Mastering AVI

Part8: Visual inspection life-cycle and control strategy

- Integration of visual inspection into overall manufacturing process
- Elements of lifecycle
- Particle identification/characterization
- Defect libraries as dynamic database
- AQL and control charting

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Mastering Automated Visual Inspection

…….control strategy is key

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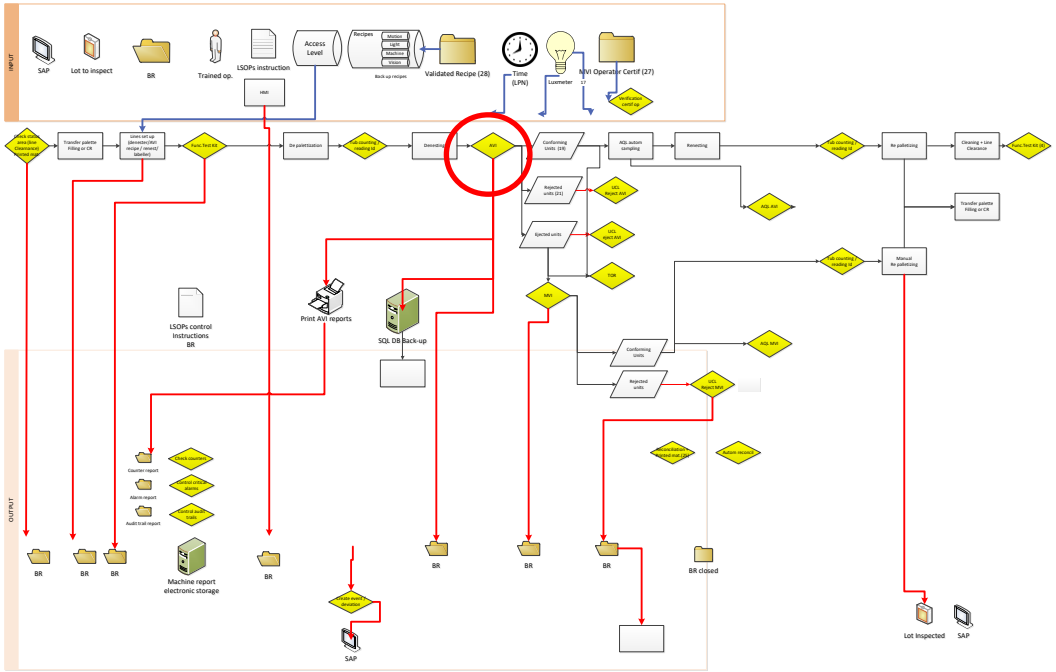
AVI Equipment is part of an overall VI process



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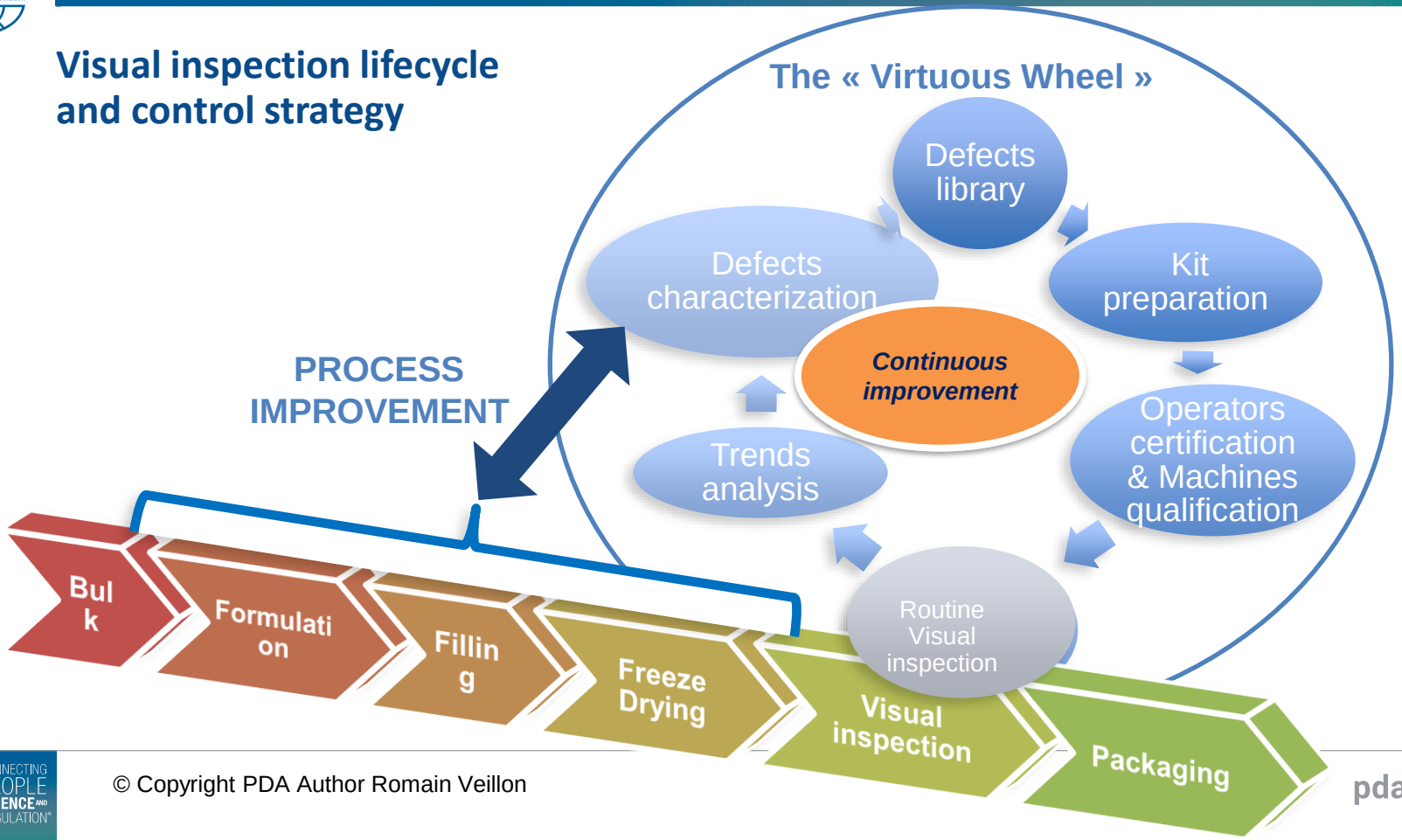
Visual inspection lifecycle and control strategy



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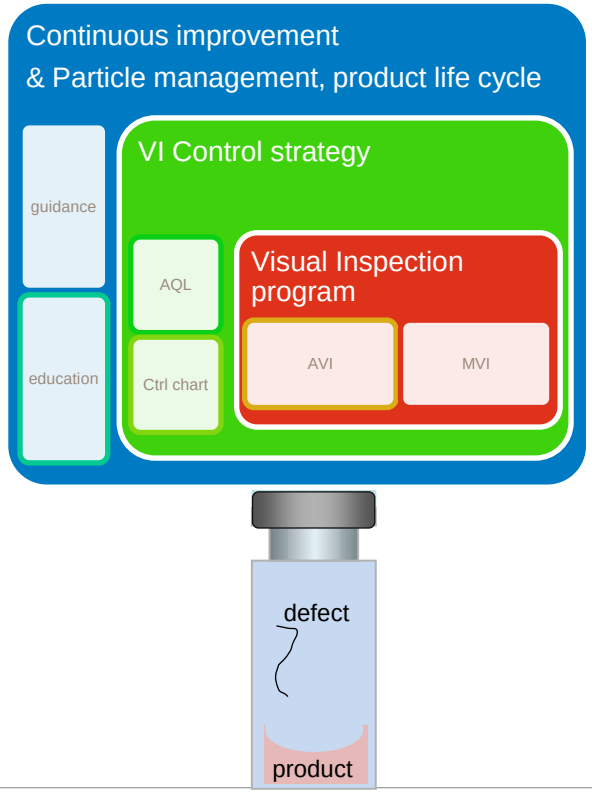
Visual inspection program in 3 layers:

- -The Core is AVI/MVI program, with strategy for DML / standard work / certification / validation
- -The control strategy with ctrl chart and AQL guarantees that VI is kept under control
- -Continuous improvement is the goal of all VI activities with CAPA mngt. The Particle management is a key to success with particle control and associated WOW & education, product life cycle approach



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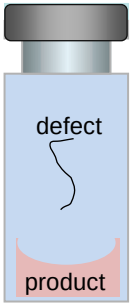
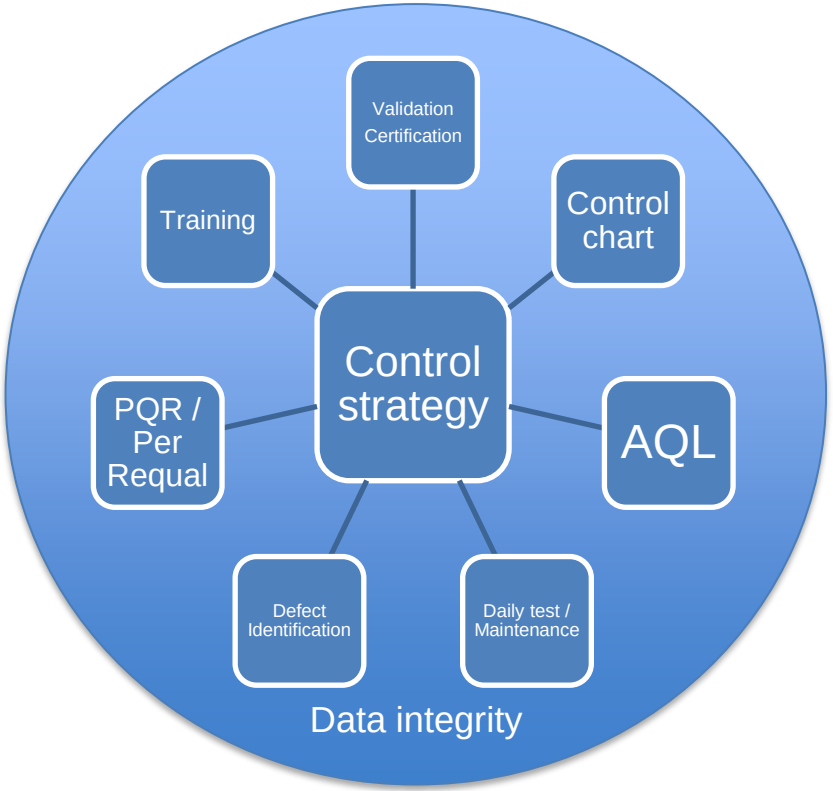
Control strategy





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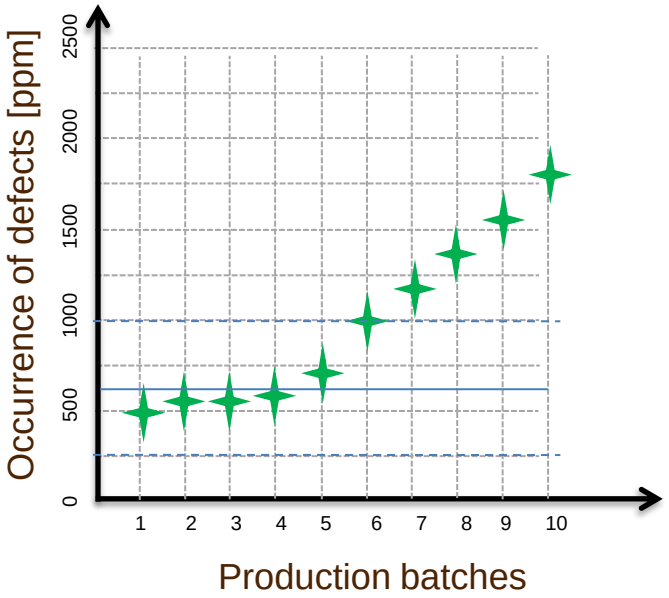
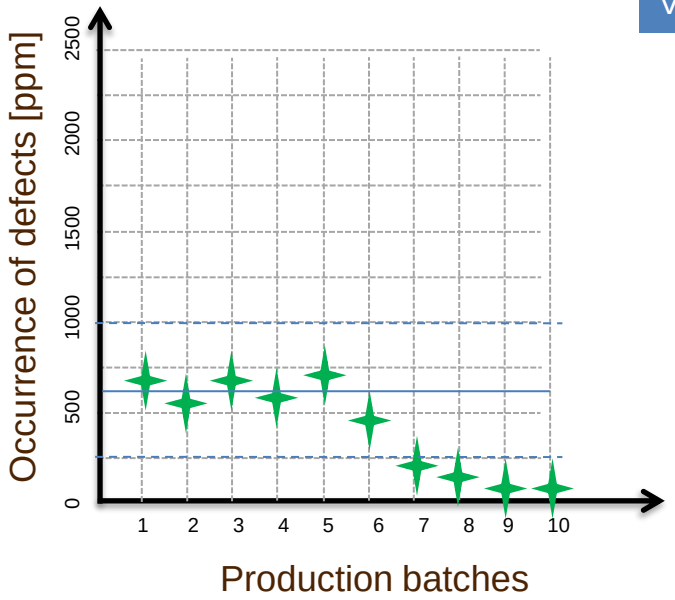
Why defect trending is key ?

Key take-away:
SPC trend chart is a way to control absence of drift of VI process





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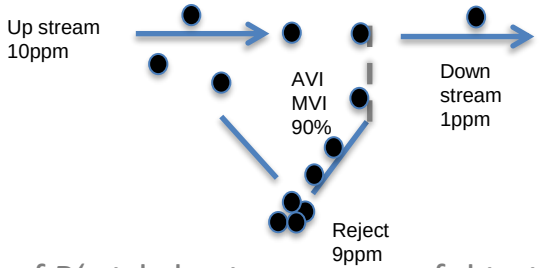
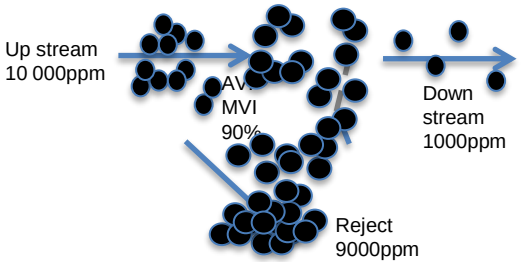
Why a robust SPC is key for VI ?

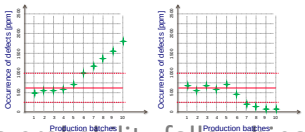
Key take-away:
AVI is probabilistic
So it is key to control source contamination upstream even if AVI is validated

– Use of ctrl chart necessary because VI is a Markov like process (probabilistic)





– Use of P‘ ctrl chart very powerful to track any drift or atypical lot



$$UCL = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n_i}}$$

$$UCL = \bar{p} + 3\, s_i s_z$$

- 3 sigma probability follow binomial law with 99,7% proportion of defective units

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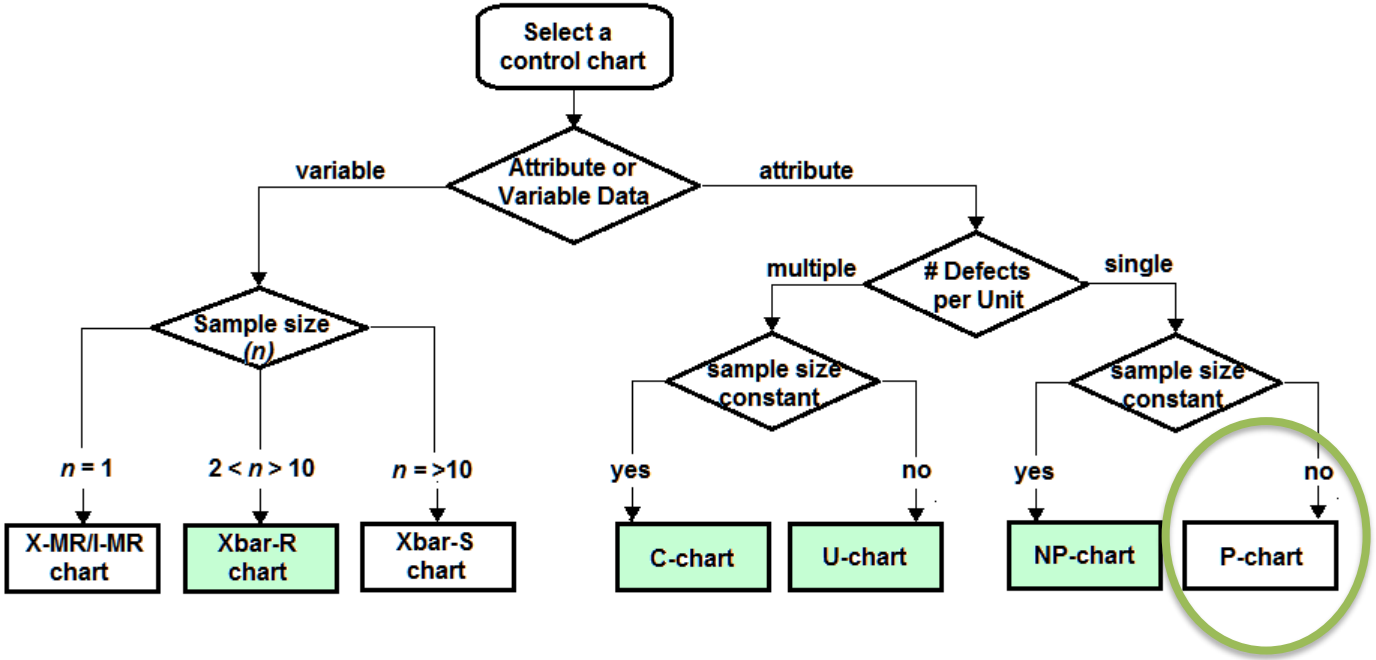
Type of control charting



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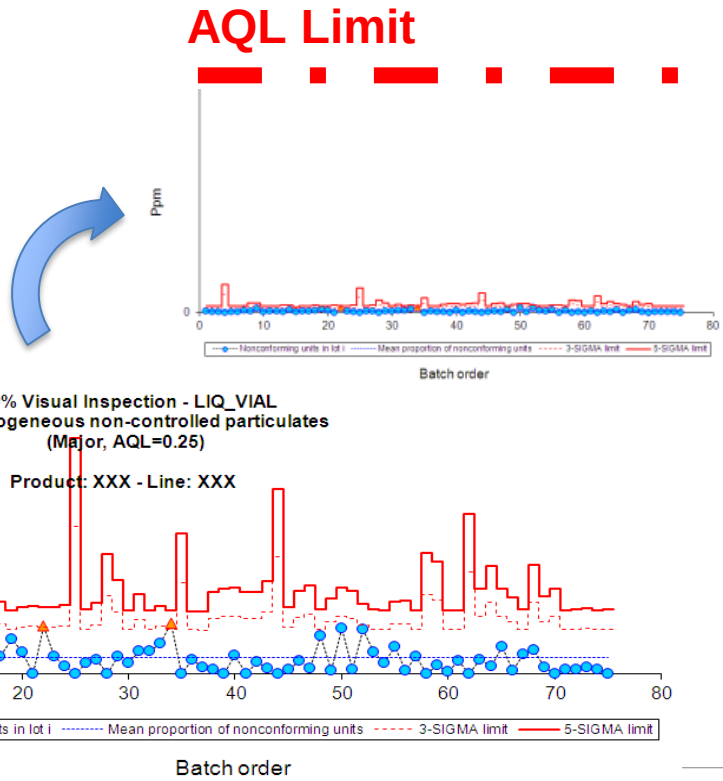
Continuous Performance Monitoring

- Control Strategy- Ctrl chart

Take AWAY: Even with a low probability of detection (non NULL!!)
the UCL limit is the strength of the control strategy, it has the ability to discard atypical lots in term of occurrences.
It has a far lower detection than AQL
Even with probabilistic detection ctrl chart can detect atypical lots



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AQL Sampling

- AQL done in MVI
- AVI qualification is compared to MVI reference
- Use ISO tables
- AQL is a quality decision test
- AQL is under quality unit reponsibility

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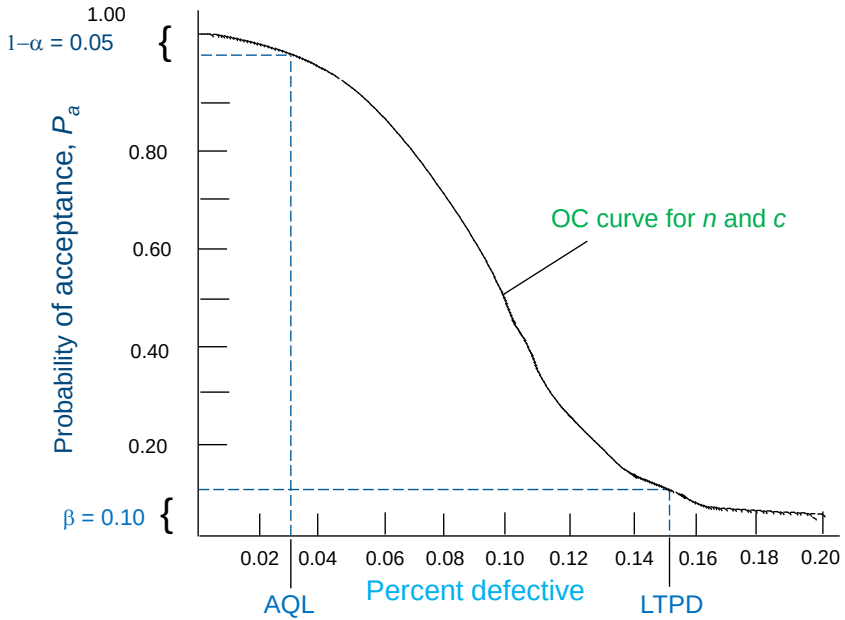
AQL Sampling and OC curve



- **Acceptable quality level (AQL)**
  - **Acceptable fraction defective in a lot**
- **Lot tolerance percent defective (LTPD or RQL)**
  - **Maximum fraction defective accepted in a lot**
- **Producer's risk, α**
  - **Type I error = P(reject a lot|probability (defective)=AQL)**
  - **AQL allow to ensure with a sufficient level of confidence the process does not reject « good batches » - Supplier risk**
- **Consumer's risk, β**
  - **Type II error = P(accept a lot| probability(defective)=LTPD or RQL)**
  - **The parameter ensuring that process does not release « bad batches » is the UQL (also called RQL, or LTPD) – Customer risk**

Key learning: AQL are always associated to RQL in an OC curve, this is the patient risk

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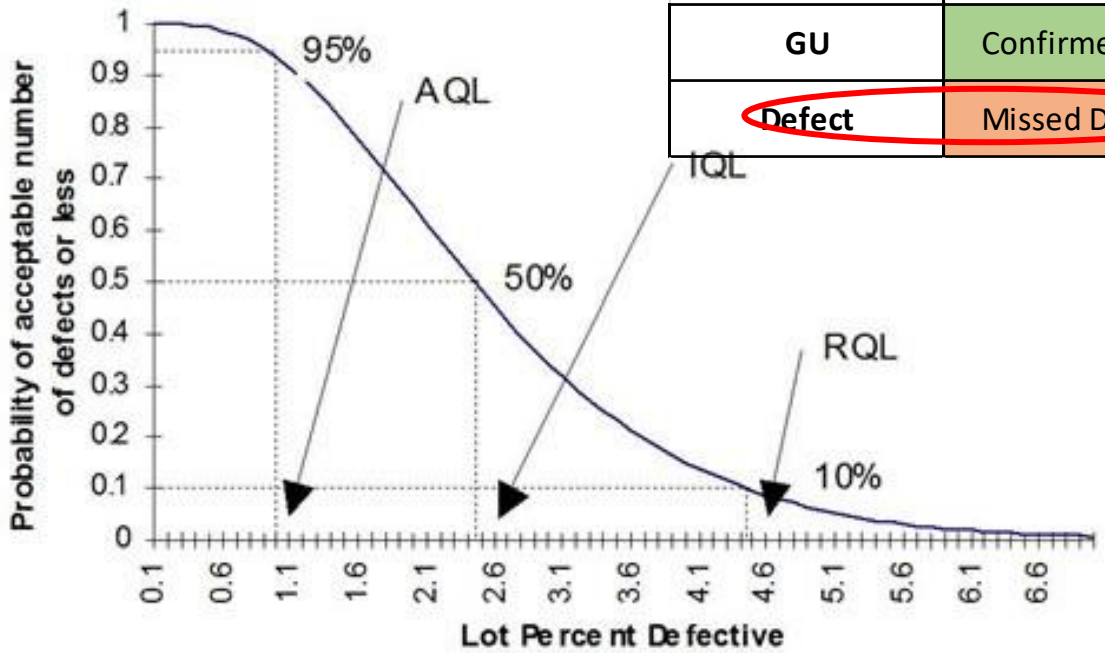
AQL

	Accepted	Rejected
GU	Confirmed GU	False-reject
Defect	Missed Defect	Confirmed defect



From Figure 21.4, *Integrated Enterprise Excellence Volume III - Improvement Project Execution: A Management and Black Belt Guide for Going Beyond Lean Six Sigma and the Balanced Scorecard*, Forrest W. Breyfogle III, Bridgeway Books/Citius Publishing, Austin, TX, 2008.

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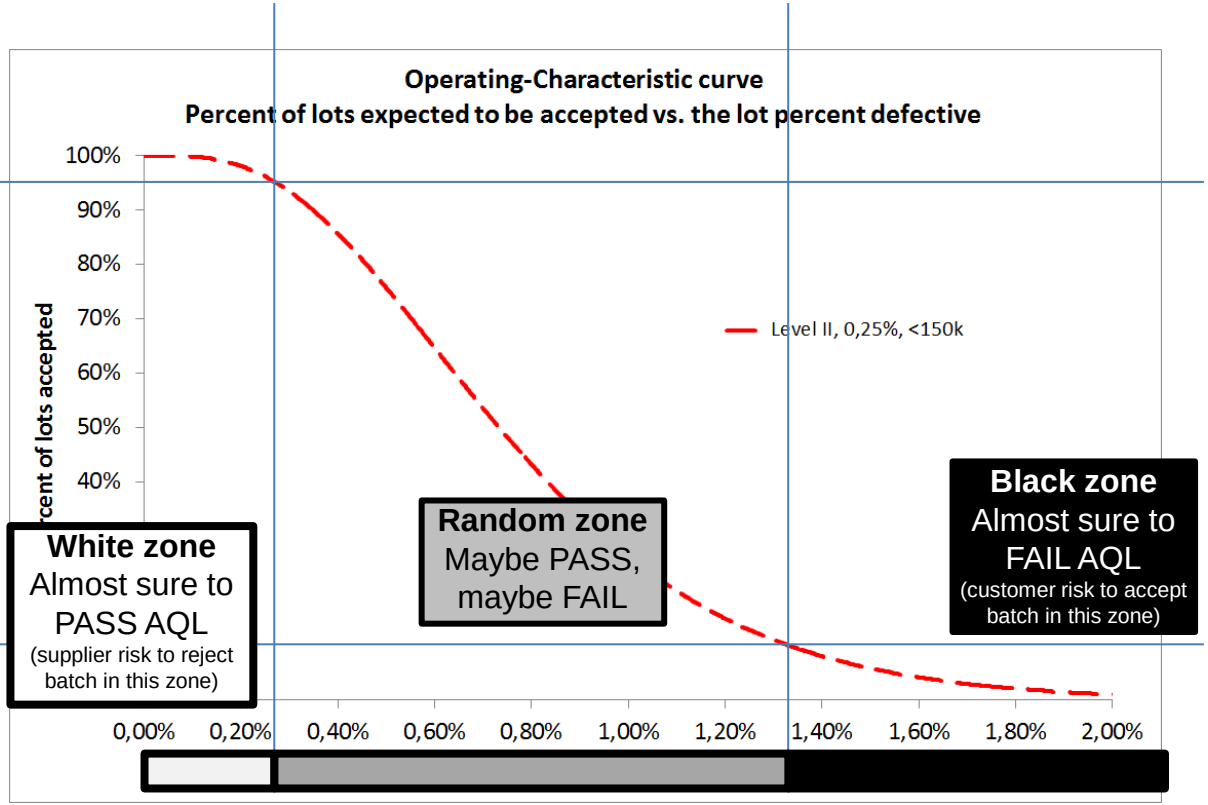
AQL



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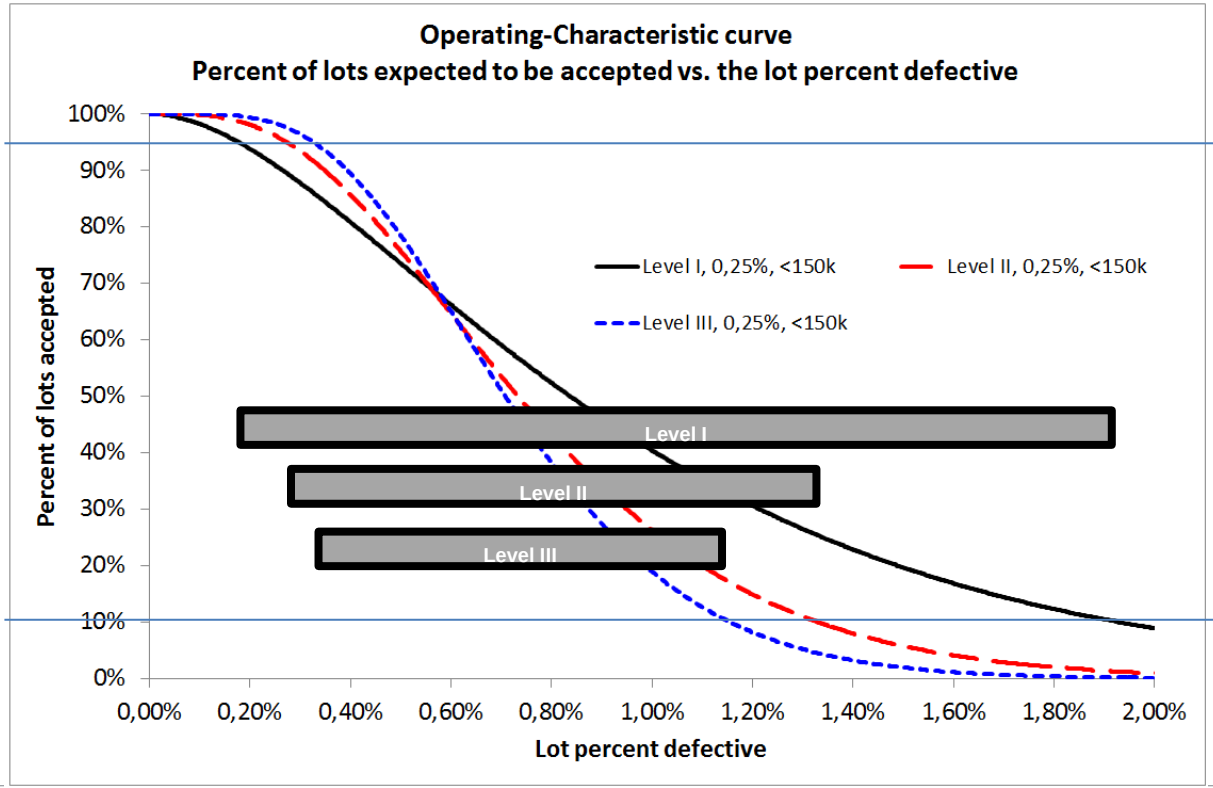
Level ?



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AQL Sampling and ISO tables

Table 2-A — Single sampling plans for normal inspection (Master table)

Sample size code letter	Sample size	Acceptance quality limit, AQL, in percent nonconforming items and nonconformities per 100 items (normal inspection)																														
		0,010		0,015		0,025		0,040		0,065		0,10		0,15		0,25		0,40		0,65		1,0		1,5		2,5		4,0		6,5		10		15		25		40		65		100		150		250		400		650		1 000	
		Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re
A	2	⇩		⇩		⇩		⇩		⇩		⇩		⇩		⇩		⇩		⇩		⇩		⇩		⇩		⇩		0	1	⇩		1	2	2	3	3	4	5	6	7	8	10	11	14	15	21	22	30	31
B	3																									⇩		0	1	⇧		⇩		1	2	2	3	3	4	5	6	7	8	10	11	14	15	21	22	30	31	44	45
C	5																							⇩		0	1	⇧		⇩		1	2	2	3	3	4	5	6	7	8	10	11	14	15	21	22	30	31	44	45	⇧	
D	8																					⇩		0	1	⇧		⇩		1	2	2	3	3	4	5	6	7	8	10	11	14	15	21	22	30	31	44	45		
E	13																					0	1	⇧		⇩		1	2	2	3	3	4	5	6	7	8	10	11	14	15	21	22	30	31	44	45				
F	20																					0	1	⇧		1	2	2	3	3	4	5	6	7	8	10	11	14	15	21	22								
G	32																			0	1	⇧		1	2	2	3	3	4	5	6	7	8	10	11	14	15	21	22										
H	50																																															
J	80																																															
K	125																																															
L	200																																															
M	315																																															
N	500																																															
P	800																																															
Q	1 250																																															
R	2 000																																															

⇩ = Use the first sampling plan below the arrow. If sample size equals, or exceeds, lot size, carry out 100 % inspection.

⇧ = Use the first sampling plan above the arrow.

Ac = Acceptance number

Re = Rejection number

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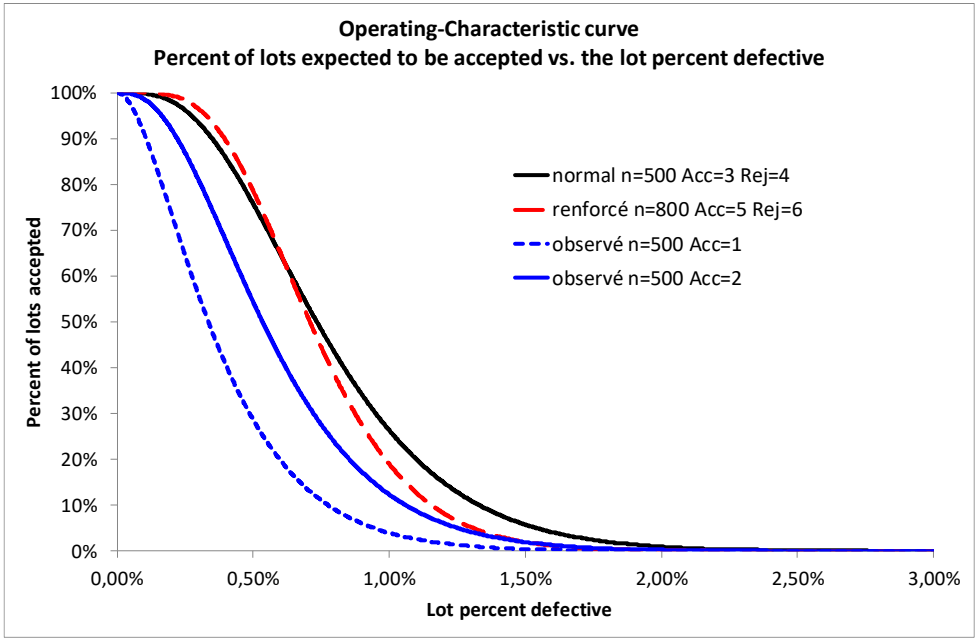
Why do we need to perform Tightened AQL in special cases ?



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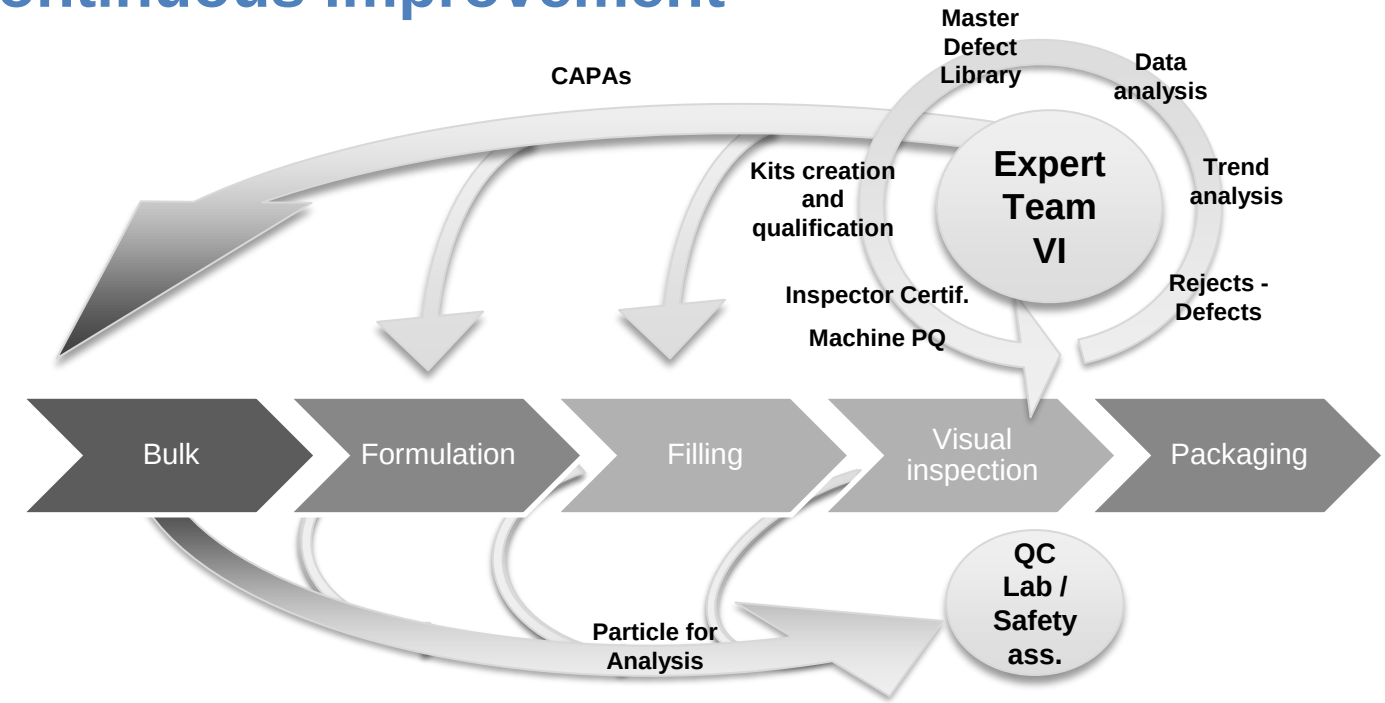
Continuous improvement



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RECAP

You have learnt
Control strategy

- Integration of visual inspection into overall manufacturing process
- Elements of lifecycle
- Particle identification/ characterization
- Defect libraries as dynamic database
- AQL and control charting

Control strategy

- Why do we need continuous improvement
- Why is defect trending key
- Which chart is commonly used
- What's the advantage Control Chart over AQL
- Why do we need to perform Tightened AQL in special cases ?

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