النيل للإستشارات والتدريب وخدمات المعامل
Committed to Quality...Committed to You

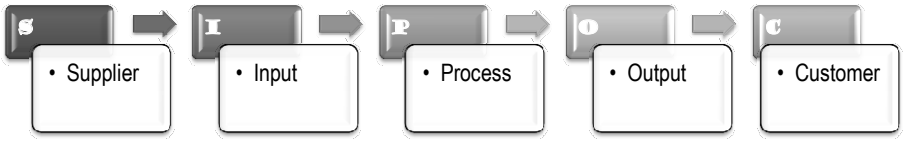
Quality Measure & Analyzing Performance Overviews

Quality Measure and Analyzing Performance

Process definition and components

3.1 Definition of a process

An activity using resources to transform input into output (tangible/ intangible)



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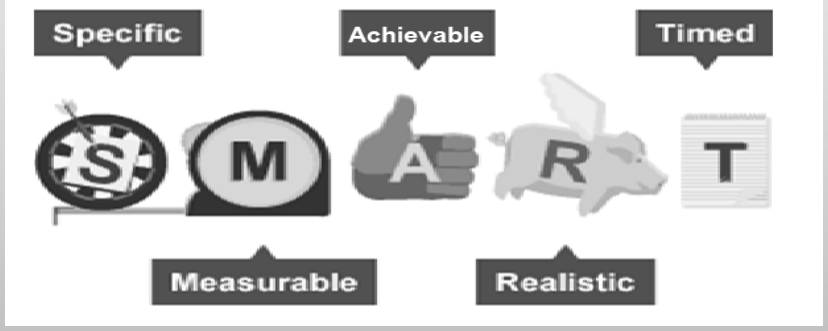
Process objectives

S.M.A.R.T. objectives

Tools for making goals a reality



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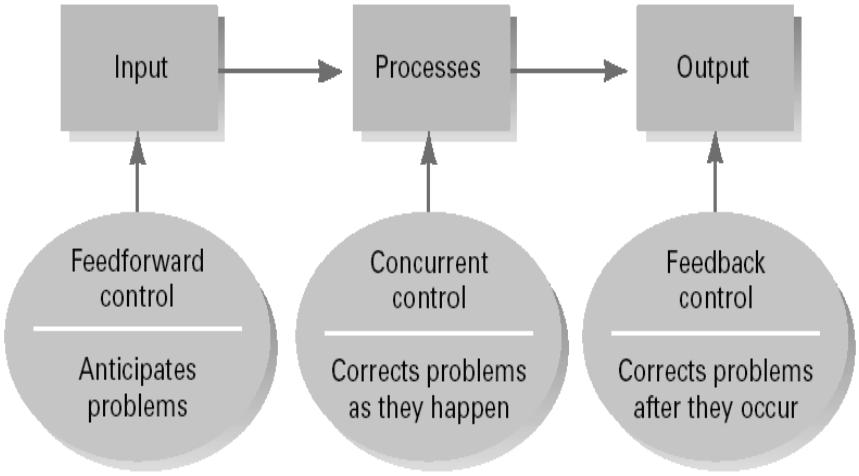
Types of Control



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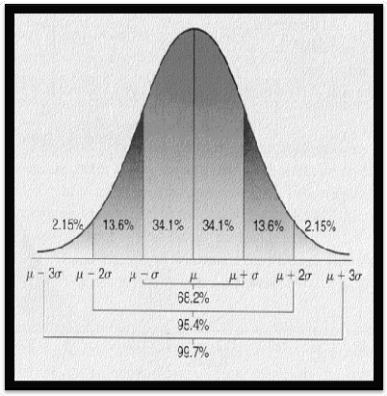
Process Behavior - Normal distribution



- ❑ It links frequency distribution to probability distribution
- ❑ Has a Bell Shape Curve and is Symmetric
- ❑ Symmetrical shape around mean value
- ❑ Mean = Mode = Median
- ❑ 68.26 % of Values in the area mean ± 1 Std
- ❑ 95.44 % of Values in the area mean ± 2 Std
- ❑ 99.73 % of Values in the area mean ± 2 Std

Number of reading = ∞

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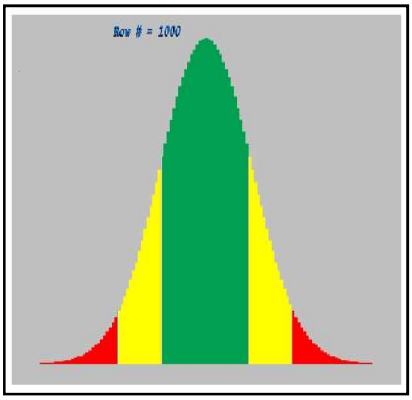
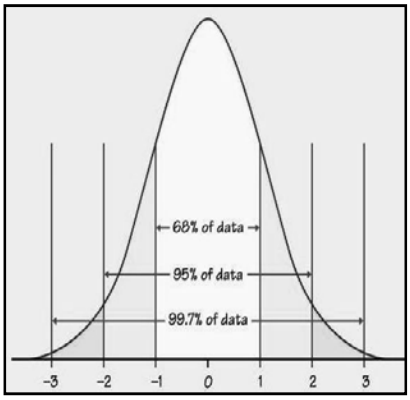
Process Behavior - Normal distribution



Number of reading = 1000



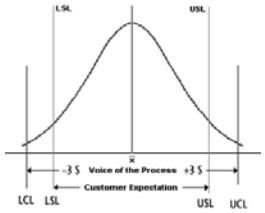
Number of reading = ∞

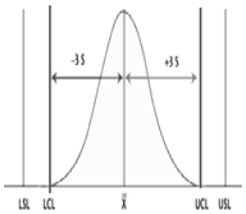
Analyzing Performance

Process Limits

A simple view of Process Control and Process Capability

- **Process control** - refers only to the "***voice of the process"*** - looking at the process using an ***agreed performance measure*** to see whether the ***process forms a stable distribution over time.***
- **Process capability** - measures the "***goodness of a process***" - comparing the ***voice of the process*** with the "***voice of the customer***". The ***voice of the customer here is the specification range (tolerance)*** and/or ***the nearest customer specification limit.***





Analyzing Performance

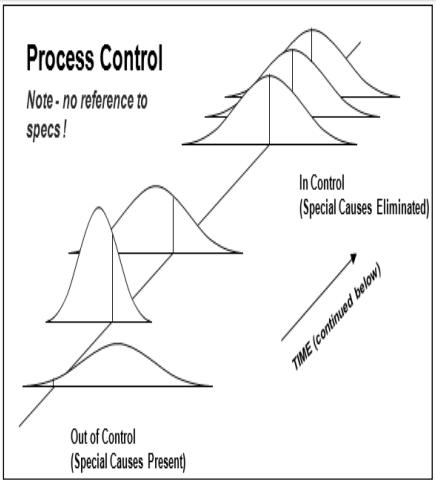
Process Limits

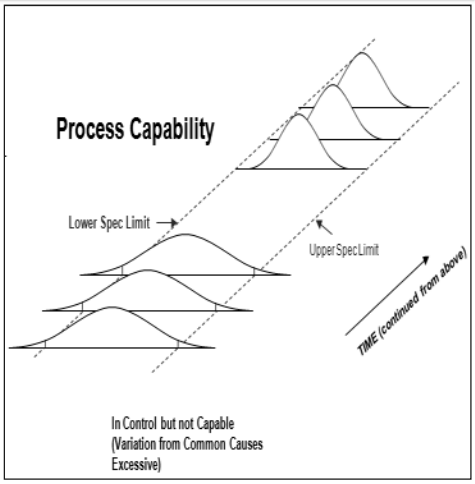
What is the difference between specification limits and control limits?

Control Limits	Specification Limits
Voice of the Process	Voice of the Customer
Values calculated by Process	Values defined by user
UCL & LCL	USL & LSL

Quality Measure and Analyzing Performance

What is the process capability





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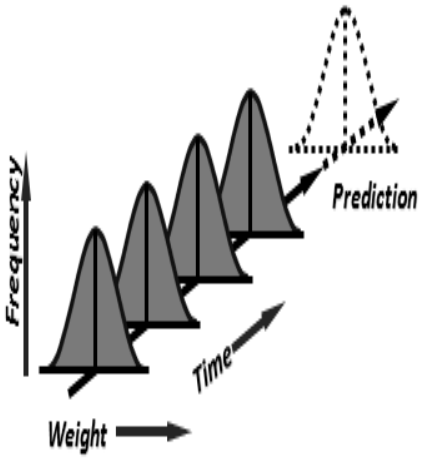
Sources of Variation

Common causes of variation

Also called random or uncontrollable **causes of variation**

causes that are random in occurrence **and are** inherent in all processes management**,**

If only natural (common) causes of variation are present, the output of a process forms a distribution that is stable over time and is predictable



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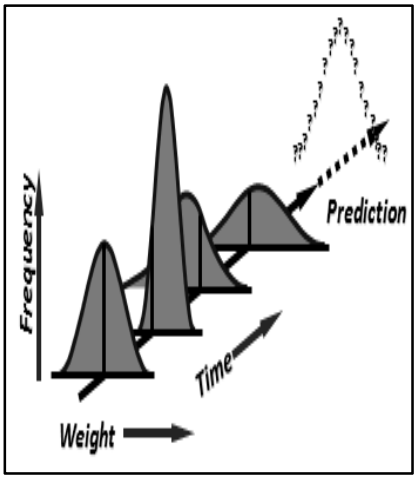
Sources of Variation

Assignable causes of variation

Also called special causes of variation the result of External **sources outside the system**

Must be detected, and corrective action must be taken to remove them from the process

If assignable causes are present, the process output is not stable over time and is not predicable



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Sources of Variation

Total Process Variation:

Total Process Variation = Common Cause Variation + Assignable Cause Variation

- Variation is natural; inherent in the world around us
- No two products or service experiences are exactly the same
- With a fine enough gauge, all things can be seen to differ

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Sources of Variation

Common Cause Variation:

Total Process Variation = Common Cause Variation + Assignable Cause Variation

Common cause variation

- naturally occurring and expected
- the result of normal variation in materials, tools, machines, operators, and the environment

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Sources of Variation

Assignable (Special) Cause Variation:

Total Process Variation = Common Cause Variation + Assignable Cause Variation

Special Causes: Five M & E

1. **Man**
2. **Material**
3. **Machine**
4. **Methods**
5. **Measurement**
6. **Environment**

Special cause variation

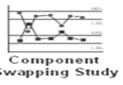
- abnormal or unexpected variation
- has an assignable cause
- variation beyond what is considered inherent to the process

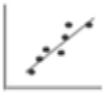
Quality Measure and Analyzing Performance

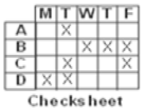
1. SPC - Statistical Process Control Tools

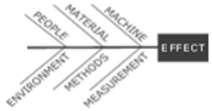
The *seven major tools* are (7 SPC Tools):

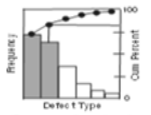
1. Flow Chart
2. Check Sheet
3. Cause and Effect Diagram
4. Histogram
5. Pareto Chart
6. Scatter Diagram
7. Control Chart











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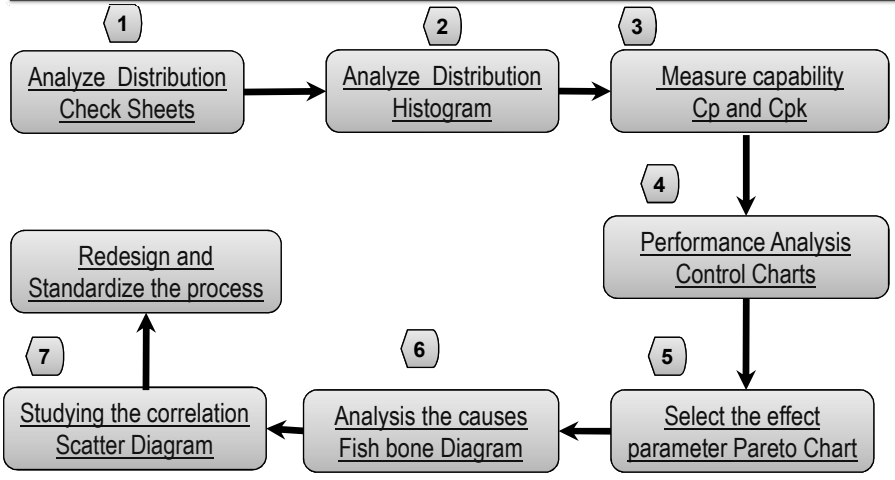
Performance analyzing – Tools [7 – QC Tools]



Quality Measure and Analyzing Performance

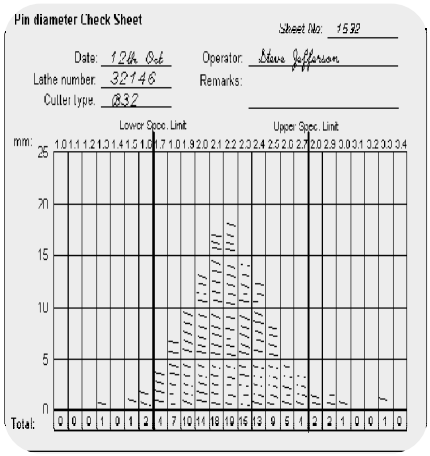
1- Collect Data - check sheet

Frequency Check Sheet

Human Resource Questions

	Monday	Tuesday	Wednesday	Thursday	Friday	Total
Health Insurance	𝍸 //	𝍸 𝍸	////	𝍸 /	𝍸 ///	35
Disability Insurance	///	////	/	𝍸 /	//	16
Sick Time	𝍸	𝍸 ///	///	////	𝍸	25
Paid Time Off	𝍸 𝍸	𝍸 𝍸	𝍸 ////	𝍸 ////	𝍸 ///	47
Tuition Reimbursement	///	//	////	///	////	16
Payroll Error	//	/	///	/	//	9
Total	30	35	25	29	29	148

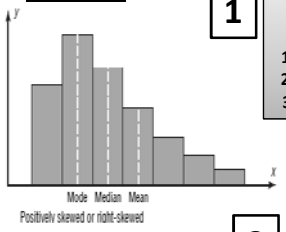
Measurement Scale Check Sheet



Analyzing Performance

2- Analyze Distribution - Histogram

Skewness > 0



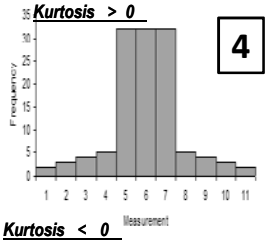
Positively skewed or right-skewed

1

Types of Distributions

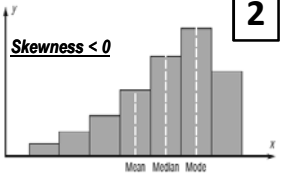
1- mean = median = mode (symmetric)
2- mean > median > mode (+ ve skewed)
3- mean < median < mode (- ve skewed)

Kurtosis > 0



4

Skewness < 0

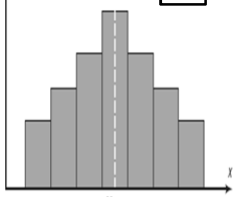


Negatively skewed or left-skewed

2

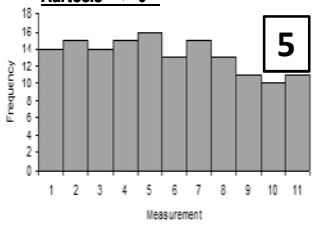
Kurtosis = 0

Skewness = 0



3

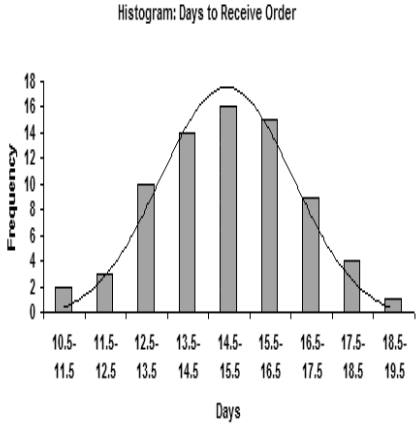
Kurtosis < 0



5

Quality Measure and Analyzing Performance

2- Analyze Distribution - Histogram



- هل التوزيع متماثل حول القيمة المركزية
- هل القيمة المركزيه للتوزيع تتوافق الى حد ما مع القيمة المركزية للمواصفات الموضوعة للعملية
- هل توجد قراءات تظهر خارج الحجدود الموضوعة للعملية
- هل التوزيع مفلطح
- هل التوزيع يظهر فيه أكثر من قمة او ان هناك فجوة فى التوزيع

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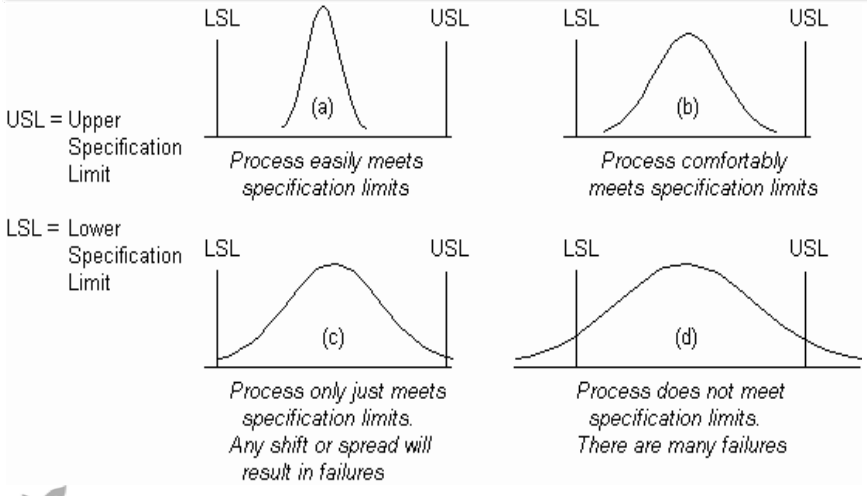
3- Measure capability Cp Cpk



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4- Process Capability Analysis

			1 CAPABILITY Short Term In Control Pooled std dev	2 PERFORMANCE Long Term Not in Control Total / overall std dev
a	How much variability	compares spec range (tolerance) to process width	C_p	P_p
b	How centred	how close process centre is to nearest spec limit	C_{pk}	P_{pk}

$$C_p = \frac{USL-LSL}{6s}$$

$$P_p = \frac{USL-LSL}{6s_P}$$

$$C_{pkl} = \frac{X-LSL}{3s} \qquad C_{pku} = \frac{USL-X}{3s} \Rightarrow C_{pk} = \min\{C_{pkl}, C_{pku}\}$$

$$P_{pkl} = \frac{X-LSL}{3s_P} \qquad P_{pku} = \frac{USL-X}{3s_P} \Rightarrow P_{pk} = \min\{P_{pkl}, P_{pku}\}$$

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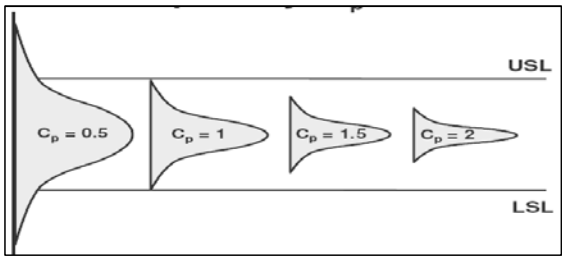
4- Process Capability Analysis

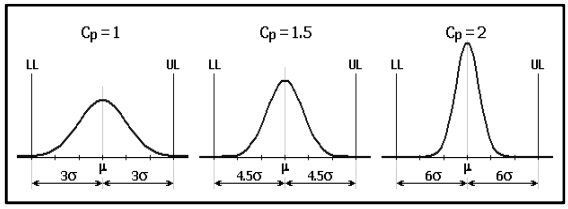
Use Minitab output whenever possible, since it combines the indexes with a graphical representation of the process: actual sample, estimated short term capability and estimated long term performance

❑ Also use ***as a rule of thumb*** the following chart



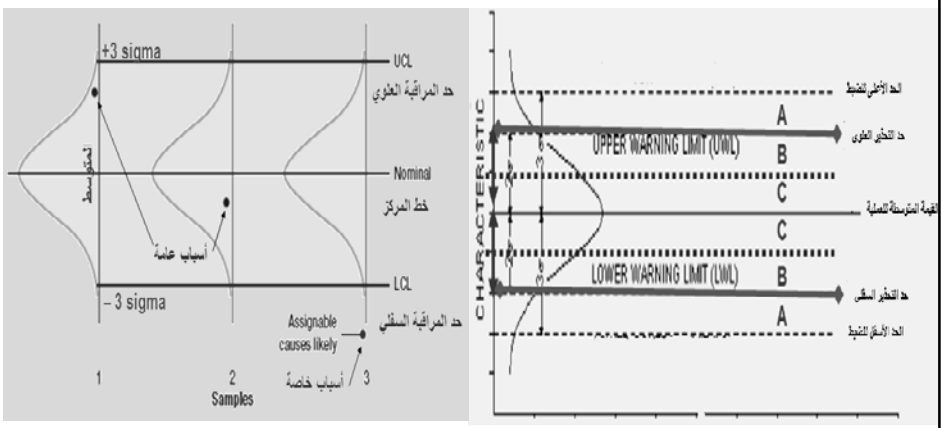
	Cp	Cpk	Pp	Ppk	Sigma
Red (Bad)	< 1.00	< 1.00	< 1.33	< 1.33	< 4.5
Yellow (OK)	1.00 - 1.33	1.00 - 1.33	1.33 - 1.67	1.33 - 1.67	4.5 - 5.5
Green (Good)	> 1.33	> 1.33	> 1.67	> 1.67	> 5.5

(Cpk x 3) +1.5 = sigma



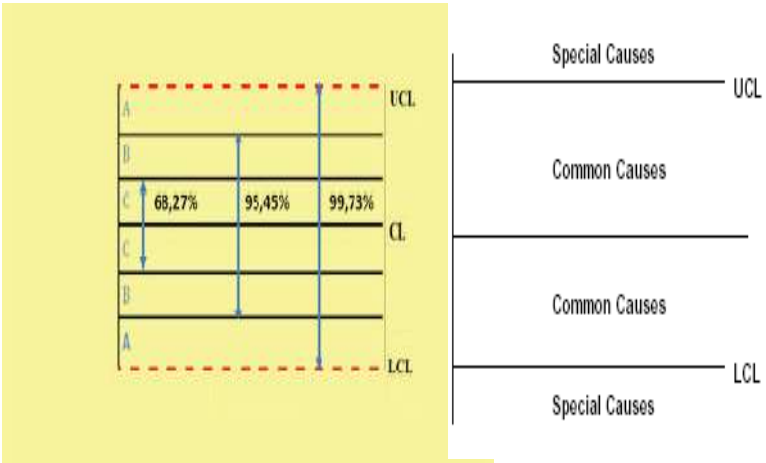
Quality Measure and Analyzing Performance

Performance Analysis – Control Charts



Quality Measure and Analyzing Performance

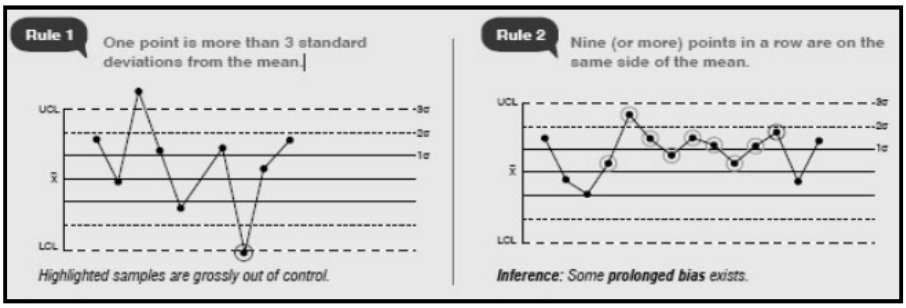
Performance Analysis – Control Charts



Quality Measure and Analyzing Performance

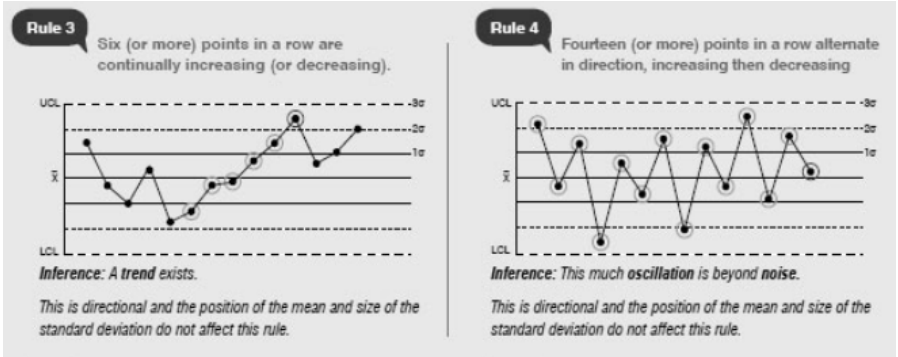
طريقة (نيلسون) لاكتشاف الأسباب في خرائط المتوسط

الاختبارات الثمانية لاكتشاف أسباب الاختلافات القابلة للتحديد بخرائط الجودة



تسعة نقاط (أو أكثر) في صف واحد على نفس الجانب (في المنطقة أعلى أو أسفل) متوسط العملية.	نقطة واحدة أعلى من الحد الأعلى للضبط (UCL)، أو أسفل الحد الأدنى للضبط (LCL). أي: النقطة تقع على مسافة أكبر من 3 إنحرافات معيارية (3σ) من متوسط العملية.

Quality Measure and Analyzing Performance



أربعة عشر نقطة (أو أكثر) تتعاقب في الاتجاه في صف واحد، تتزايد ثم تتناقص. (حالة تذبذب)	ستة نقاط (أو أكثر) في صف (متزايدة في المنطقة أعلى خط متوسط العملية). أو ستة نقاط (أو أكثر) في صف (متناقصة في المنطقة أسفل خط متوسط العملية).

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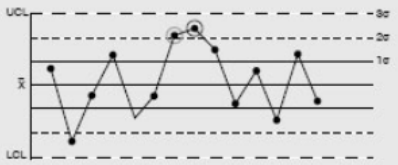
Rule 5

Two (or three) out of three points in a row are more than 2 standard deviations from the mean in the same direction.



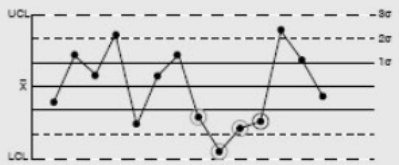
Inference: *There is a medium tendency for samples to be mediumly out of control.*

The side of the mean for the third point is unspecified.

نقطتان (أو أكثر) من ثلاثة نقاط في صف واحد على مسافة أكبر من 2 انحراف معياري (2σ) من متوسط العملية، في نفس الاتجاه.

Rule 6

Four (or five) out of five points in a row are more than 1 standard deviation from the mean in the same direction.



Inference: *There is a strong tendency for samples to be slightly out of control. The side of the mea n for the fifth point is unspecified.*

أربعة نقاط (أو أكثر) من خمسة نقاط في صف واحد على مسافة أكبر من 1 انحراف معياري (1σ) من متوسط العملية، في نفس الاتجاه.

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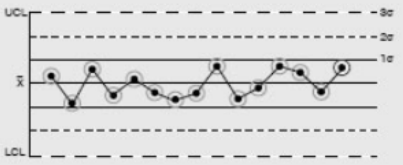
Rule 7

Fifteen points in a row are all within 1 standard deviation of the mean on either side of the mean.

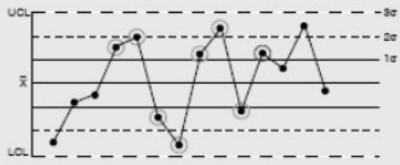


Inference: *With 1 standard deviation, greater variation would be expected.*

خمسة عشر نقطة تقع جميعها في المنطقة (C) أي على مسافة 1 انحراف معياري (1σ) على جانبي خط متوسط العملية.

Rule 8

Eight points in a row exist with none within 1 standard deviation of the mean and the points are in both directions from the mean.

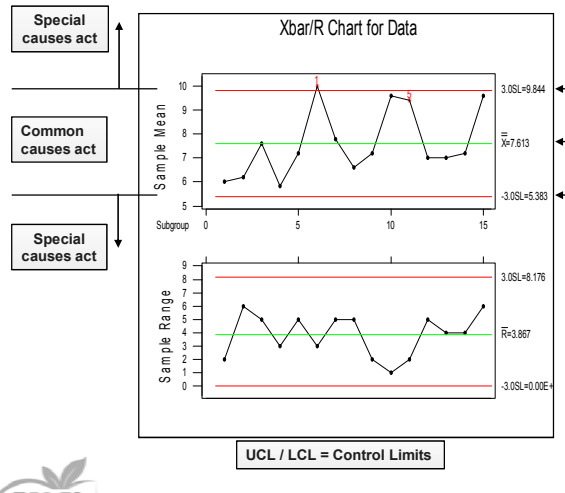


Inference: *Jumping from above to below whilst missing the first standard deviation band is rarely random.*

ثمانية نقاط تقع جميعها في المنطقتين (A , B) أي على مسافة 1 انحراف معياري (1σ) أعلى وأسفل خط متوسط العملية.

Analyzing Performance

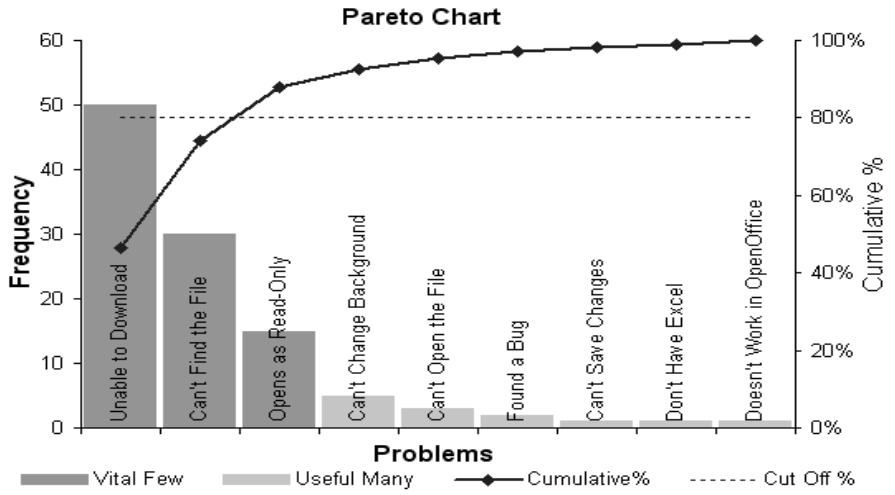
Performance Study - Control Chart



- هل توجد أحد النقاط خارج حدود الضبط control Limits
- هل توجد اكثر من نقطة متتالية تقترب من حدود الضبط control Limits
- هل هناك 9 نقاط متتالية او اكثر لهم نفس النزعة الى اعلى او الى أسفل
- هل هناك 9 نقاط متتالية او اكثر فى إتجاه واحد من خط التحكم المركزى Center Line
- هل يظهر فى المخطط اى نزعات متكررة

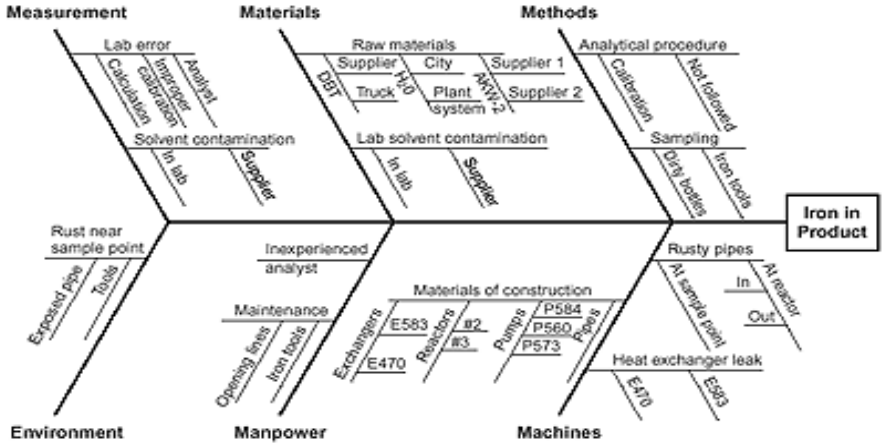
Quality Measure and Analyzing Performance

Select the effect parameter - Pareto Chart



Quality Measure and Analyzing Performance

Analysis the root cause - Fish bone diagram

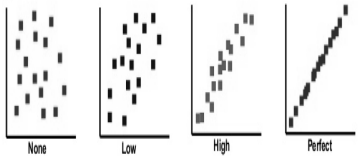


Quality Measure and Analyzing Performance

Studying the correlation between Input with the output - Scatter diagram

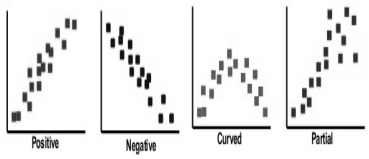
Scatter Diagram - How do I use it? - Correlation

Degrees of correlation:



- هل يوجد أتجاه واضح يشير الى أن هناك ارتباط بين المتغيرات (Positive , Negative)
- هل شكل النقاط يوضح أن الارتباط خطى
- هل شكل النقاط يوضح أن هناك قوة او شده فى الارتباط
- هل توجد اى نقاط Outliers متطرفة بعيدا عن جميع النقاط

Types of correlation:



Quality Measure and Analyzing Performance

Redesign process (Flow Chart)

- Monitor the Inputs, Resources, Outputs & Feedback associated with a system process
- Easily identify how an action item fits into the process of the system
- **Increase Efficiency**