# 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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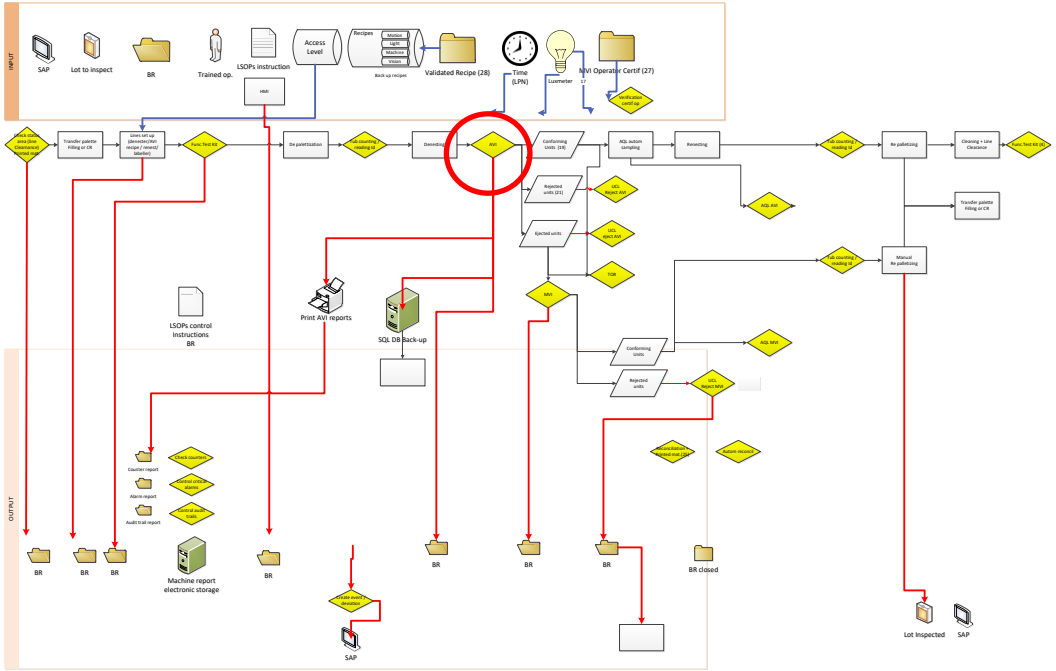
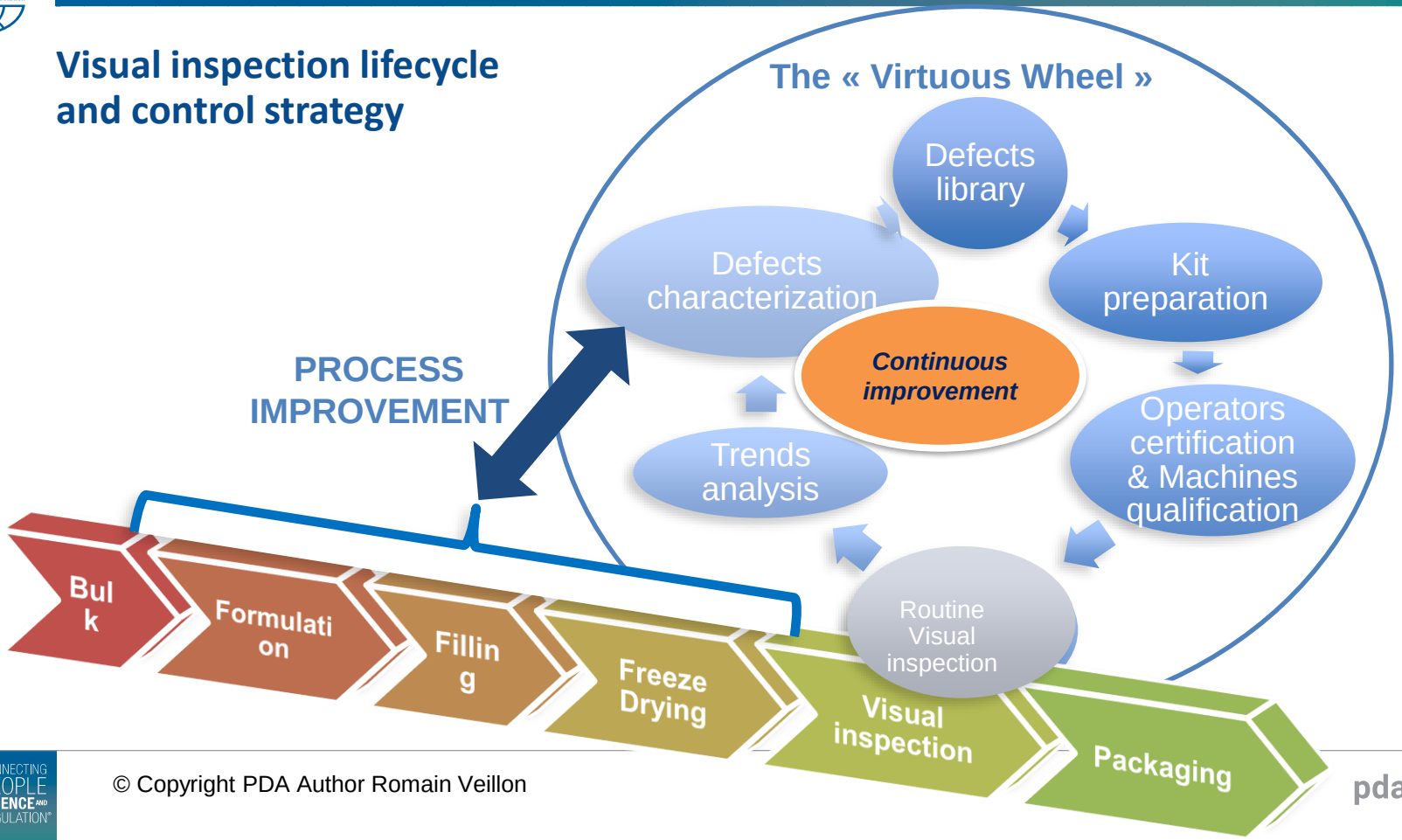
# Mastering Automated Visual Inspection

## …….control strategy is key

# AVI Equipment is part of an overall VI process

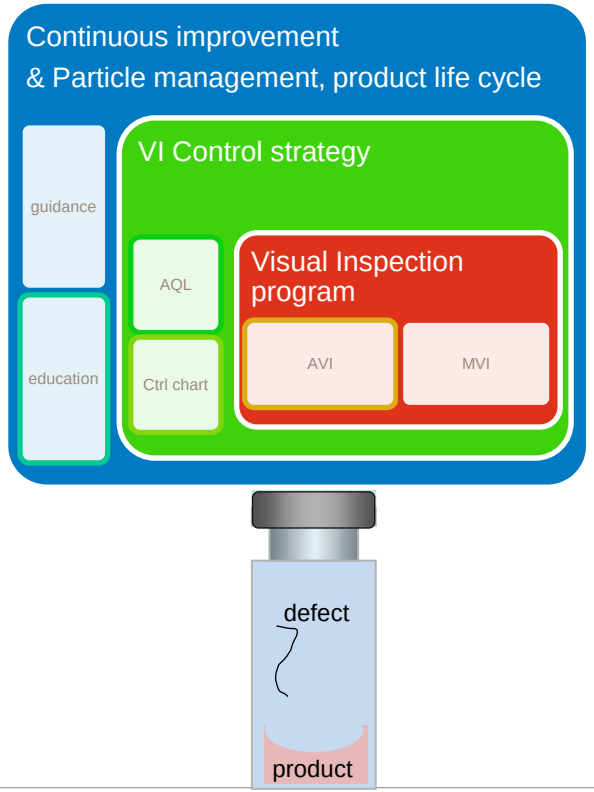


# Visual inspection lifecycle and control strategy

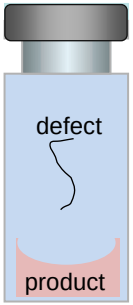


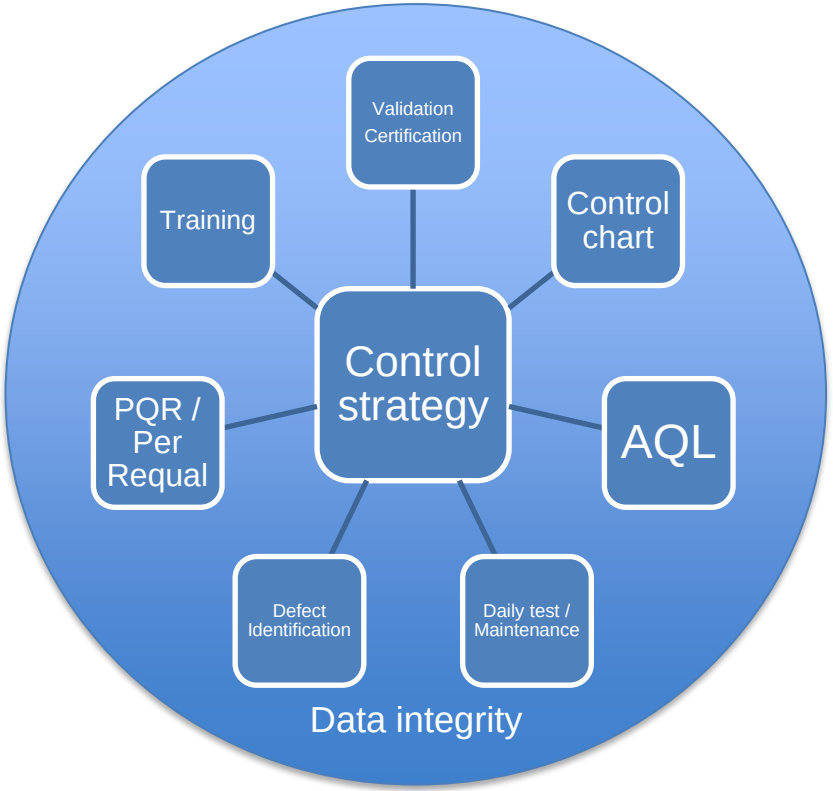
# Visual inspection program in 3 layers:

- -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



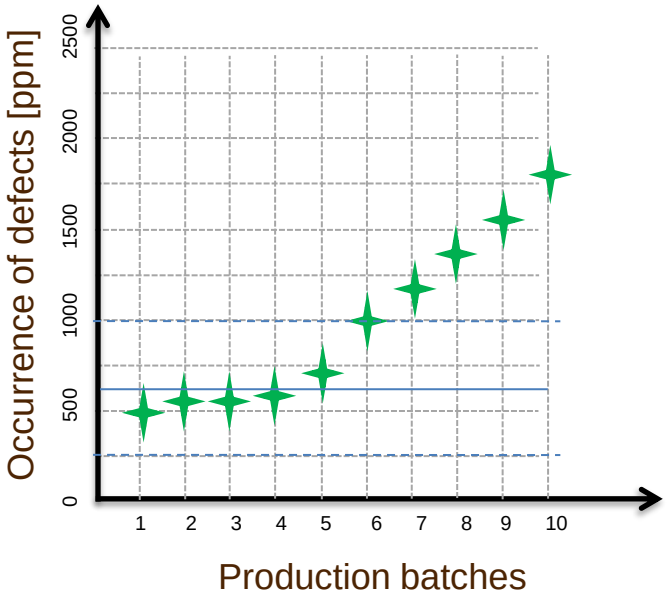
# Control strategy

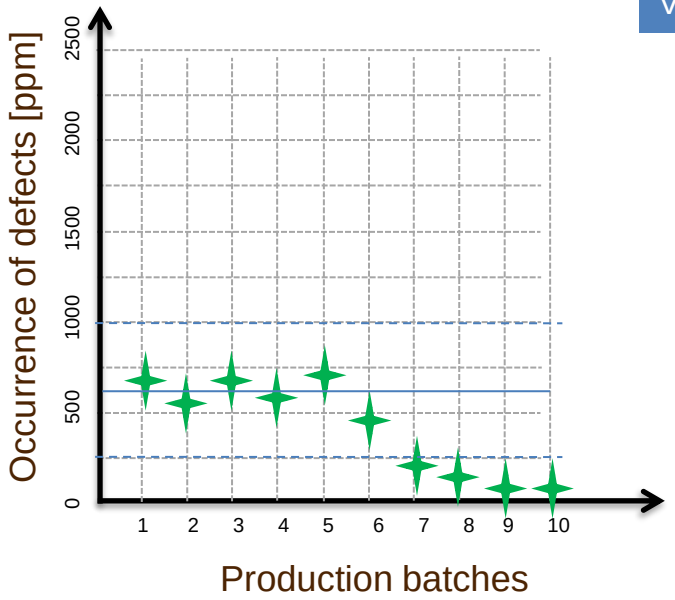


# Why defect trending is key ?

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

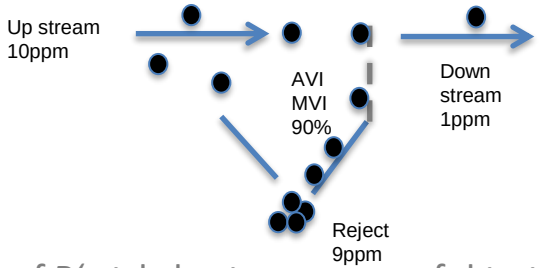


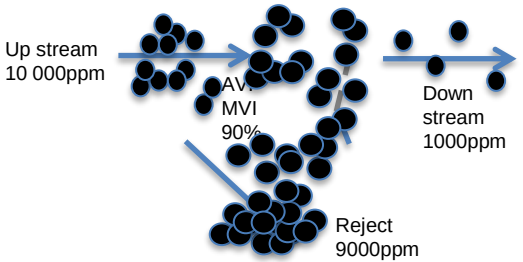



# Why a robust SPC is key for VI ?

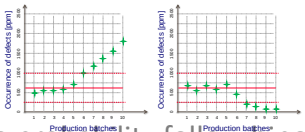
**Key take-away:**
AVI is probabilistic
So it is key to control source contamination upstream even if AVI is validated

– 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

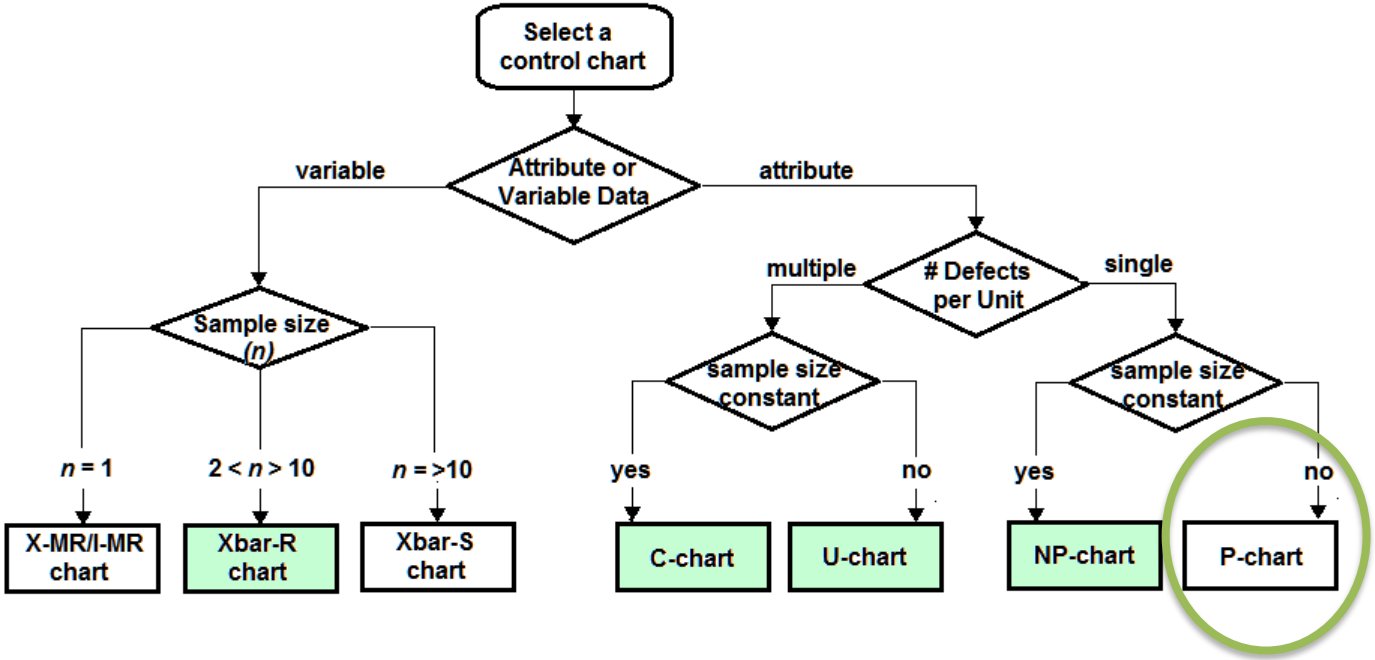


$$UCL = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n_i}}$$

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

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

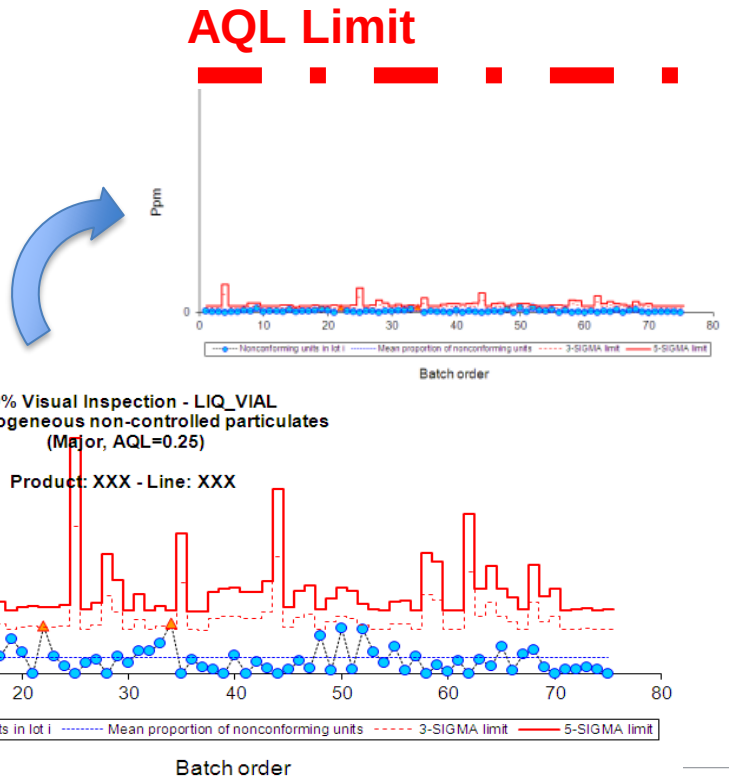
# Type of control charting



# Continuous Performance Monitoring

- Control Strategy- Ctrl chart

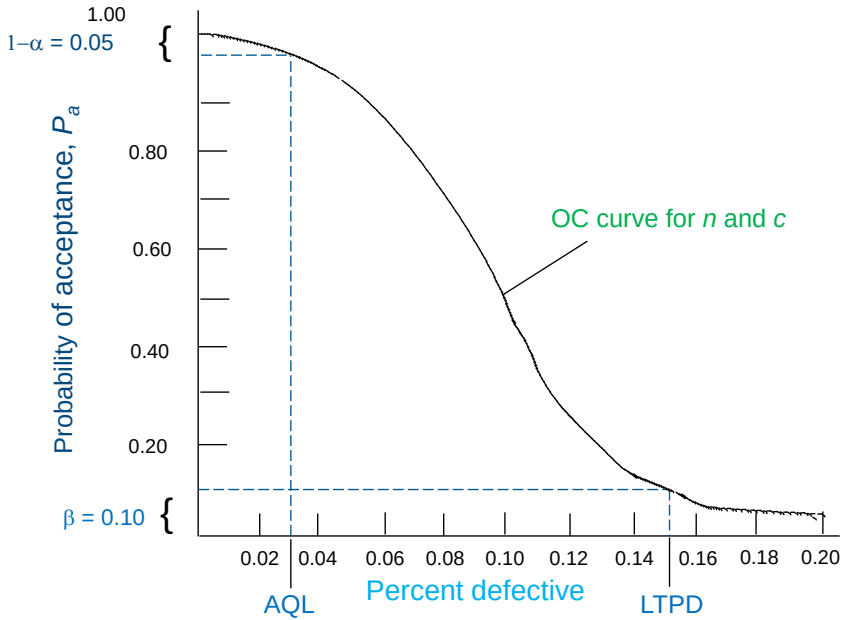
**Take AWAY:** Even with a low probability of detection (non NULL!!)
the UCL limit is the strength of the control strategy, it has the ability to discard atypical lots in term of occurrences.
It has a far lower detection than AQL
Even with probabilistic detection ctrl chart can detect atypical lots




# 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

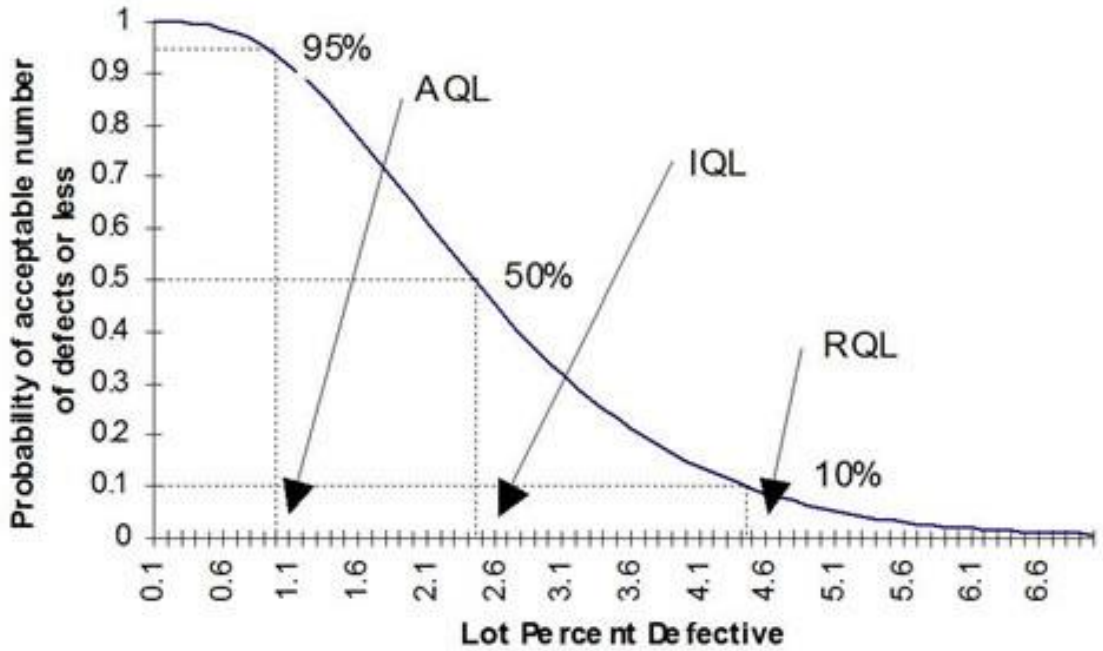
# AQL Sampling and OC curve




- **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)**
- **Consumer's risk, β**
  - **Type II error = P(accept a lot\| probability(defective)=LTPD or RQL)**

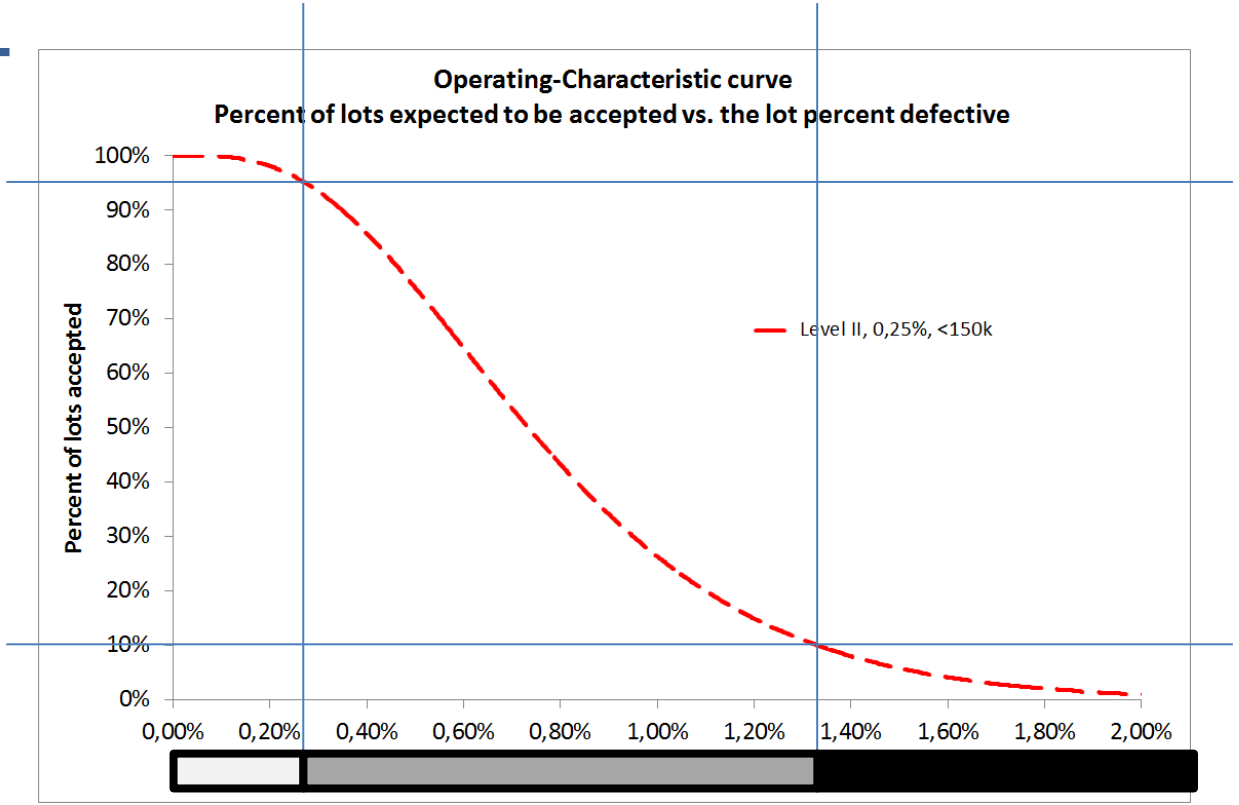
**Key learning: AQL are always associated to RQL in an OC curve, this is the patient risk**

# AQL



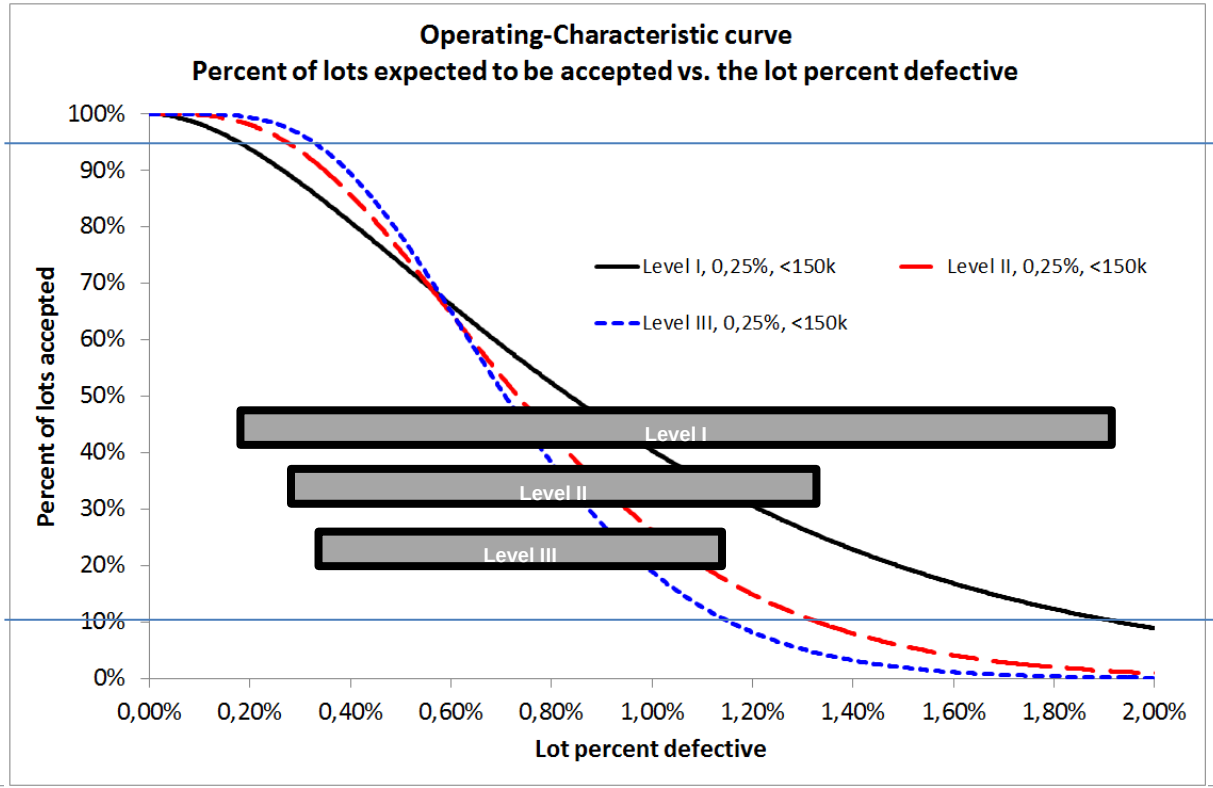

From Figure 21.4, *Integrated Enterprise Excellence Volume III - Improvement Project Execution: A Management and Black Belt Guide for Going Beyond Lean Six Sigma and the Balanced Scorecard*, Forrest W. Breyfogle III, Bridgeway Books/Citius Publishing, Austin, TX, 2008.

# AQL



# Level ?





# 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 | 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 | ⇩ | ⇩ | ⇩ | ⇩ | ⇩ | ⇩ | ⇩ | 0 1 | ⇧ | ⇩ | 1 2 | 2 3 | 3 4 | 5 6 | 7 8 | 10 11 | 14 15 | 21 22 | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ |
| J | 80 | ⇩ | ⇩ | ⇩ | ⇩ | ⇩ | ⇩ | 0 1 | ⇧ | ⇩ | 1 2 | 2 3 | 3 4 | 5 6 | 7 8 | 10 11 | 14 15 | 21 22 | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ |
| K | 125 | ⇩ | ⇩ | ⇩ | ⇩ | ⇩ | 0 1 | ⇧ | ⇩ | 1 2 | 2 3 | 3 4 | 5 6 | 7 8 | 10 11 | 14 15 | 21 22 | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ |
| L | 200 | ⇩ | ⇩ | ⇩ | ⇩ | 0 1 | ⇧ | ⇩ | 1 2 | 2 3 | 3 4 | 5 6 | 7 8 | 10 11 | 14 15 | 21 22 | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ |
| M | 315 | ⇩ | ⇩ | ⇩ | 0 1 | ⇧ | ⇩ | 1 2 | 2 3 | 3 4 | 5 6 | 7 8 | 10 11 | 14 15 | 21 22 | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ |
| N | 500 | ⇩ | ⇩ | 0 1 | ⇧ | ⇩ | 1 2 | 2 3 | 3 4 | 5 6 | 7 8 | 10 11 | 14 15 | 21 22 | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ |
| P | 800 | ⇩ | 0 1 | ⇧ | ⇩ | 1 2 | 2 3 | 3 4 | 5 6 | 7 8 | 10 11 | 14 15 | 21 22 | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ |
| Q | 1 250 | 0 1 | ⇧ | ⇩ | 1 2 | 2 3 | 3 4 | 5 6 | 7 8 | 10 11 | 14 15 | 21 22 | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ |
| R | 2 000 | ⇧ | ⇧ | 1 2 | 2 3 | 3 4 | 5 6 | 7 8 | 10 11 | 14 15 | 21 22 | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ | ⇧ |

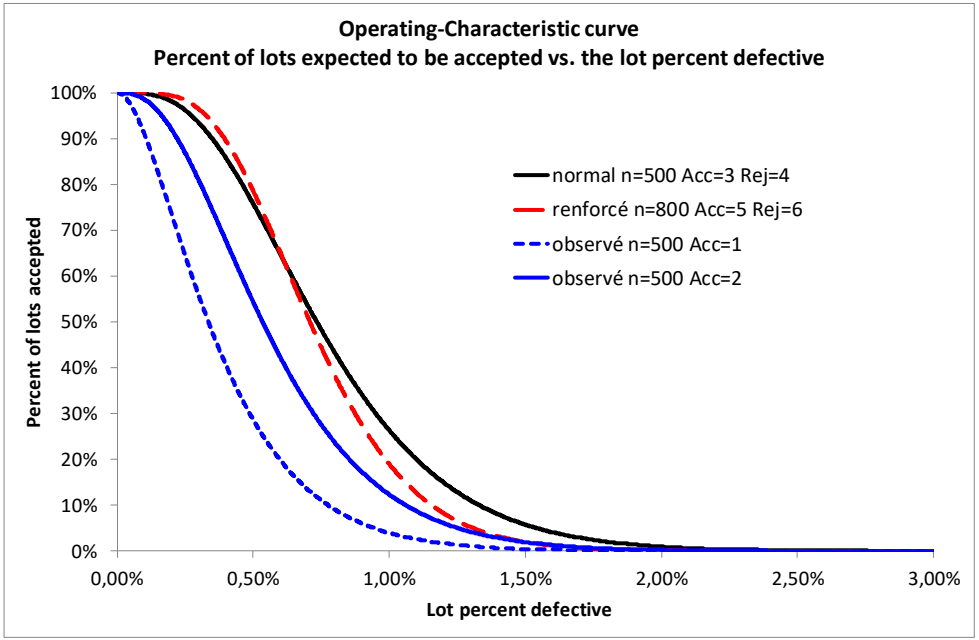
⇩ = Use the first sampling plan below the arrow. If sample size equals, or exceeds, lot size, carry out 100 % inspection.

⇧ = Use the first sampling plan above the arrow.

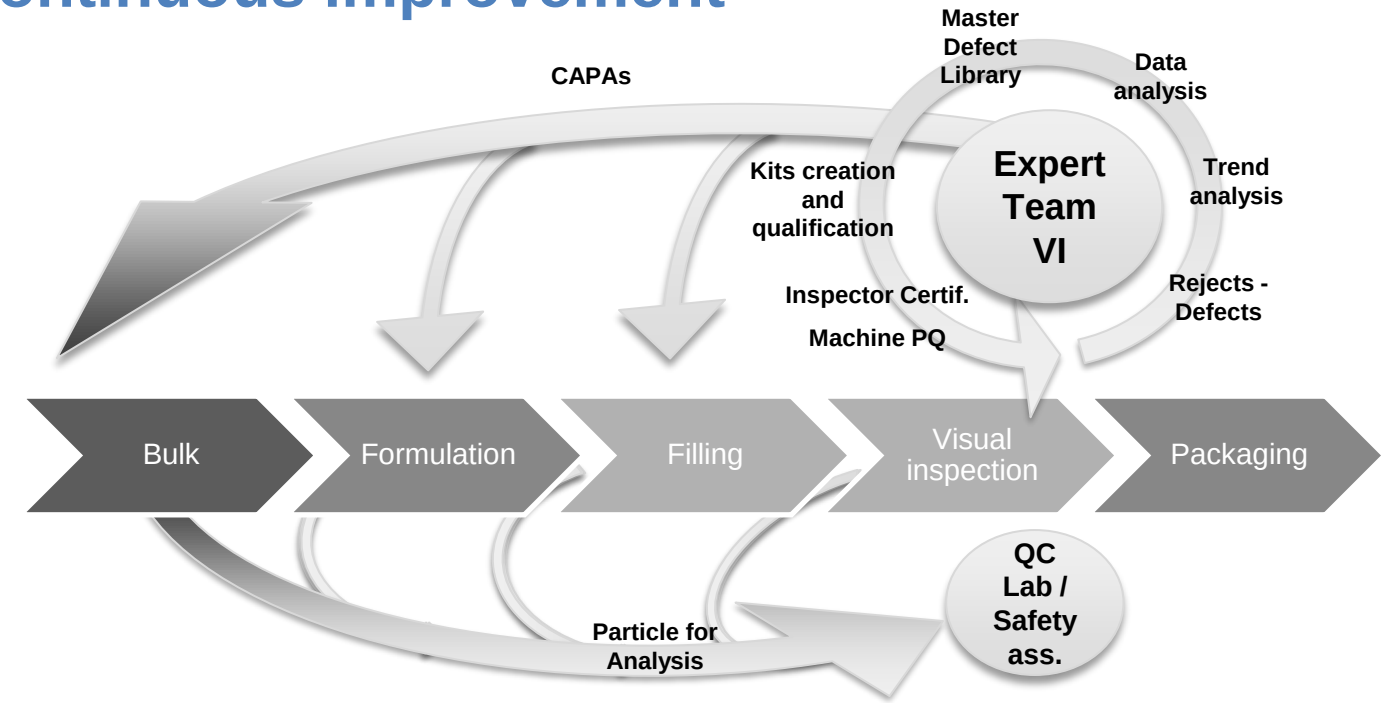
Ac = Acceptance number

Re = Rejection number

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



# Continuous improvement



In this section you have learnt:

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