FEFCO
Technical Seminar
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Bella Center

"ZERO DEFECT"

A buzz word or reality?

Fefco Technical Seminar 2013

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"There is nothing that is a more certain sign of insanity than to do the same thing over and over and expect the results to be different"
Albert Einstein



Zero Defect

- ***Introduction Zero Defect***



- Zero Defect & Culture
- Zero Defect & Knowledge

- Zero Defect & Quality
- Zero Defect & Innovation

- Conclusion

Customer/Supplier & Zero Defect

- The customer presented his requirements

➔ Can the box plant supply accordingly?

- The machine suppliers showed what they have available

➔ Does this help to solve the current issues between customer and box plant?



Introduction Zero Defect



- How many of you have made mistakes since waking-up this morning?
  - If **Zero** ➔ did you do anything?
- We all make mistakes every day!
- At best we can extend the time between consecutive mistakes
- The best way to achieve a longer time between consecutive mistakes is to record every mistake we make and learn how to avoid them



Zero Defect Definition

Infinite **Time** until the next **Defect** to occur

Zero Defect has no meaning without Targets!



The impact of a defective product?

Use risk engineering:

- What will be the impact of a failing product?
  - Fatal accident or injury
  - Loss of production or product
  - Reputation damage
- How much do we invest to detect/avoid failing products?
- Analyse the product failing interval. This in time and number of products produced
- Do we provide training?



The biggest risk is: “Ignorance”



Zero defect interpretations

1. Focus only on zero defect products send to the customer ➔ Customer ☺
2. Focus on all raw materials converted to zero defect products at maximum production speed ➔ All ☺

Interpretation 1 results in waste!



The way to Zero Defect:

Process variability at target level

< (smaller)

Customer agreed tolerances



This for all property tolerances agreed with the customer



Zero Defect
Custom or Standard product

- Process capabilities set the standard for what can be promised in terms of Zero Defect targets
- The process needs upgrading if it is not meeting customer requirements ➔ Investment in higher level process! (Training, machines, retrofits et

Never lower process performance due to low customer demands!

Zero Defect

- Introduction Zero Defect
- ***Zero Defect & Culture***
- Zero Defect & Knowledge
- Zero Defect & Quality
- Zero Defect & Innovation
- Conclusion

Infinite Time until the next Defect to occur



Zero Defect & Culture



- Follow the airline principle:
  - A pilot is never blamed if a major problem occurs so he will provide all information freely needed to investigate the case
  - The exception is in case of proven negligence, fraud and or deception
- Management need to allow the making of mistakes ➔ else you can't detect and avoid them

No Blame Culture!

Zero Defect

- Introduction Zero Defect
- Zero Defect & Culture
- ***Zero Defect & Knowledge***
- Zero Defect & Quality
- Zero Defect & Innovation
- Conclusion

Infinite Time until the next Defect to occur

No Blame!





“Believing” or “Knowing” Why…?

- ..is a **box plant supplier** allowed to agree tolerances with a **box plant customer** not understanding the box plant process variability?
- ..is a box plant customer asking for Zero Defect products without a list of parameters and targets for these parameters?
- ..are box plants understanding so little and believing so much?



What is knowledge?



Knowledge is valuable!
- **Document it**
- **Use it for training**

Relation between Knowledge and Defects



Knowledge about what you are doing

⇕

Believing that you know what you are doing

Long time between two defects

⇕

Short time between two defects

Zero Defect

- Introduction Zero Defect — Infinite Time until the next Defect to occur
- Zero Defect & Culture — No Blame!
- Zero Defect & Knowledge — Quantitative tests, Observations, Training
- ***Zero Defect & Quality***
- Zero Defect & Innovation





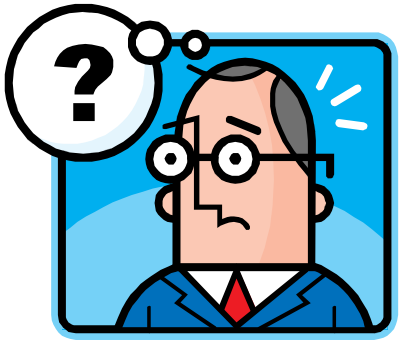






What is current practise?

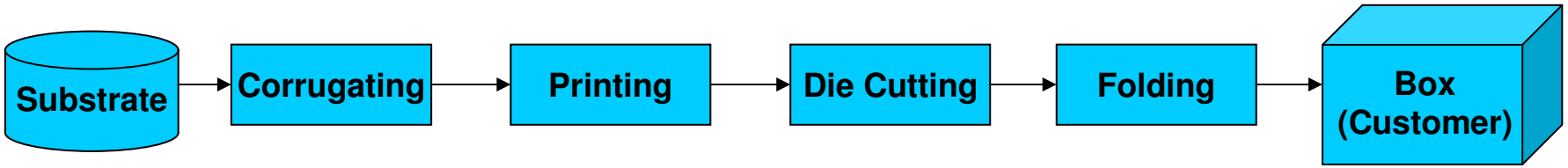
- All box plants have a lab facility with measuring equipment
- For what is the lab facility used?
  1. To check the board grade of a competitor box?
  2. When there is a customer complaint?
  3. To systematically monitor product performance?



Let's look at the box plant process



Box Plant "Process"
All elements need to "Pass" for Zero defect



- Colour
- Grade
- Moisture
- Strength
- Delaminating
- Etc.

- Board grade
- Calliper
- ECT
- FCT
- No Wash Boarding
- No Warp
- Bond
- Etc.

- Colour to colour register
- Dot size
- Colour target
- Colour variation
- Bar-code readable
- Defects
- Edge Sharpness
- Etc.

- Print to die cut register
- Box Dimension
- Scoring depth
- Cutting
- Cracking
- Etc.

- Fishtailing
- Gap
- Glue
- Box Dimension
- Etc.

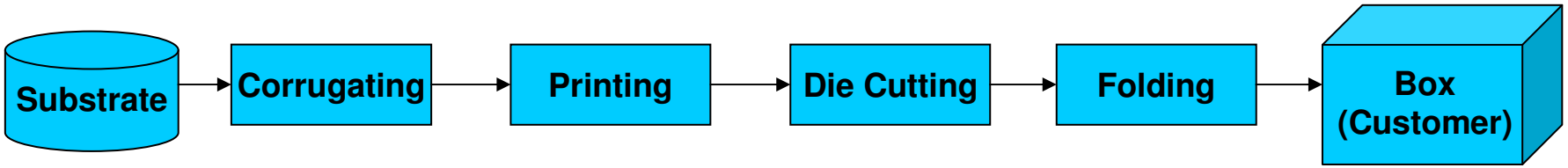
- BCT
- Erection
- # Boxes
- On time delivery
- Etc.

All elements need a quantitative and measurable specification





Box Plant "Process"
All elements need to "Pass" for Zero defect



Substrate	Corrugating	Printing	Die Cutting	Folding	Box (Customer)
•Colour •Grade •Moisture •Strength •Delaminating •Etc.	•Board grade •Calliper •ECT •FCT •No Wash Boarding •No Warp •Bond •Etc.	•Colour to colour register •Dot size •Colour target •Colour variation •Bar-code readable •Defects •Edge Sharpness •Etc.	•Print to die cut register •Box Dimension •Scoring depth •Cutting •Cracking •Etc.	•Fishtailing •Gap •Glue •Box Dimension •Etc.	•BCT •Erection •# Boxes •On time delivery •Etc.

If one element fails then the total box fails!





Zero Defect & Quality
Important about "Acceptable" Quality!

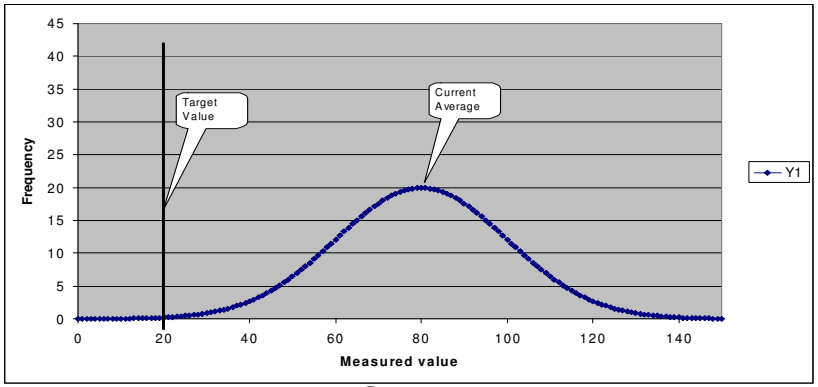
- Quality is a True/False property. Better than 100% is not possible ➔ high quality is a buzz word!
- Measure properties at regular interval
- For destructive measurements use a product that is produced weekly
  - Do not take one measurement of all products
  - Take regular many measurements of a few regularly produced products ➔ it will provide the process quality assurance evidence needed for zero defect production



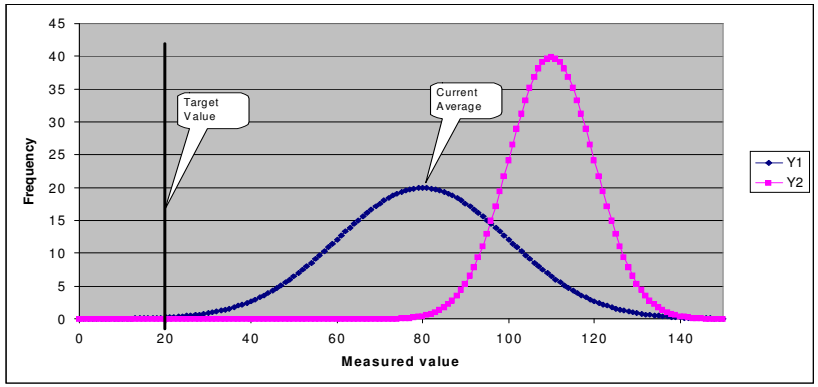
A closer look at variability and the impact reducing it



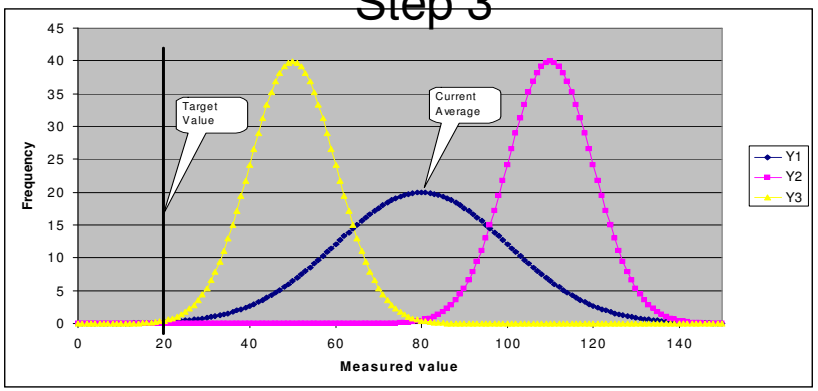
Step 1



Step 2



Step 3



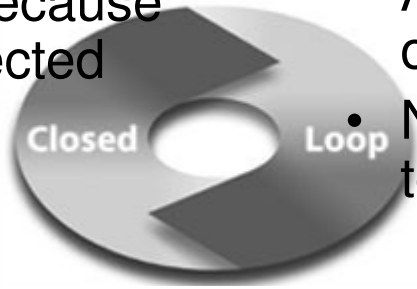
1. Determine process variability by systematic measuring e.g. WARP
2. Reduce process variability by implementing working standards and procedures (magenta curve). Resulting in:
   - Increased product level
   - Variation reduction
3. Lower specification while the product performance still meets customer demands (Yellow curve)



Extending time between Defects

What is current practise?

- Measure properties
- Decide if properties are within customer tolerance
- Eject if not!
- Next product produced might need again ejection because process was not corrected
- Waste is produced ☹



What would be better to do?

- Agree tolerances
- Set “control” limits (lower than agreed tolerance)
- Measure properties, preferably in line
- Adjust process setting when outside “control” limits
- Next product is always within tolerance ➔ No waste ☺

- **It is a must to understand the relation between process variables and product quality**
- **A feed-forward closed loop is not common available yet!**



Zero Defect
Do and Don’ts, 2 examples

1. Colour case ➔ The wrong solution for a problem?
2. Folding case ➔ Does measuring and ejecting solve the problem?



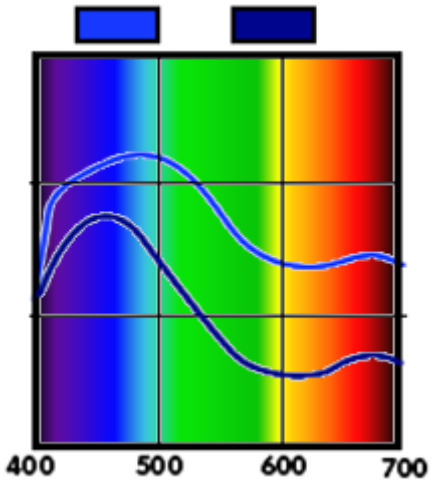


1 Colour Case
What has the largest impact on colour?

- On an off line printer a spectrophotometer and colour matching software was used to correct the ink formulation before starting production due to colour deviations

➔ This only corrects the consequence of a process defect but not the reason

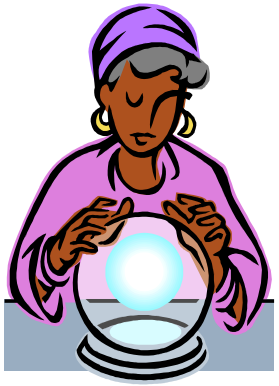
- Downtime evaluation on this off line printer revealed:
  - 33% colour related downtime of the total production time
- The implemented working procedure for correcting colour on the press is the source for high downtime
- Tests showed that the main problem for the start-up colour deviation was the screen roll specification and unpredictable status



The target:
Print all sheets "Zero Defect" starting with the first



Colour case solution



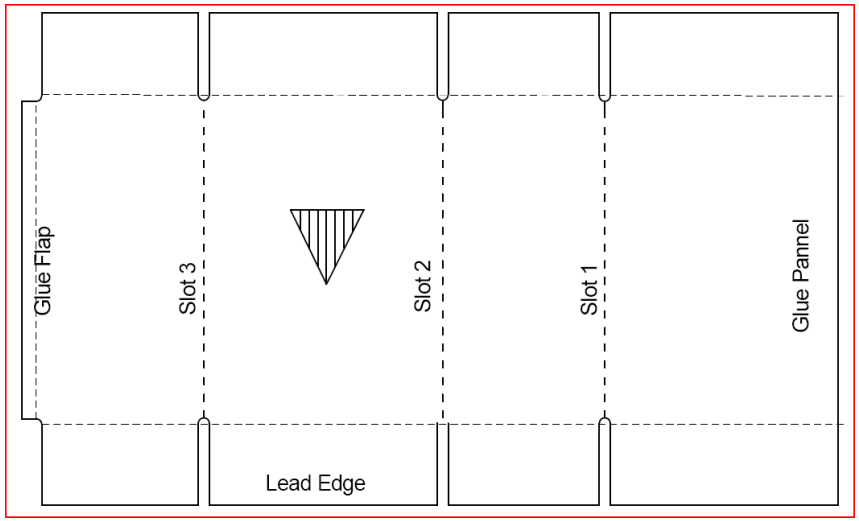
- Screen roll related ink transfer problems result in:
  - Unpredictable colour!
  - Unpredictable dot gain!
- Change the screen roll specification to an ink film thickness and line count allowing:
  - Releasing the ink
  - Being cleanable
- Implement strict screen roll cleaning procedures
- Check everyday the screen roll on cleanliness

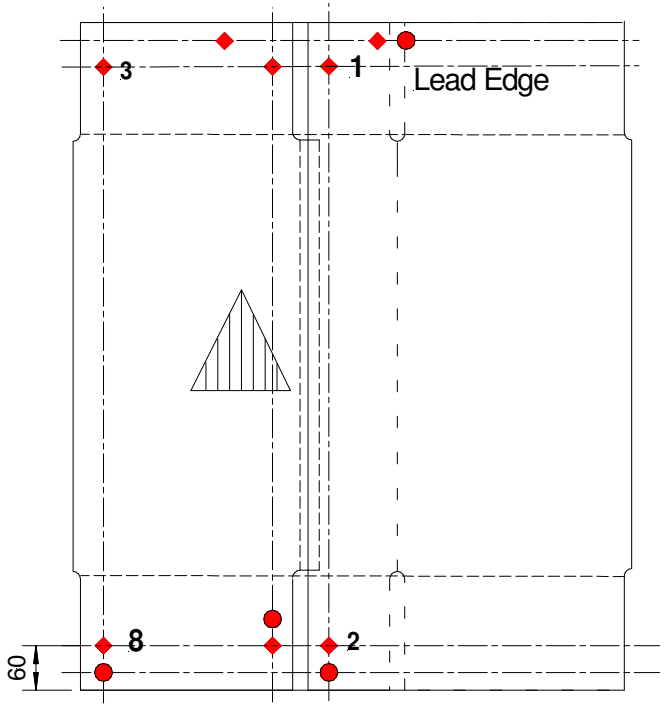
Colour related downtime reduced to 0%!
Colour was printed with Zero defect



2 Folding Case

- What is the problem?
- Inline data collection
- In depth Analysis
- Gap fishtailing simulation

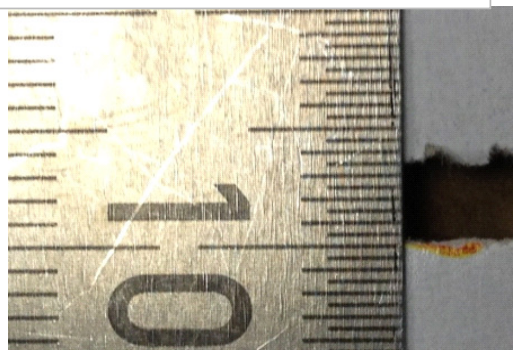




What is the problem?

Gap at the glue flap not under control + Skew + Alignment edge



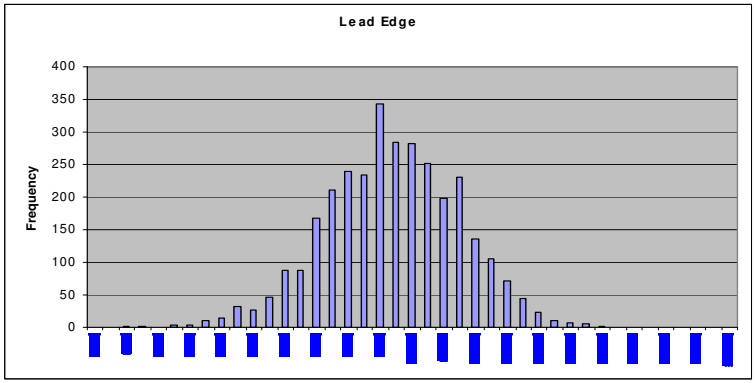


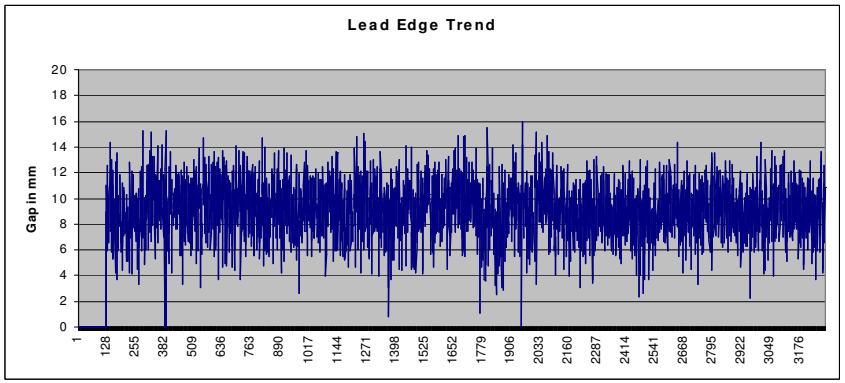


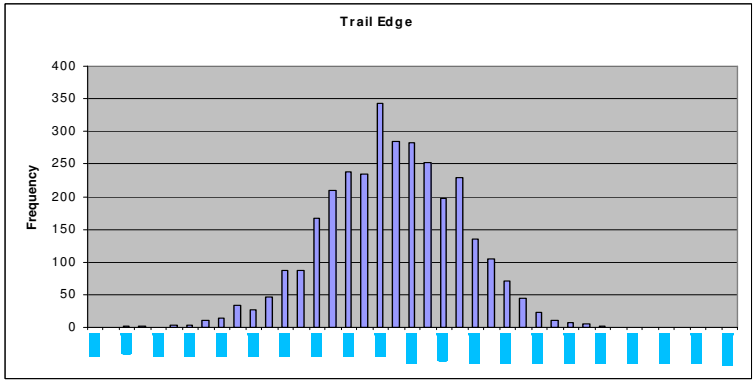


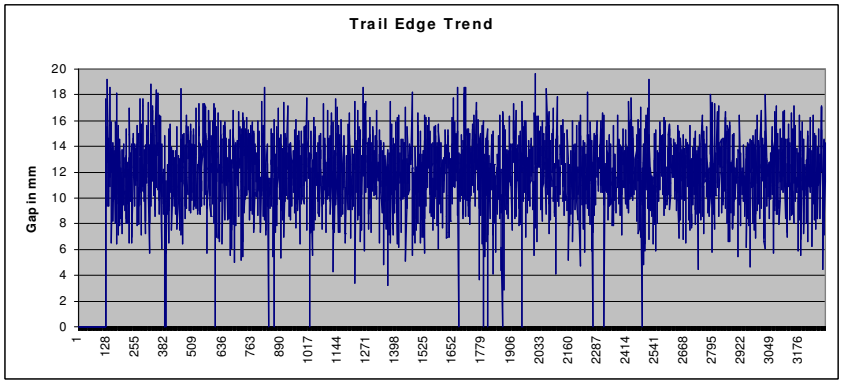


Folding data of 3,200 boxes Lead/Trail edge Gap



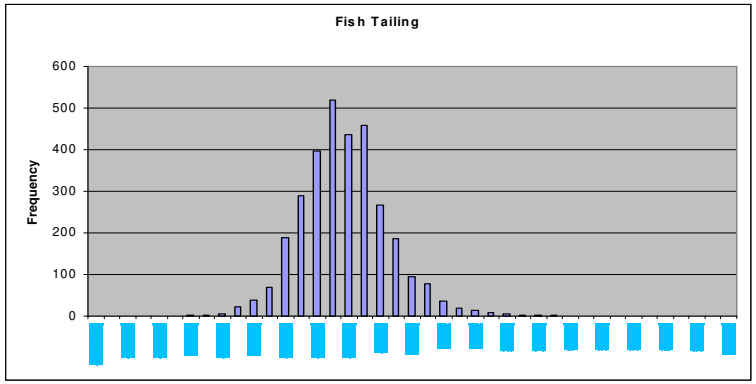


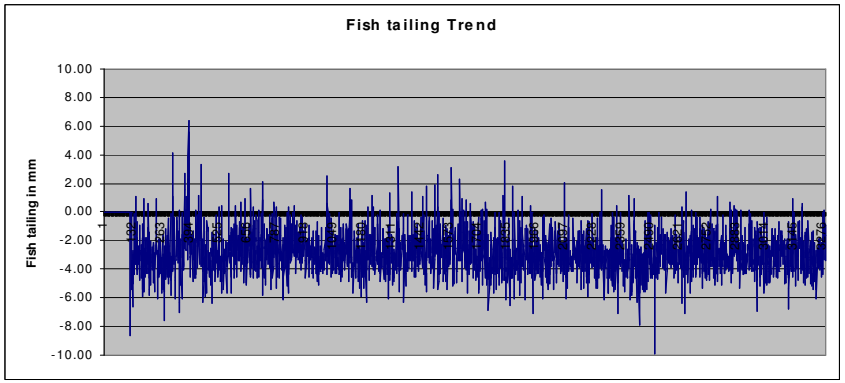






Fishtailing

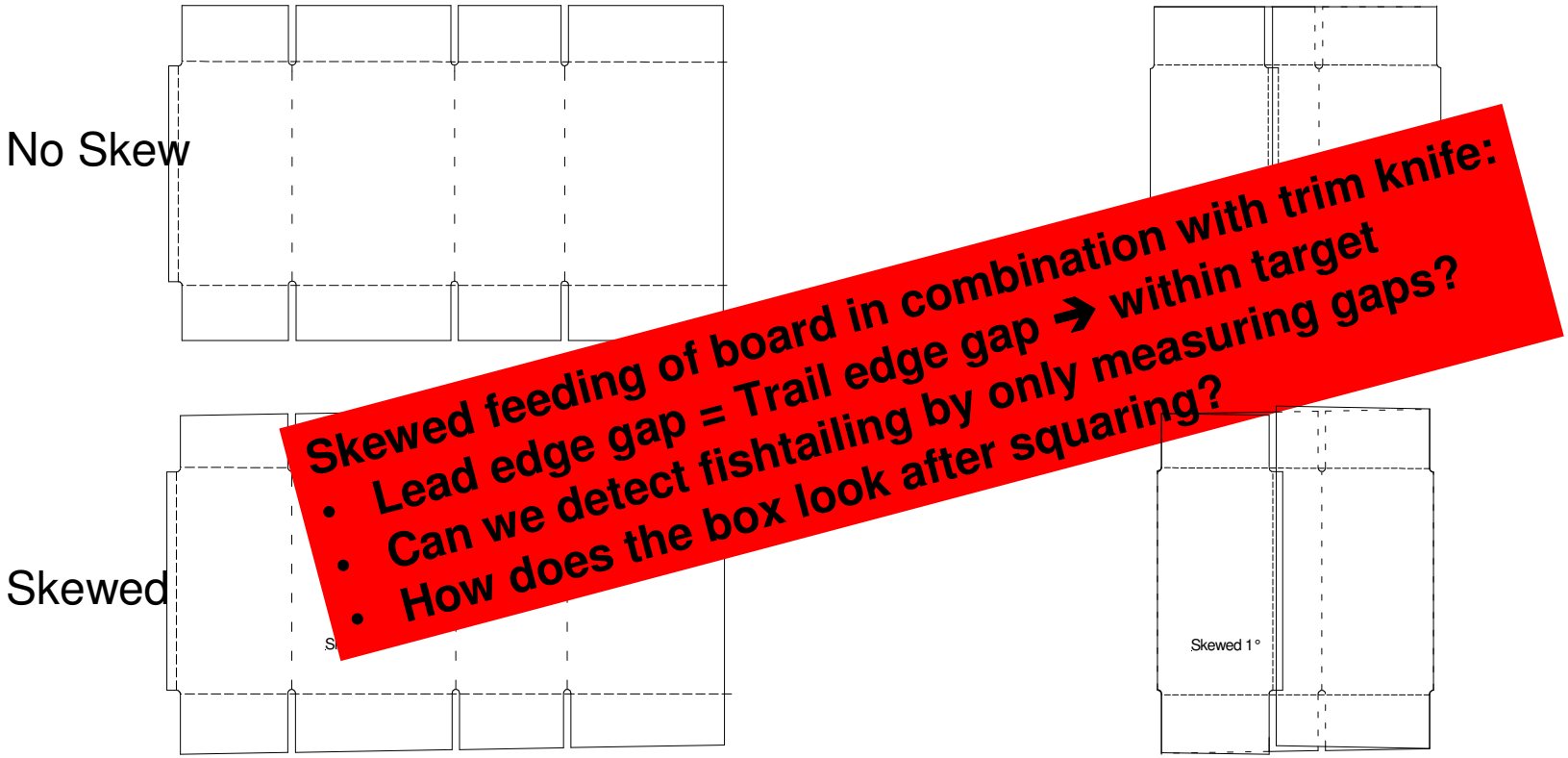




- Is this approach OK or is it “Lottery” data?
- What happens to the faulty product?
- What can be done to reduce variability?
- What is really happening?



Feeding skewed board using trim knife



Skewed feeding of board in combination with trim knife:

- **Lead edge gap = Trail edge gap ➔ within target**
- **Can we detect fishtailing by only measuring gaps?**
- **How does the box look after squaring?**



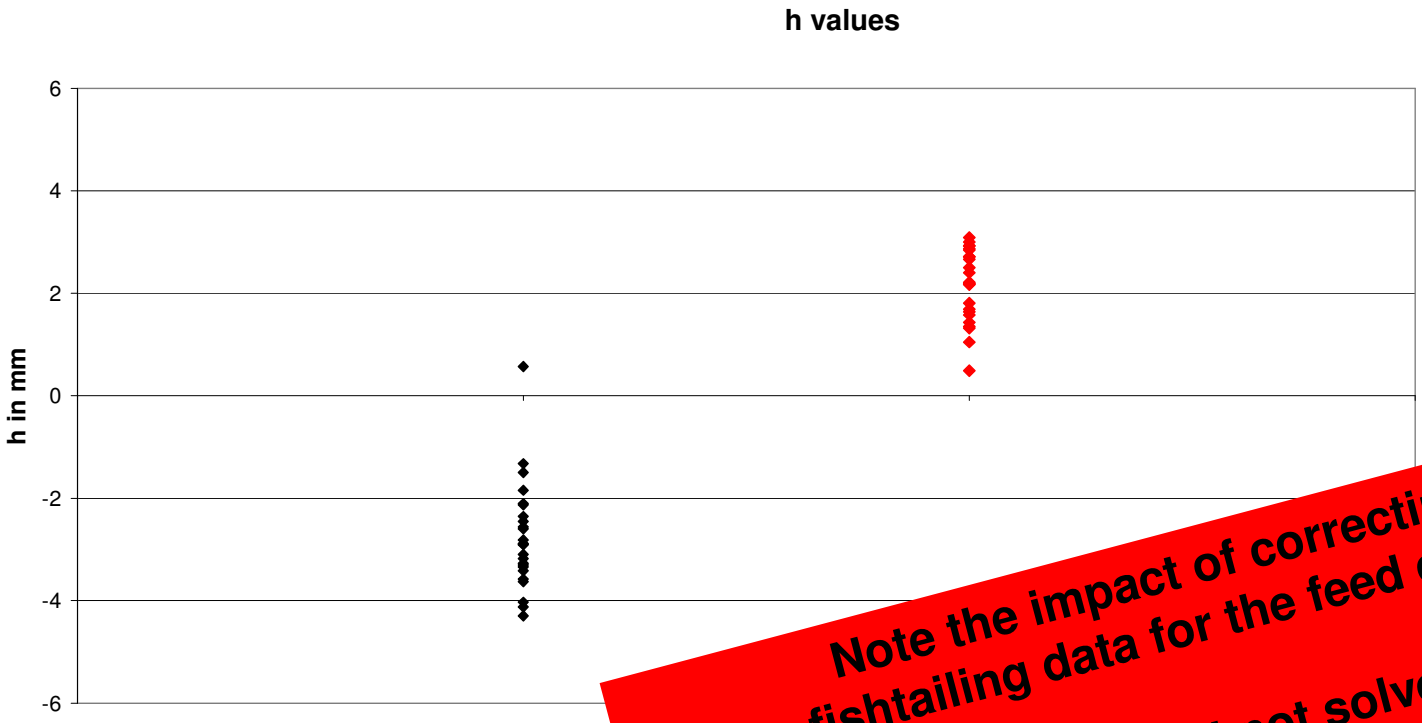
In depth folding analysis

(No trim knife used!)



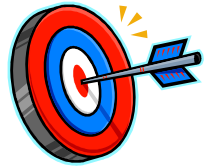


Correcting the fishtailing for the feeding error



Note the impact of correcting fishtailing data for the feed error!

Ejecting faulty boxes will not solve the problem!



Folding Case

- Data collected inline will show if there is a problem but not the problem source
- Detailed testing of production equipment is needed to find the problem source
- Ejecting bundles will avoid problems at the customer ➔ Is that the best option for Zero Defect product?
- Do we know what folding tolerances are acceptable?

What about a folding error simulation?

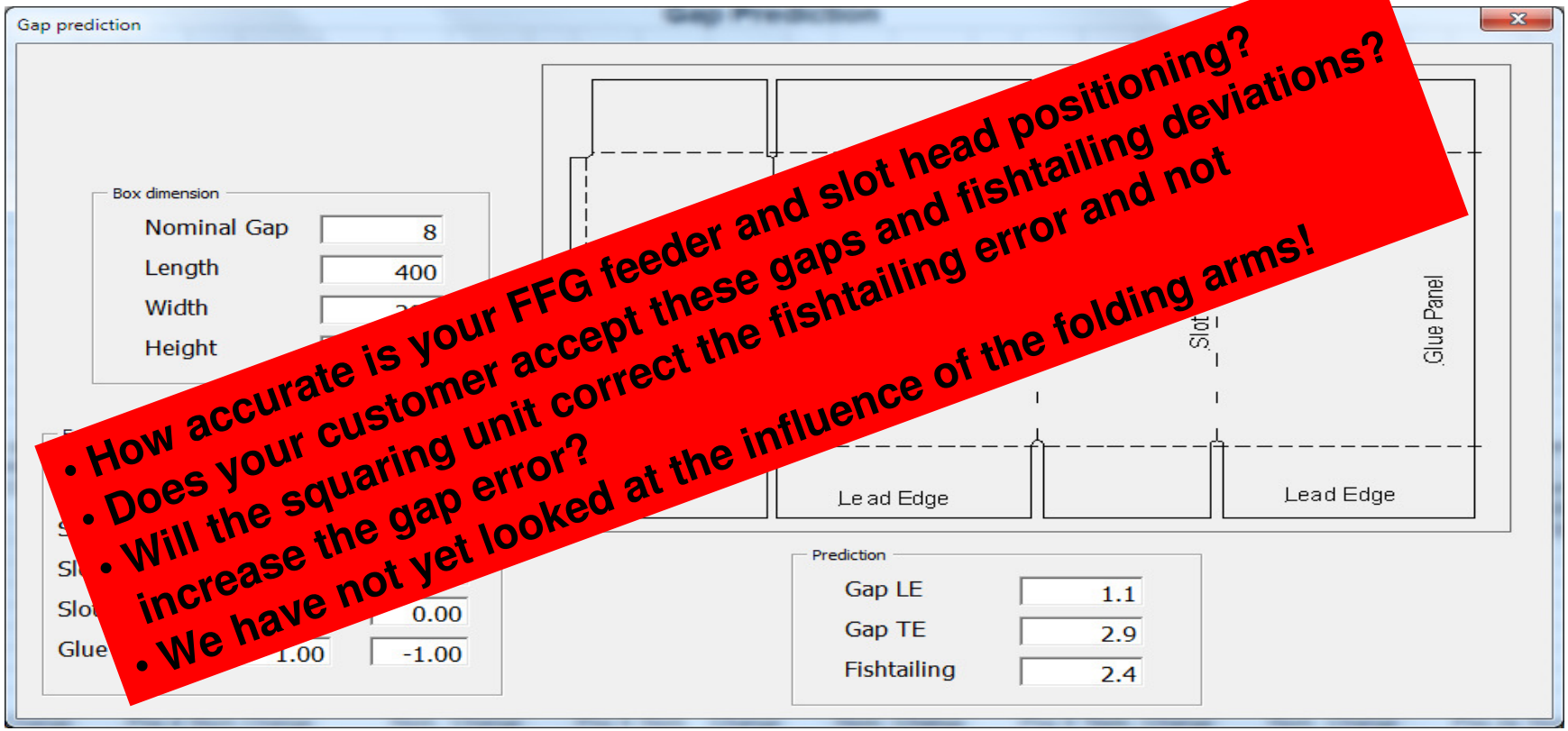


What folding tolerances are machine suppliers promising and what is delivered?

- Check during machine commissioning if the supplier delivers what is promised?
- The next slide will show a mathematical simulation on how gap and fishtailing are affected by:
  - Feed variation
  - Skew (Due to a feed skew)
  - Slot position
  - Glue lash position
  - Glue panel position

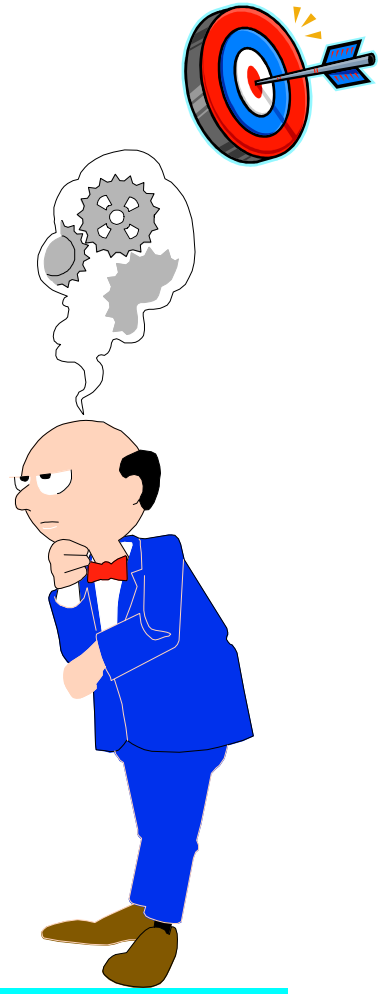


Folding Error Simulation



Specification

- Quantitative ➔
  - Based on facts and figures
  - Represent the objectives to achieve
  - Realistic tolerance based on the capabilities of:
    - Process
    - Equipment
    - Raw materials
- Measurable ➔ Measuring equipment that has sufficient resolution to detect if the property is inside or outside the set tolerance



Measuring is done systematically and not only when there is a complaint!



Always agree “SMART” targets

- S ➔ Specific
- M ➔ Measurable
- A ➔ Achievable
- R ➔ Realistic
- T ➔ Timed



• It is easy to make this slide!
• Brain power is needed to define “SMART” targets!

Zero Defect

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- Zero Defect & Culture — No Blame!
- Zero Defect & Knowledge — Quantitative tests, Observations, Training
- Zero Defect & Quality — SMART Target
- ***Zero Defect & Innovation***







- Conclusion

Zero defect & Innovation



The paradox



- Innovation is based on the evolution of correcting mistakes
- Would avoiding defects stop Innovation?
- According Murphy's law it is likely that (unknown) defects will continue to occur
  At best we can extend the time between the events!

And… New technology might be needed to improve

Zero defect & Innovation
What can be used now and in 2025

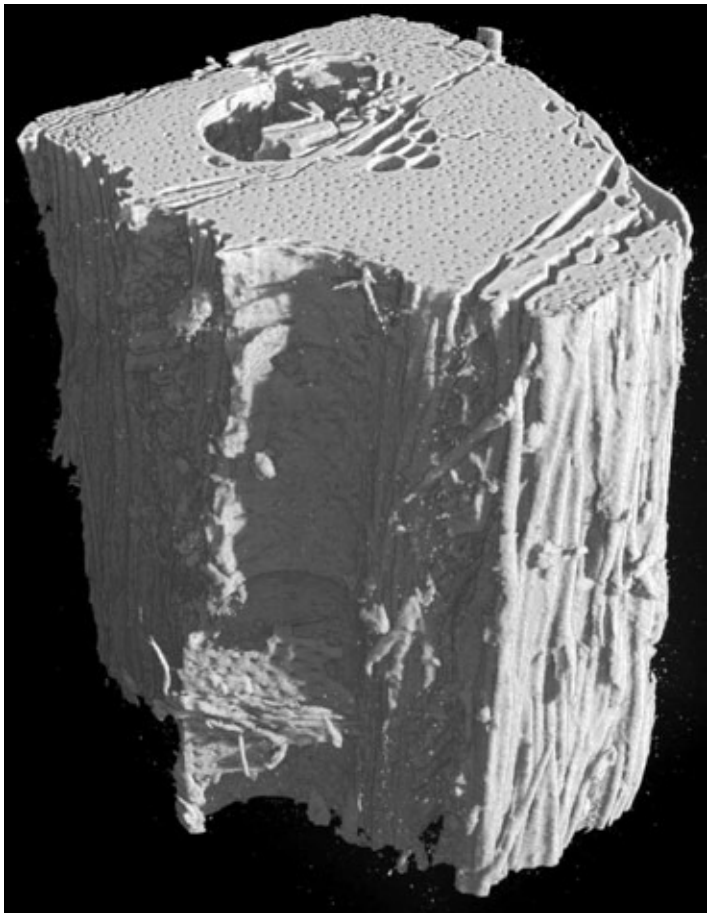


- How to produce Zero Defect if testing damages the product?
- Is it possible to investigate paper and board non destructive?
- We know CT scanning for medical use
- Inside Matters, a University Gent spinoff company, make CT scans of any material and/or object

INSIDE MATTERS
INSIGHTS TO INNOVATE

CT scanning of paper and board will provide new ways for detecting defects!

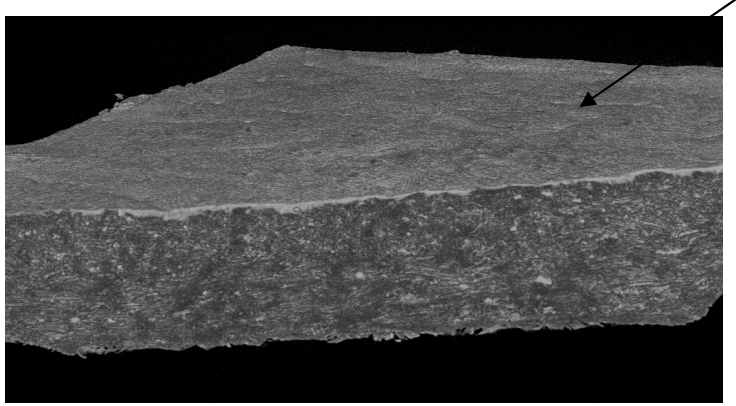
CT scan of wood



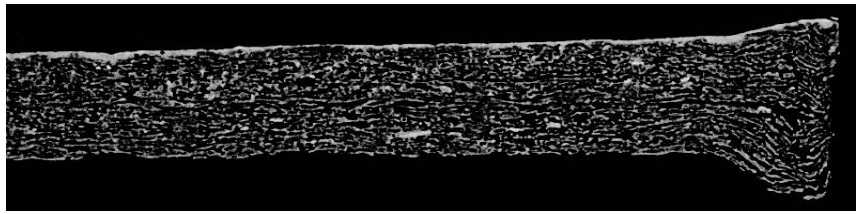
CT scans paper

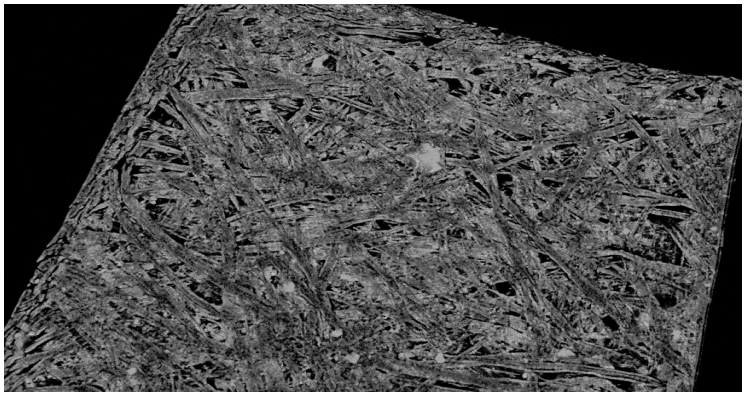
3D image

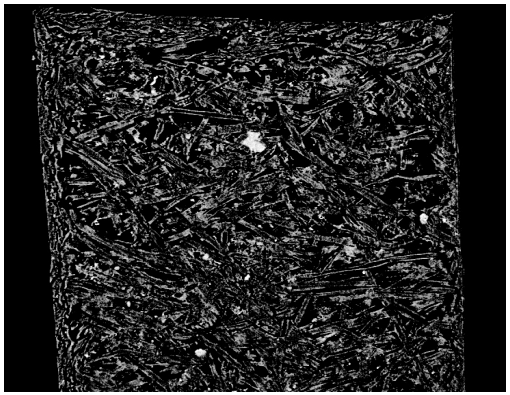
Ink



2D cross section

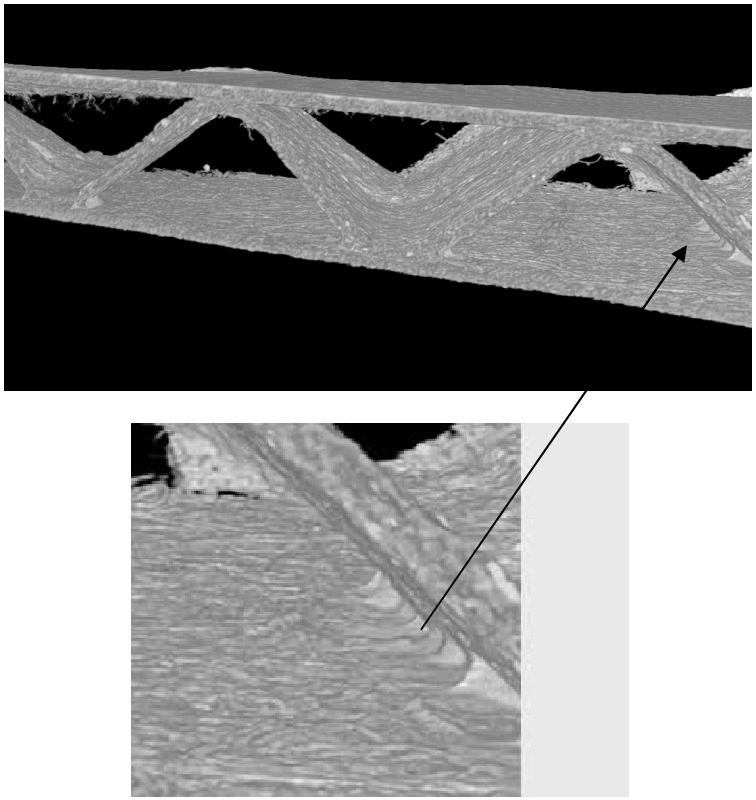




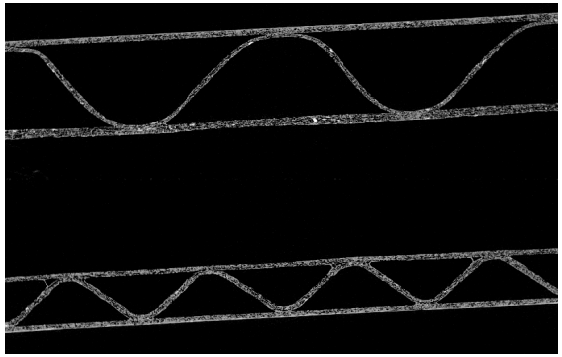


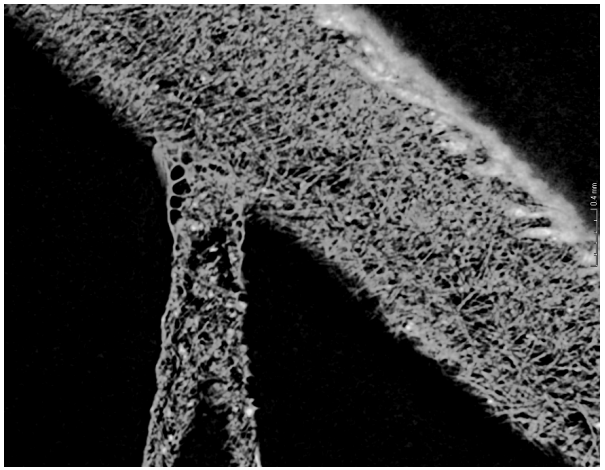
CT scans corrugated board

3D image



2D cross section





Zero Defect

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- Zero Defect & Culture — No Blame!
- Zero Defect & Knowledge — Quantitative tests, Observations, Training
- Zero Defect & Quality — SMART Target
- Zero Defect & Innovation — New technology will support improvement
- ***Conclusion***



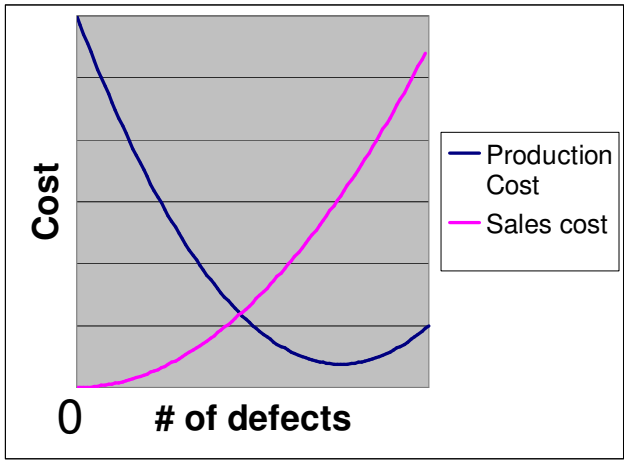







Conclusion

- Zero Defect might be a “ghost” objective at best the time between two detectable defects can be extended
- Minimizing defects will reduce cost for all up to a certain level after that the customer and supplier have to understand the economics
- It requires:
  - Open fact based mind set
  - Specifications that confirm quality targets
  - No blame mentality
  - Responsibility for what you claim
  - Accepting the need for changes
  - New technology
  - Training and education





There are no shortcuts to Zero Defect only detours

Zero Defect

- Introduction Zero Defect — Infinite Time until the next Defect to occur



- Zero Defect & Culture — No Blame!



- Zero Defect & Knowledge — Quantitative tests, Observations, Training



- Zero Defect & Quality — SMART Target



- Zero Defect & Innovation — New technology will support improvement



- Conclusion — There are no shortcuts to Zero Defect only detours



Thank you for your attention

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Technology Coaching BvbA
www.tcbvba.be