MinebeaMitsumi

Passion to Create Value through Difference

Capability Analysis

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- References
- Qualification Pyramid
- Correlation and System influences
- Measurement Capability
- Machine Capability
- Process Capability
- Increasing requirements (ppm Value)

References

- QS 9000
- QS 9000 (Measurement System Analysis (AIAG))
- IATF 16949

9.1.1.1 Monitoring and measurement of manufacturing processes

The organization shall perform process studies on all new manufacturing (including assembly or sequencing) processes to verify process capability and to provide additional input for process control, including those for special characteristics.

- VDA Booklet 4 and 5
- "Measurement System Capability" Reference Manual

References

- Guidline ("Measurement System Capability" Reference Manual)

Audi AG
Peter Friedrich
Siegfried Hübner
Christian Neukirch

BMW AG
Helmut Simon

Robert Bosch GmbH
Rolf Ofen

DaimlerChrysler AG
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Rainer Koch
Martin Künster
Herbert Löschner
Franz-Georg Reitinger

Adam Opel AG
Hans Stritzl
Bruno Winkler

Q-DAS® GmbH
Dr. Edgar Dietrich
Alfred Schulze

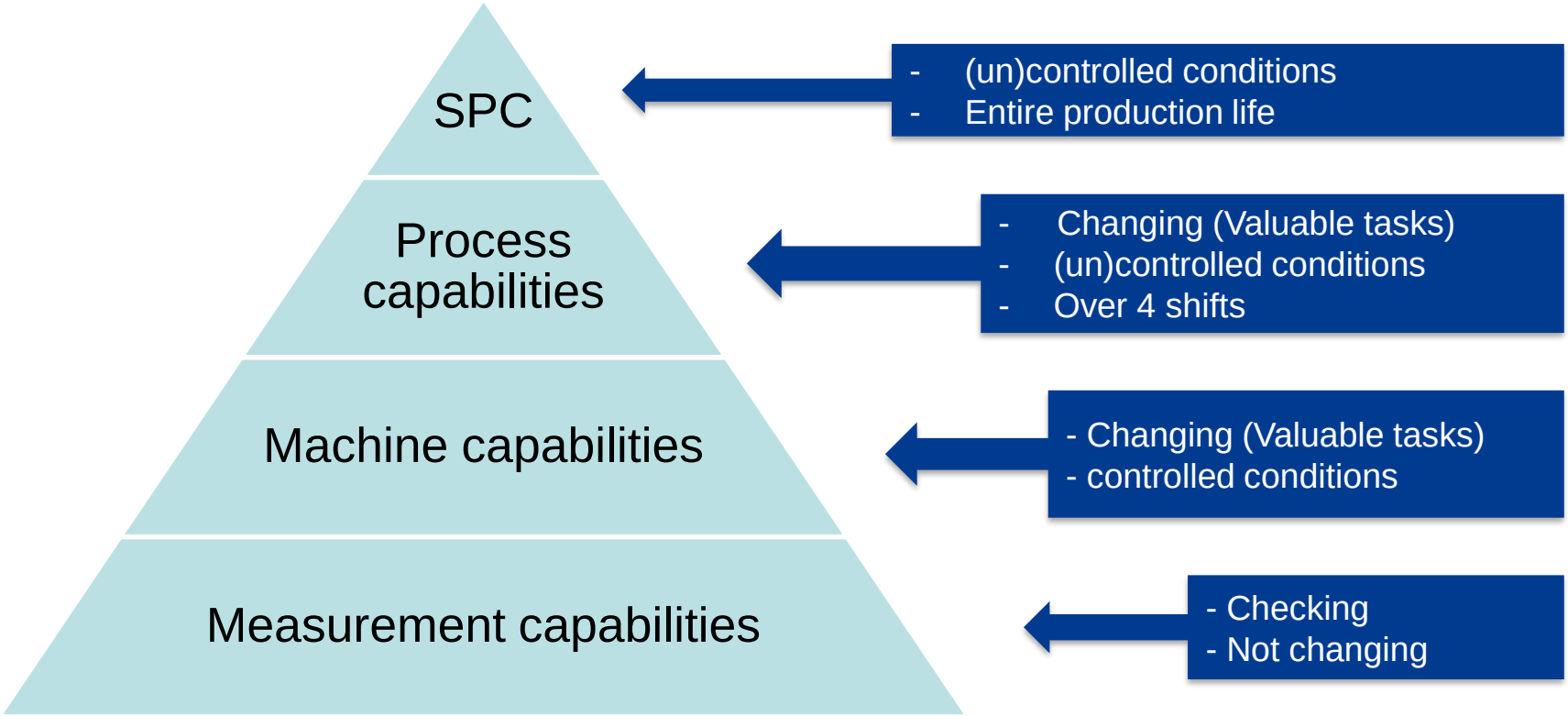
T.Q.M. Itaca s.r.l.
Vincenzo Guerrini

Volkswagen AG
Dr. Michael Sandau
Dietrich Sawallisch
Reinhard Stief

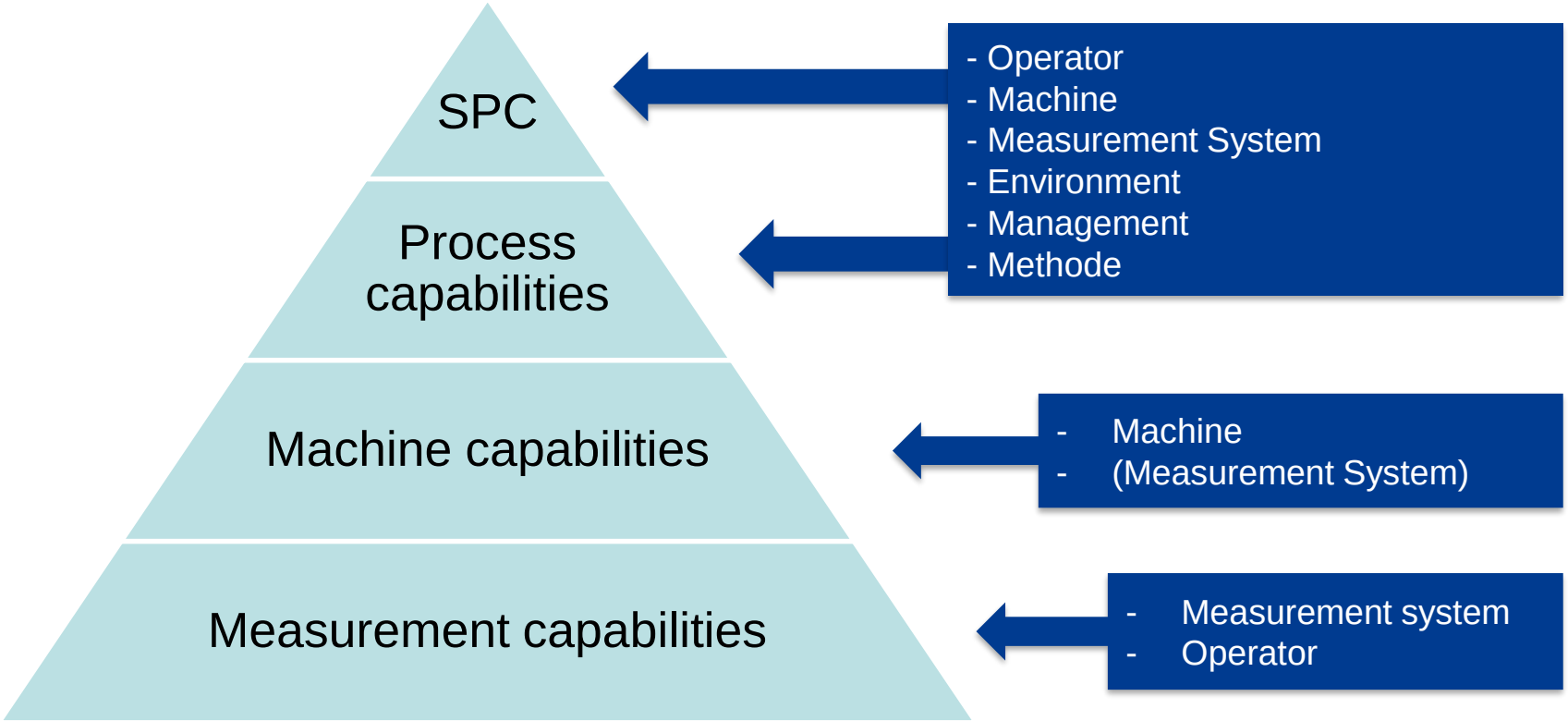
Leiter des Arbeitskreises:
Head of the work group:

Dr. Edgar Dietrich
Q-DAS® GmbH, Birkenau

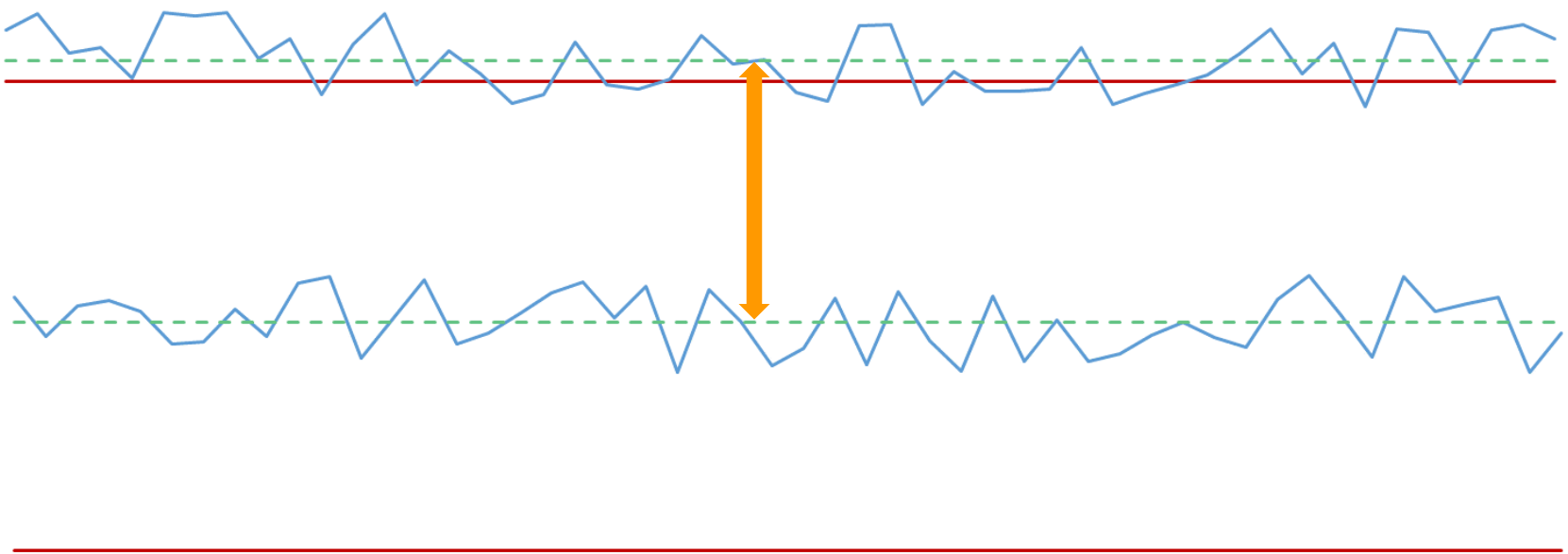
Qualification Pyramid



Qualification Pyramid

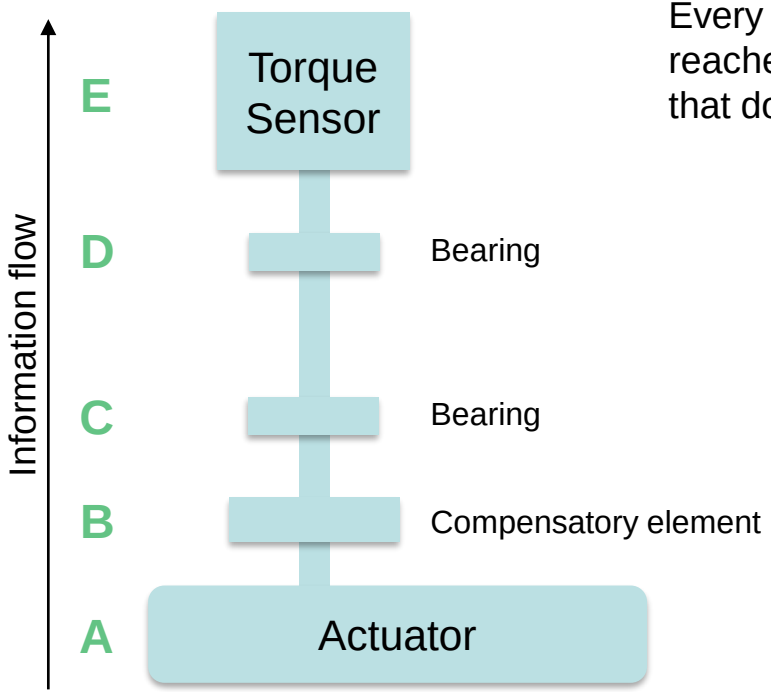


Correlation and System influences

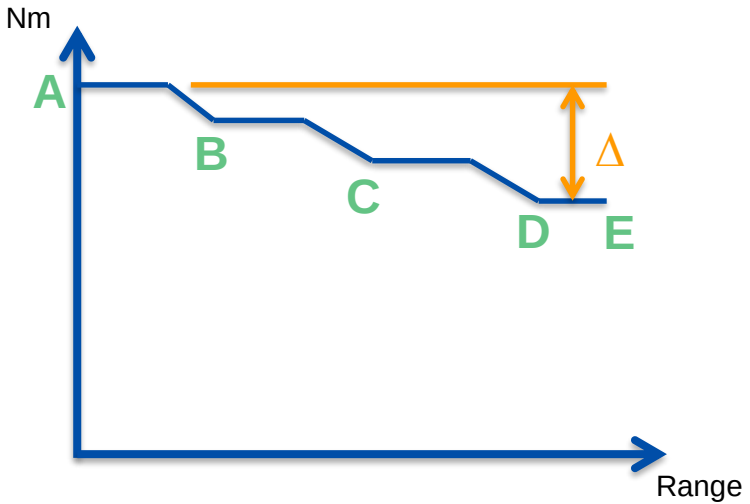


Different Measurmentsystems can capture different results. The need is to understand the reason for this difference.

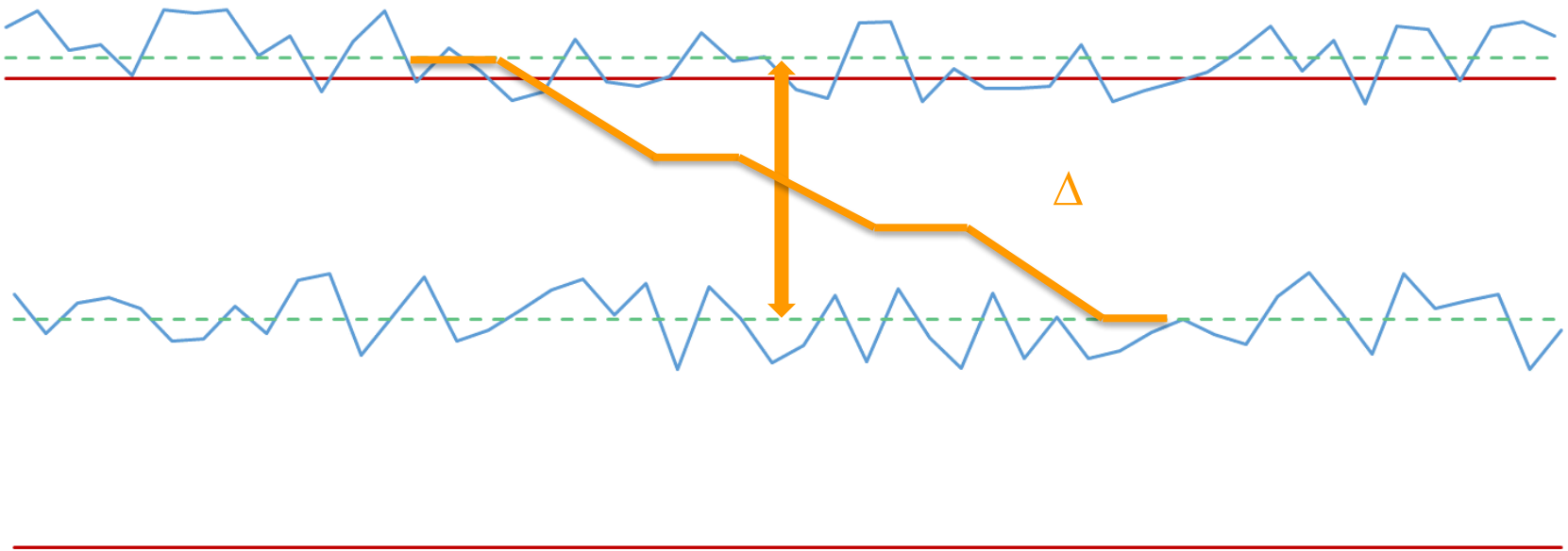
Correlation and System influences



Every measuring system can only capture information that reaches a sensor. Unfortunately, there is always information that does not reach the sensor, e.g. due to friction.



Correlation and System influences

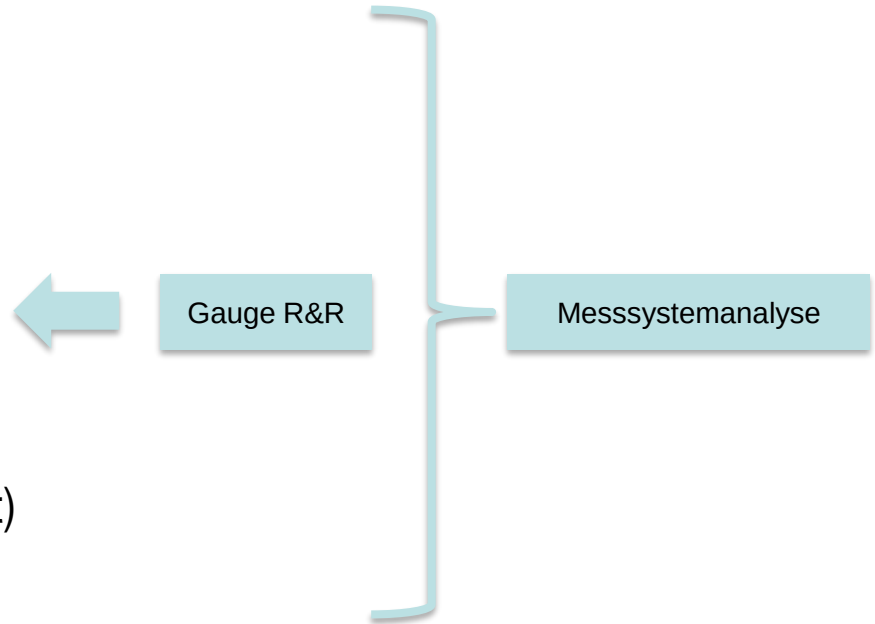


This lack of information caused by systematic influences can lead to different coverage.

Qualification Pyramid

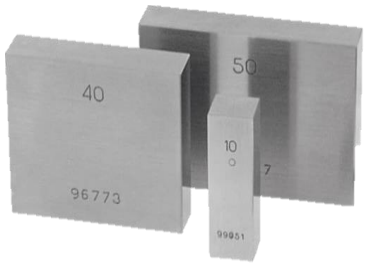
Measurement capability

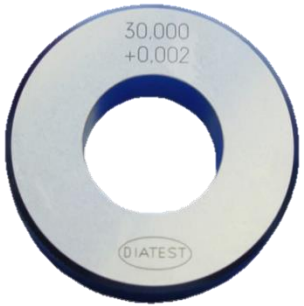
- Method 1 (every equipment)
  - Cg
  - Cgk
- Method 2 (manual equipment)
  - R&R
- Method 3 (automatic equipment)
  - R&R



Measurement capability Method 1

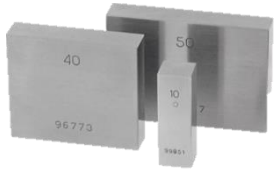
- Check 1 Part (Normal) 50 times
- Normal checked according DIN EN ISO/IEC 17025 (IATF requirement)

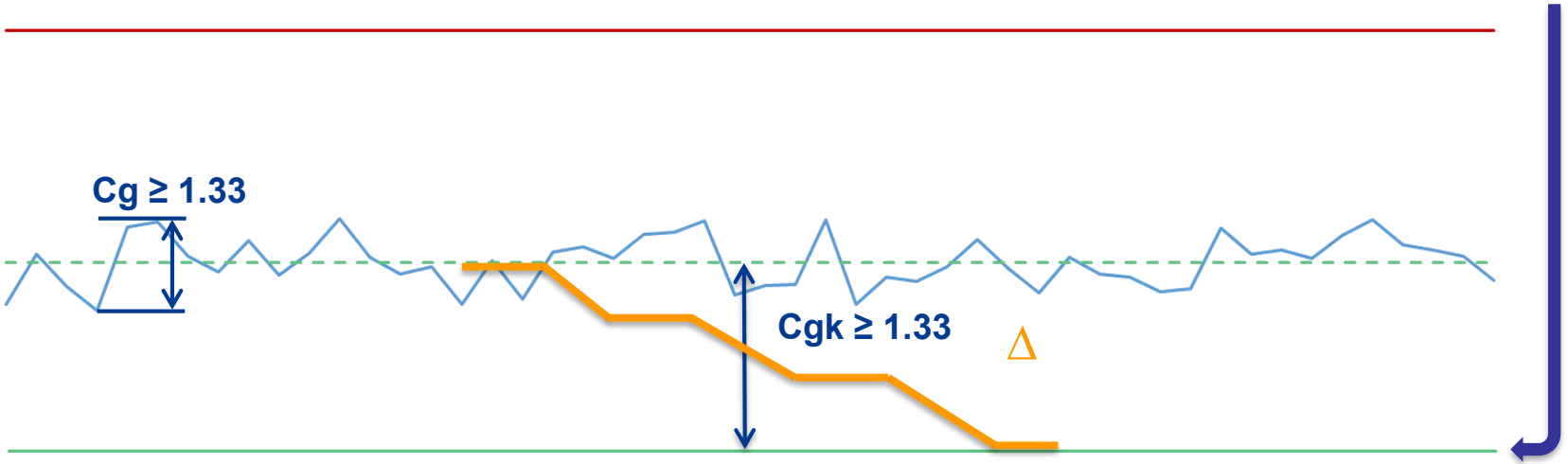




- Indices: Cg; Cgk (Capability gauge; Capability gauge Katayori)
- Detected Influences: Measurement system

Measurement capability Method 1

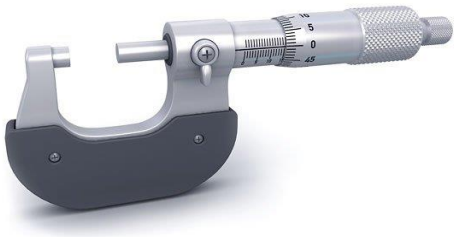




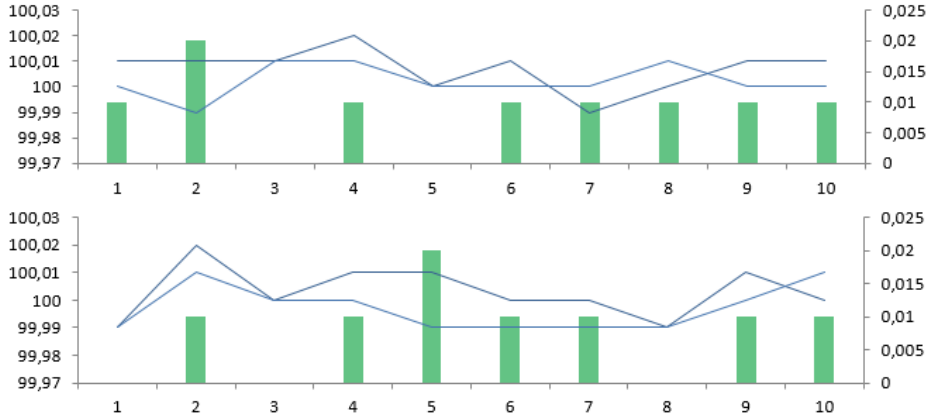
Cg: Indicator for the spread width.
Cgk: Indicator of the systematical deviation.

Measurement capability Method 2

- Check 10 Parts, 2 times by 3 Operators each.
- Indices: %R&R (earlier %GR&R) (Repeatability & Reproducibility)
- Detected Influences: Measurement System; Operator

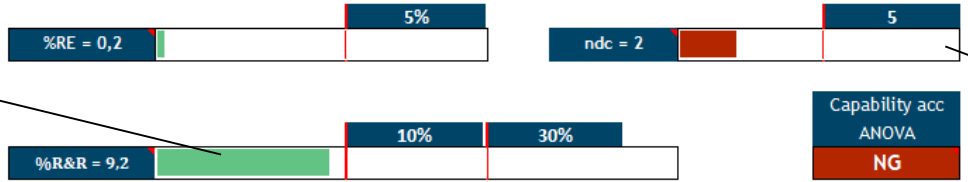


Measurement capability Method 2



Characteristics

	Varianz	Sigma			10%
Repeatability	0,000068	0,008216	%EV =	8,46	
Reproducibility	0,000013	0,003613	%AV =	3,72	
Interaction	0,000000	0	%IA =		
Gauge distribution	0,000081	0,008975275			



Repeatability

Reproducibility

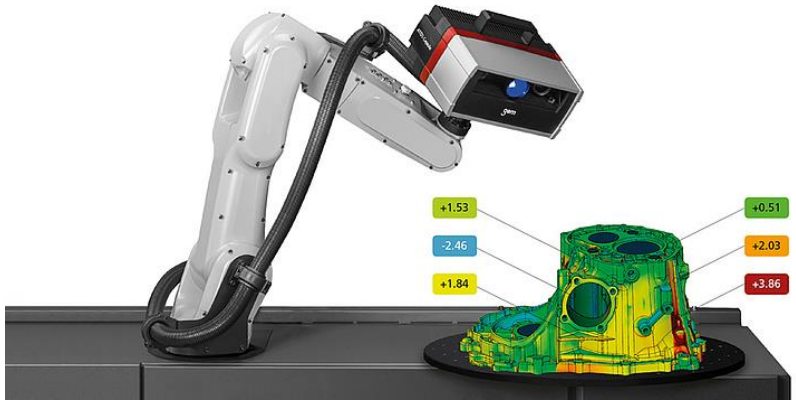
Interaction

Number of distinct categories

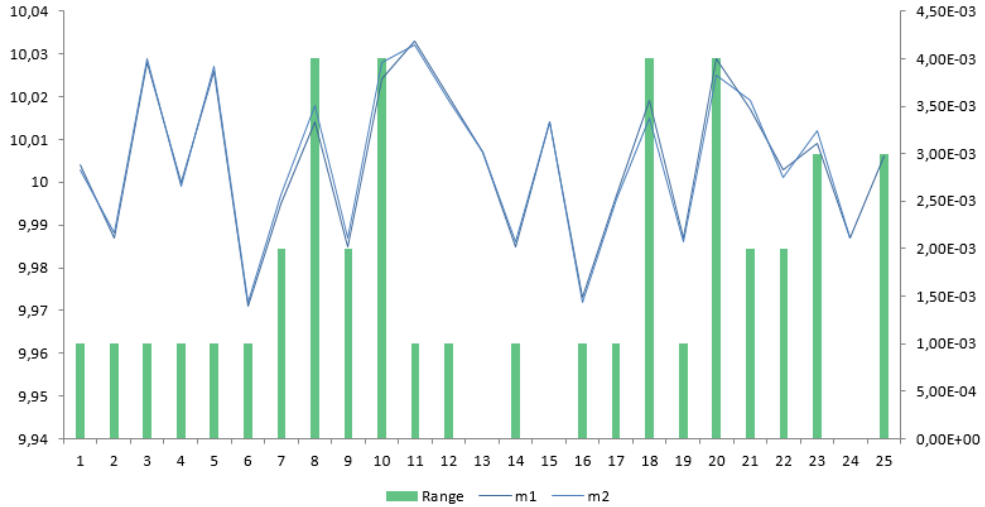
R&R or GR&R < 10%

Measurement capability Method 3

- Check 25 Parts, 2 times
- Indices: %R&R (Repeatability & Reproducibility)
- Detected Influences: Measurement System



Measurement capability Method 3



Characteristics

	Varianz	Sigma			10%
Repeatability	0,00000220	0,007639	%EV =	3,06	
Repeatability & Reproductivity	0,00000220	0,007639			

	5%
%RE = 0,4	

	10%	30%
%R&R = 3,06		

	5
ndc = 17	

Capability acc. ANOVA
Approved

Repeatability

Number of distinct categories

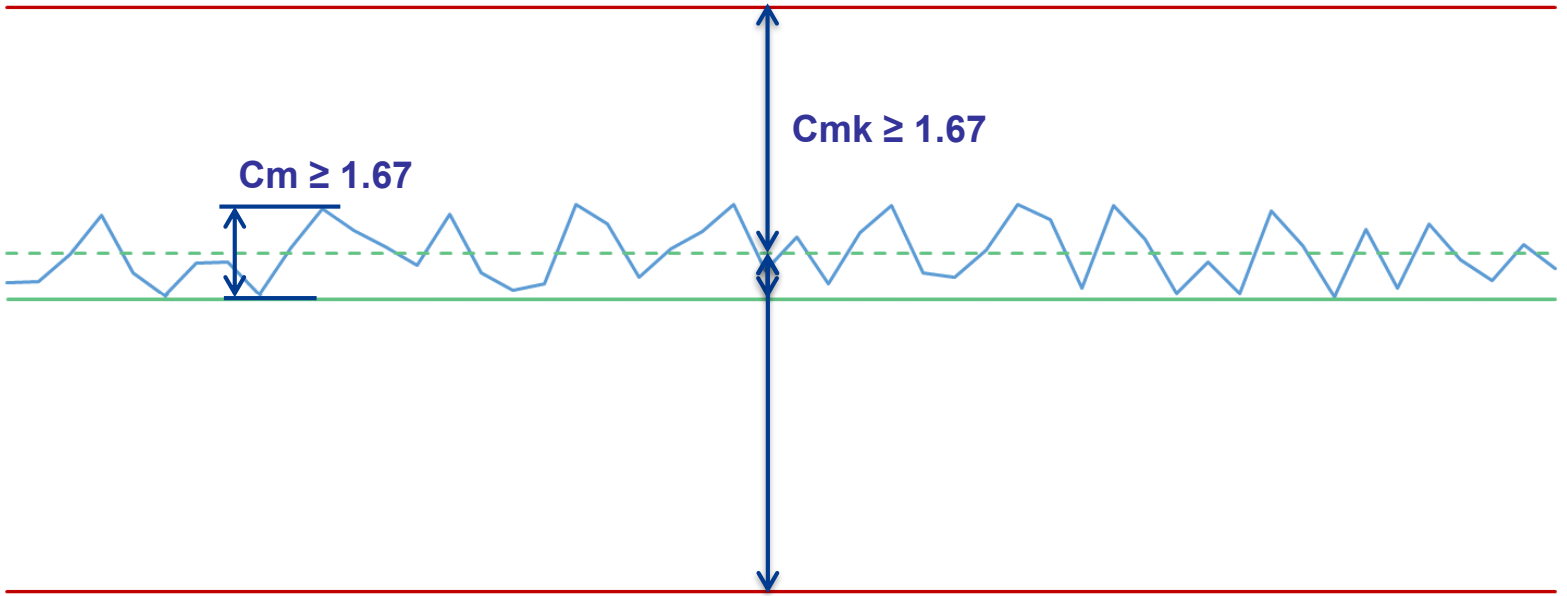
R&R or GR&R < 10%

Qualification Pyramid

Machine capability

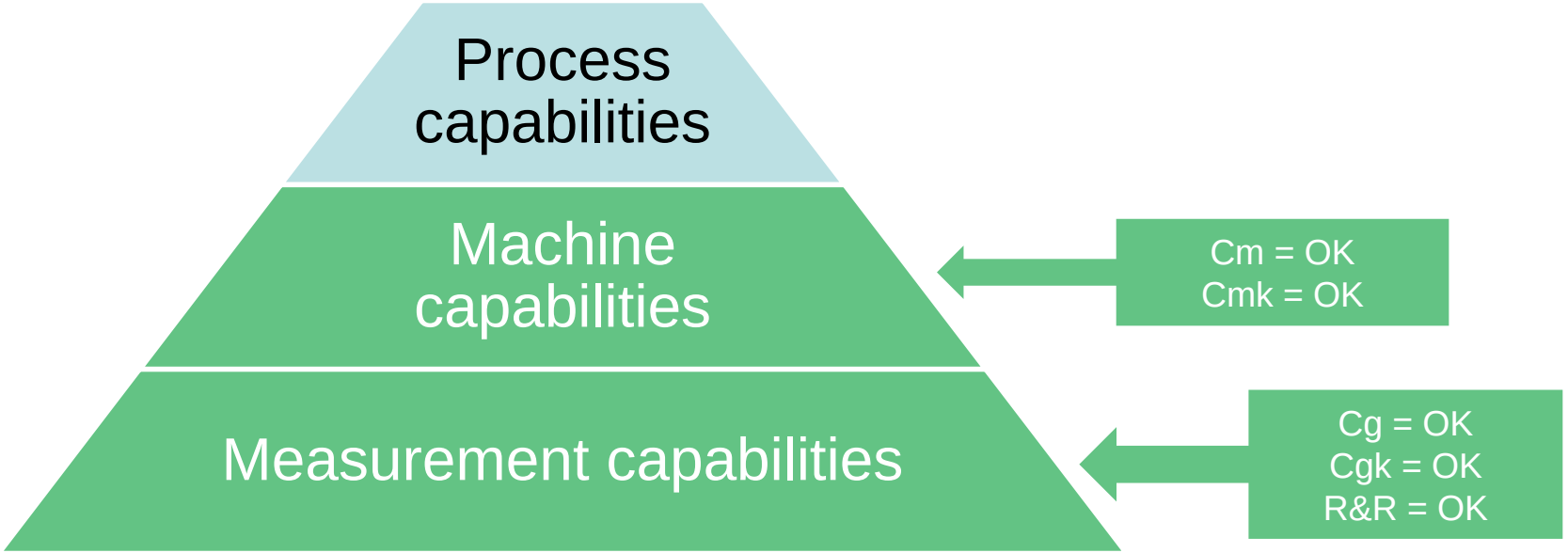
- Produce 50 Parts without adjust the machine
- Measure the parts according their production sequence
- Indices: Cm; Cmk (Capability machine; Capability machine Katayori)
- Detected Influences: Machine

Machine capability



Cm: Indicator for the spread width.
Cmk: Indicator of the distance to the next specification limit.

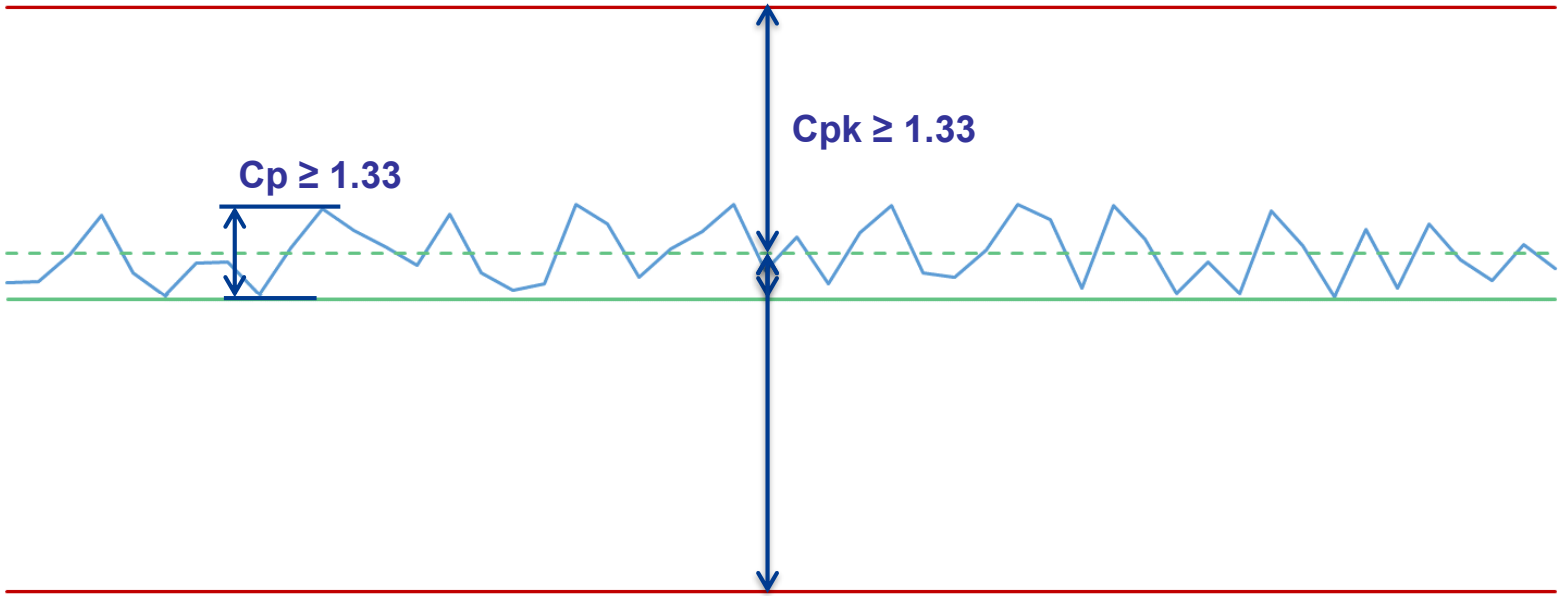
Qualification Pyramid



Process capability

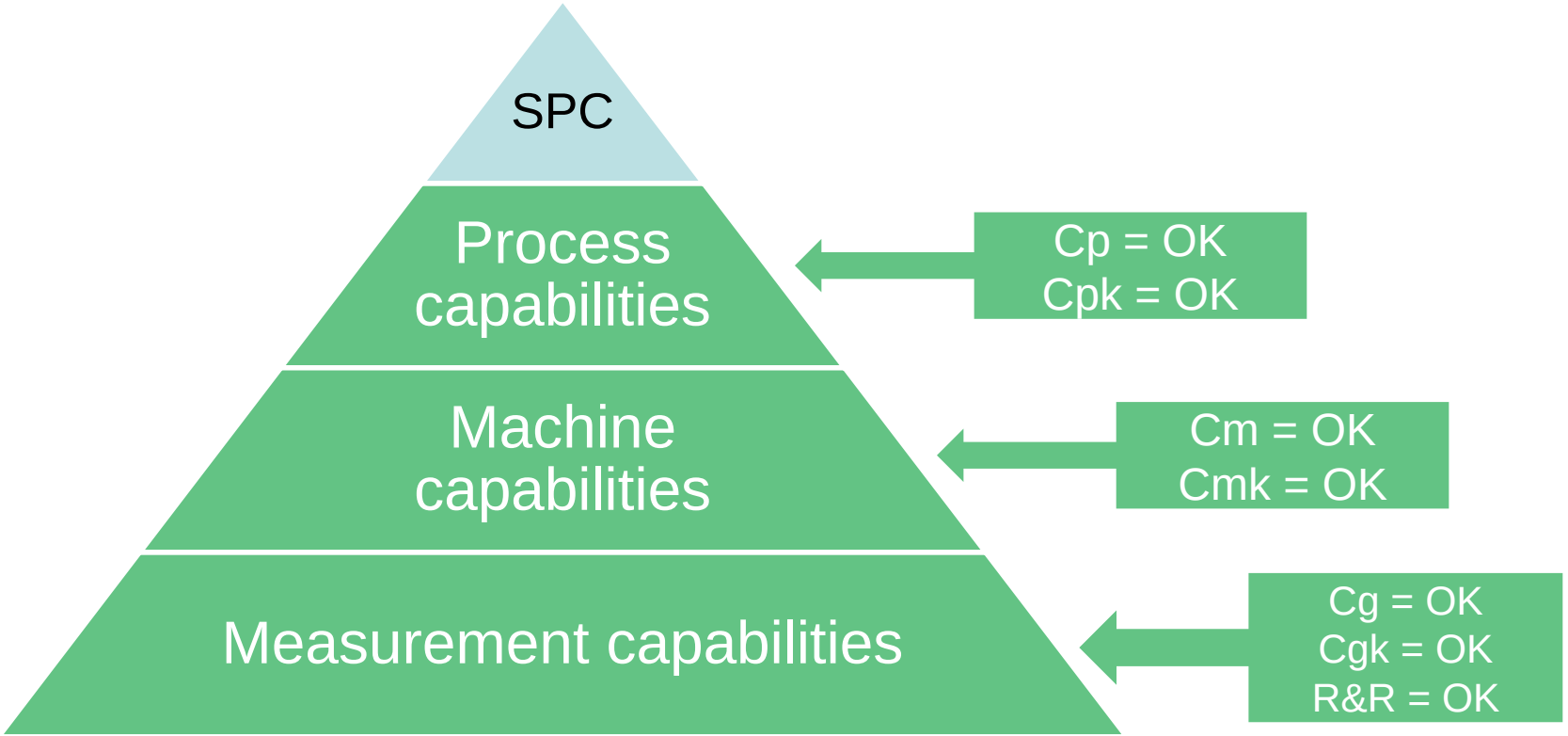
- Produce 125 Parts over 4 shifts with all influences
- Measure the parts according their production sequence
- Indices: Cp; Cpk (Capability process; Capability process Katayori)
- Detected Influences: All „M“ Influences

Process capability

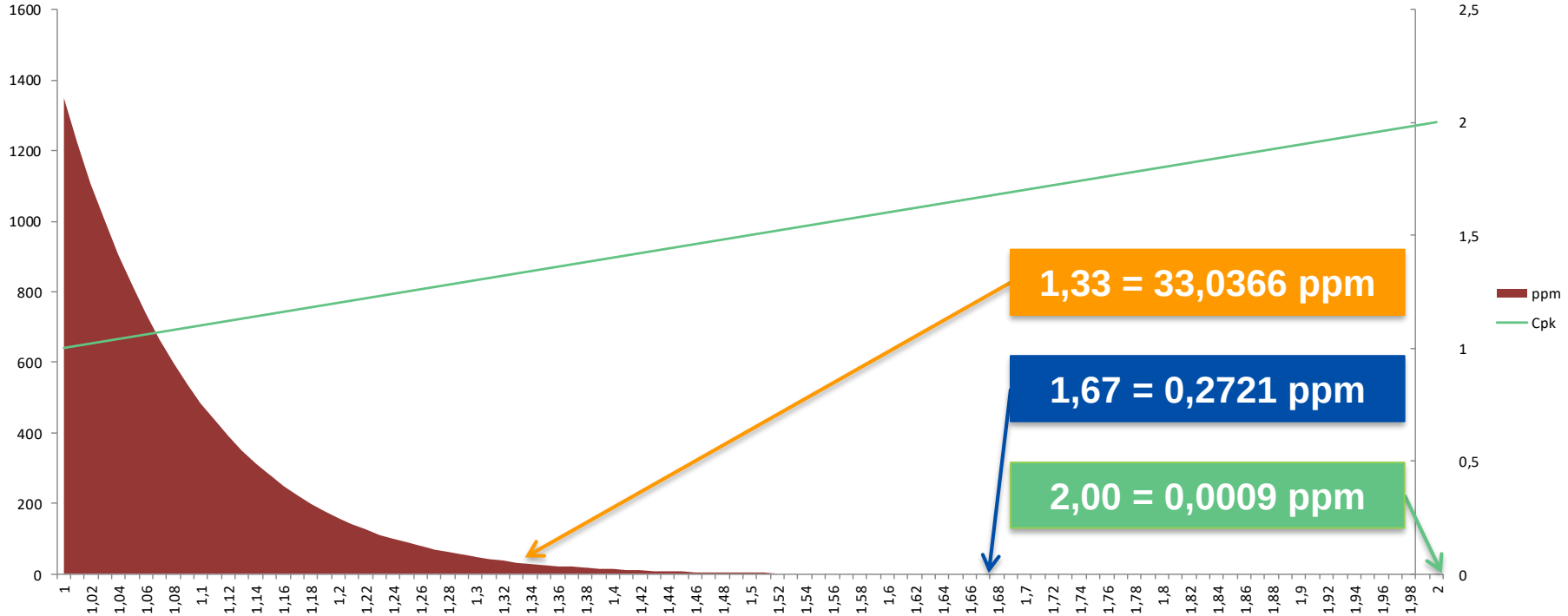


Cp: Indicator for the spread width.
Cpk: Indicator of the distance to the next specification limit.

Qualification Pyramid

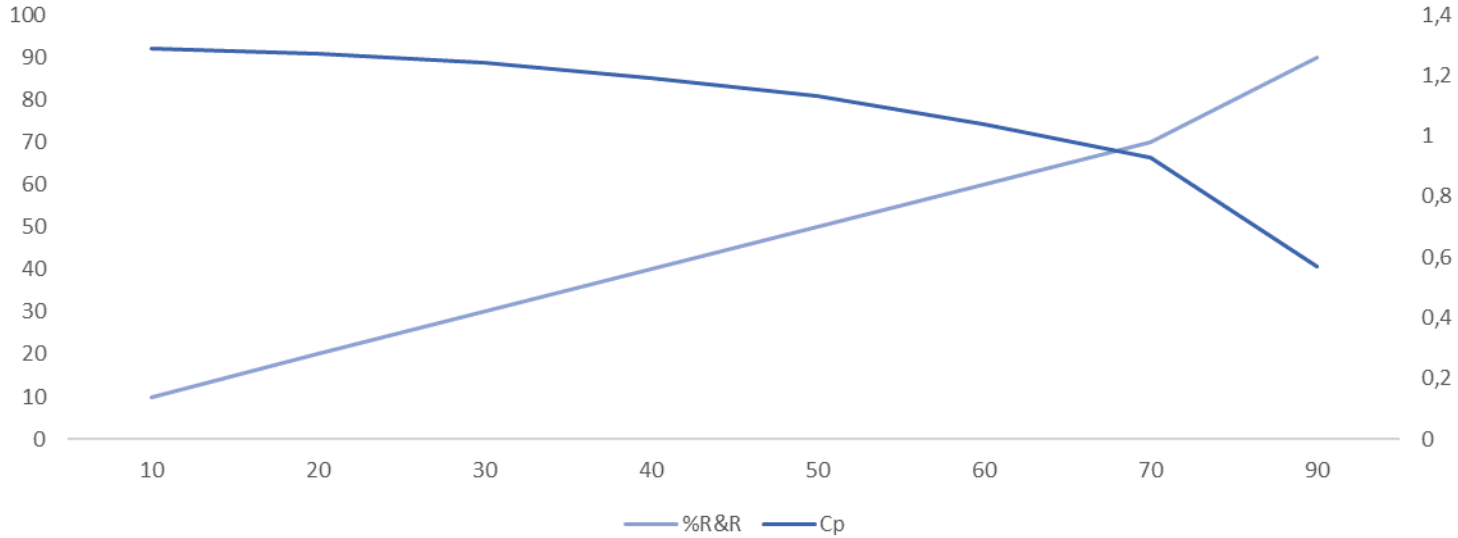


Increasing requirements



If a normal distribution is proven, there is a direct connection between Cpk and ppm. Due to cost reduction and quality improvement, Cpk values increasing in the last 20 years.

Connection between GRR% and Cp



Actual	GRR%							
	10	20	30	40	50	60	70	90
	Cp calculated by Tolerance							
1.3	1.29	1.27	1.24	1.19	1.13	1.04	0.93	0.57

Further there is a direct connection between Cp and the %R&R values (previously %GR&R).
The larger the %R&R value, the smaller the Cp value and therefore also the Cpk.