of VarComp)
Total Gage R&R	157,68	7,50
Repeatability	36,18	1,72
Reproducibility	121,50	5,78
Operator	86,49	4,11
Operator*No. de parte	35,01	1,67
Part-To-Part	1944,33	92,50
Total Variation	2102,01	100,00

< 9%

Source	StdDev (SD)	Study Var (6 × SD)	%Study Var (%SV)
Total Gage R&R	12,5569	75,341	27,39
Repeatability	6,0146	36,087	13,12
Reproducibility	11,0227	66,136	24,04
Operator	9,3001	55,801	20,28
Operator*No. de parte	5,9168	35,501	12,91
Part-To-Part	44,0946	264,568	96,18
Total Variation	45,8477	275,086	100,00

< 30%

Number of Distinct Categories = 4 >= 5



- Se necesita desarrollar un SOP (Standard Operation Procedure). No importa quien haga la prueba, los resultados tienen que ser los mismos. Si dos operadores hacen el trabajo diferente, eso está mal desde el punto de vista estadístico.
- Resultados del ejemplo: Está en la raya, “pasando de panzazo”. En lo personal yo vería oportunidades de mejorar el sistema de medición (ejemplo SOP, entrenando personal, ¿otro equipo de medición?). Estando al límite puede ser una razón para que el sistema se salga de control.