Container Glass Forming in 2020/2025

The dark factory

Glassman Bangkok, January 2018

xpar vision
heading for perfection

20 years track record of innovating the glass forming process

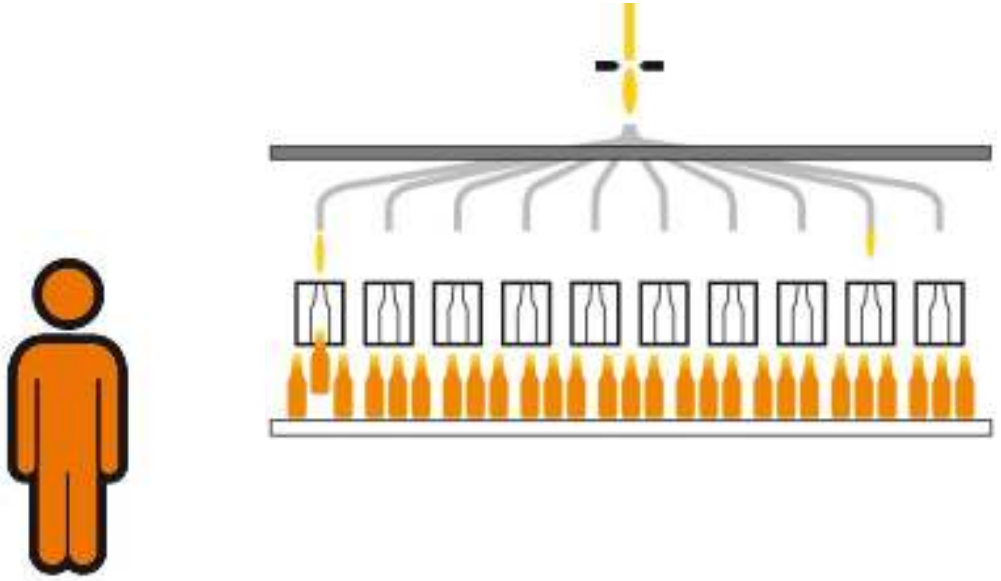
- 1999 Foundation XPAR Vision
- Focus on container glass industry
- Focus on hot end production process
  - Inspection, process monitoring → one product
  - Sensors, automation, robots → process improvement & quality control → portfolio of products

The dark factory

- A dark factory is a fully automated shop floor
- Smart Manufacturing / Industry 4.0

In general we (our industry) are very conservative

Glass forming today: Industry 2.0



No real time factual information on forming process and bottle quality in hot end

More focus on HE pack than on HE quality: level of forming process control is very low

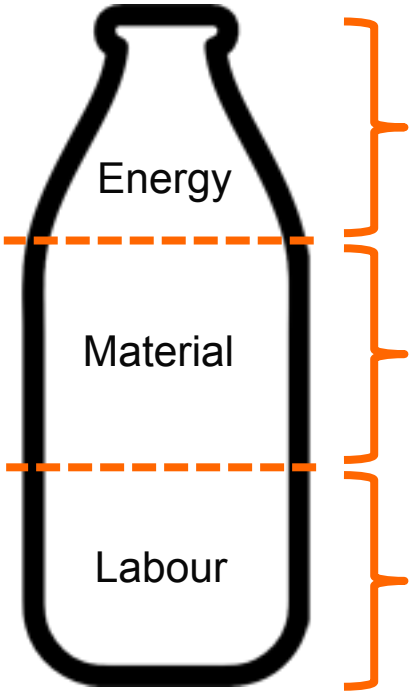
The dark factory is not the aim, it is the result

Main drivers: efficiency/quality & weight/speed

Sustainability

- Environmental (waste/energy/carbon)
- Social (labour conditions)

Cost



Characteristics

- **Efficiency low: 85-90%**
- Quality to customer < 100%
- Many unknown variables
- **No/slow (quality) feedback loop**
- **Forming highly human dependent**
- **Labour is aging, experience disappears**
- **Health/safety is a concern**
- Flexibility is low
- **Containers are too heavy (40%)**
- Speed of production too low

Alternatives

- Plastic, Aluminium, PET
- Cheap, flexible, light

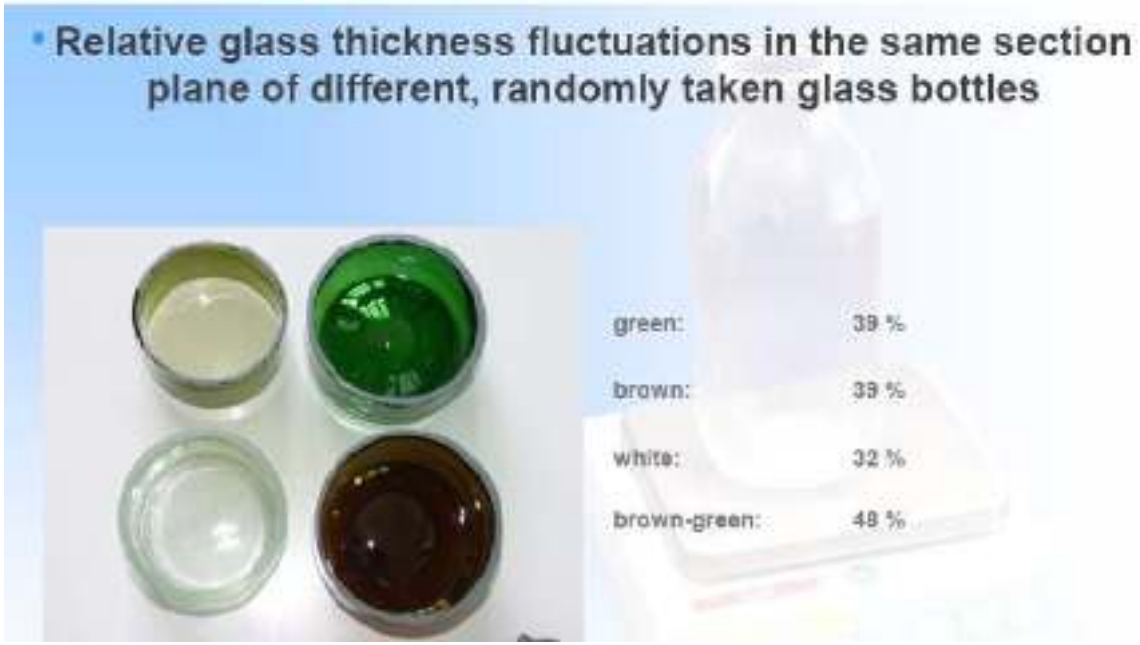
Main drivers: cost, quality, labour

Containers are (designed to be) too heavy

Example:

Beer bottle, customer spec. = min. thickness shoulder/body/heel 1 mm.

Beer bottle, design spec. = 1.8-1.9 mm thickness



Source: Prof. Dr.-Ing. H. Hessenkemper, Glas- und Emailtechnik (TU Bergakademie Freiberg)

The level of (forming) process control is (very) low: efficiency/quality & weight/speed

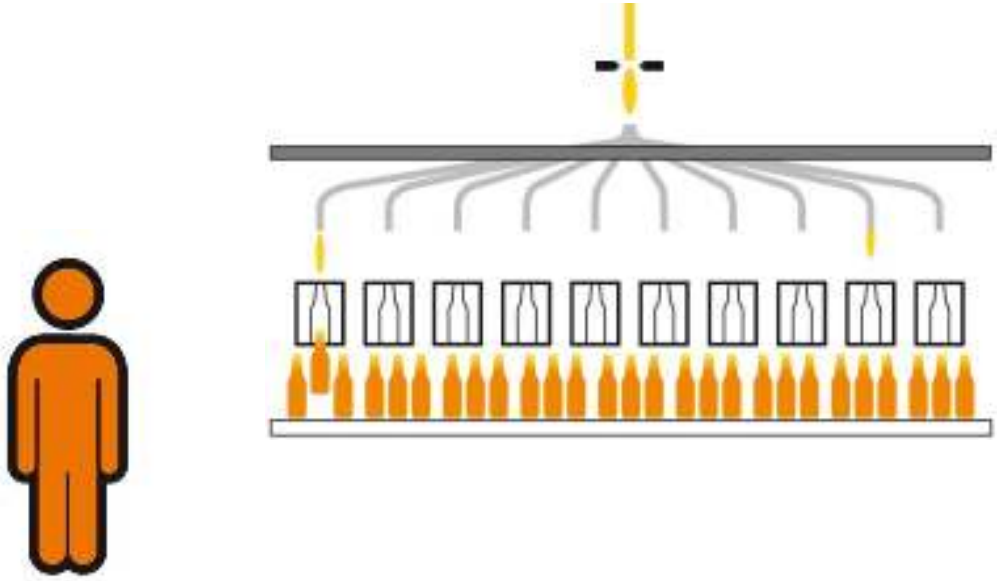
→ Process stability is the key towards optimization

Many process disturbances causing process variations

- Cullet
- Batch/homogenity
- Viscosity/temperature /homogenity
- Feeder pull
- Ambient temperature
- **Deterioration/wear**
- Material change
- Operator change
- Stop/start
- Swabbing
- Gob condition (weight/shape/temperature) variation
- Loading variation
- Temperature variation
- Bottle variation/defects

Which operator can control 24 – 36 - 48 cavities?

Process stability requires automation



- Complexity, tools, time, # cavities (experiences disappears!)

Huge savings potential!

Lighter and stronger containers.....

produced with (almost) zero defects…..

at higher speed….

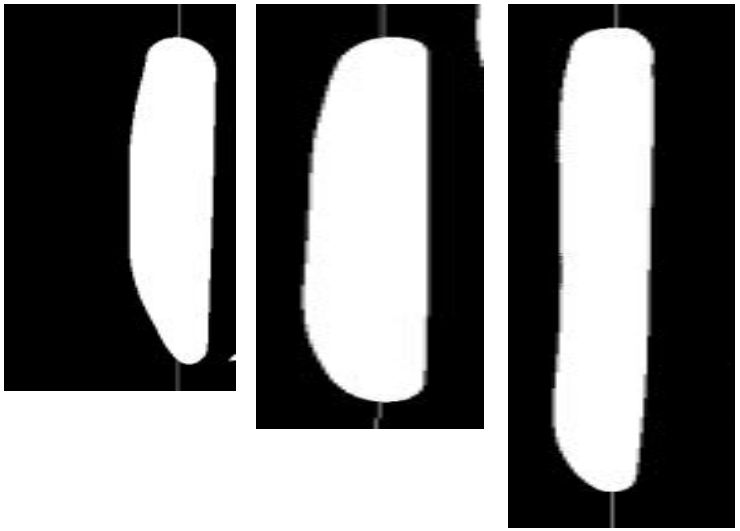
with minimal human dependency.

Deflector

- Normally a coating is used in the deflector
- This coating wears out after a while and more and more friction will appear in this area
- When the gob meets more friction it will start to deform:
  - Shorter lenght
  - Increased diameter
  - Shape deviation (from cylindrical)
  - Decreased speed
- More defects (or blocked sections) are the result

Example process variation: deterioration and wear

Deflector: gob changes



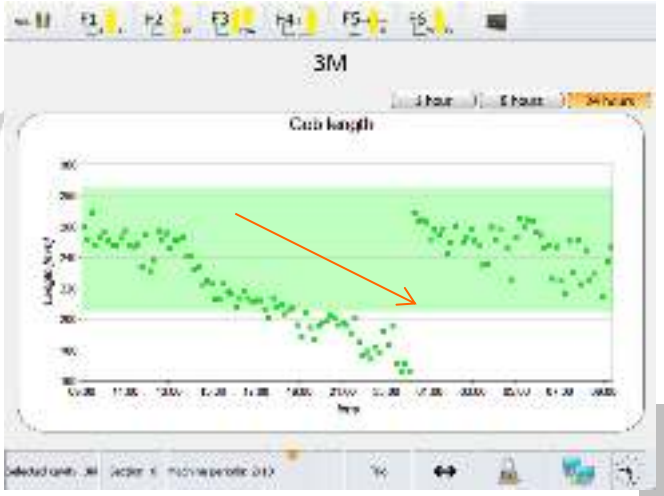
At gob cut shape of gobs might look equal…

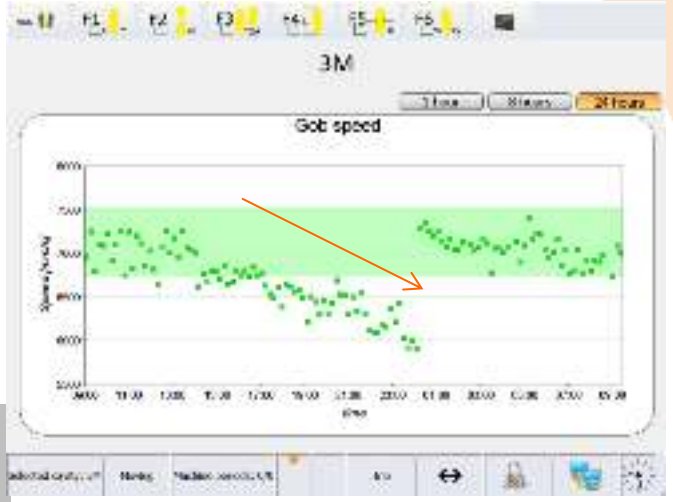
…but length, shape and diameter can be different when loading into the blank…

…due to friction in the delivery system

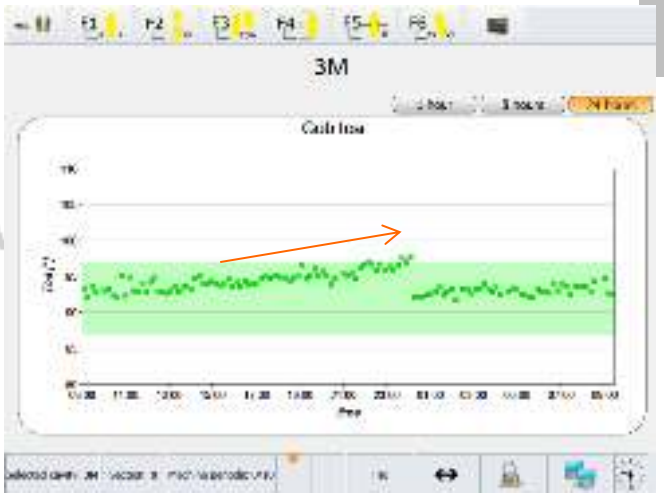
Example process variation: deterioration and wear

Gob Assist: cavity 3 M, 15-07 00:15



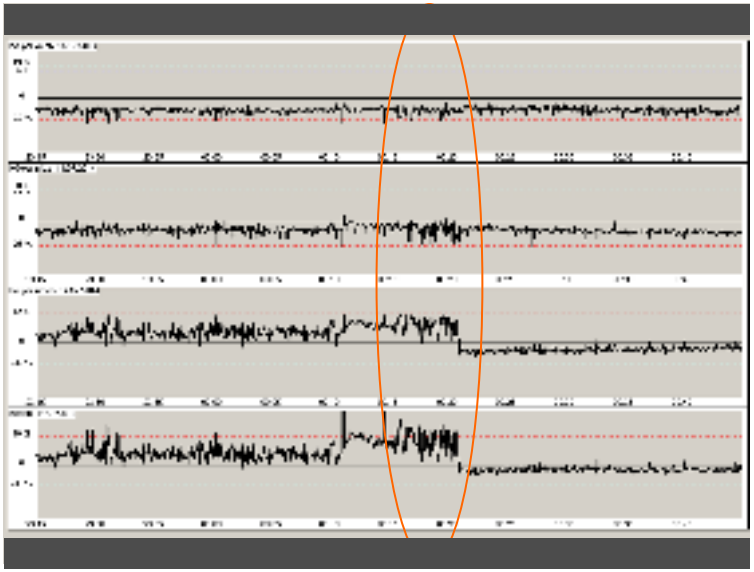


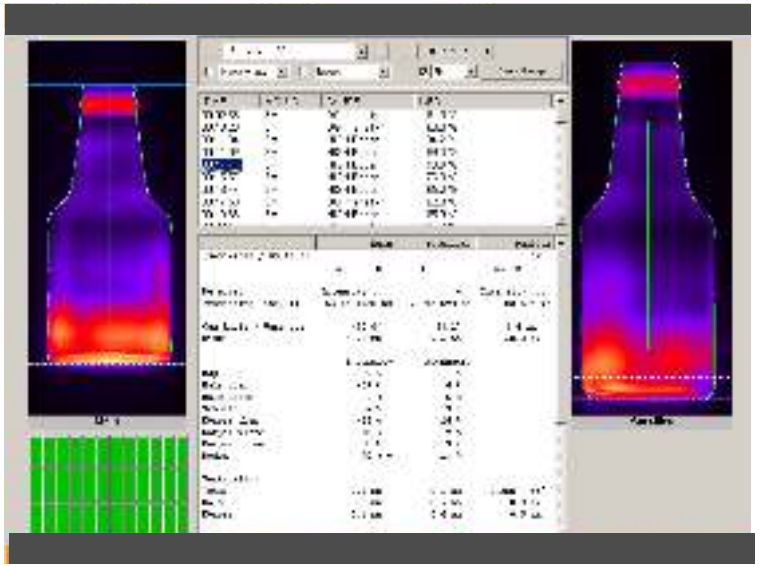
Due to higher friction in delivery



Example process variation: deterioration and wear

IR-D: cavity 3 M, 15-07 00:15

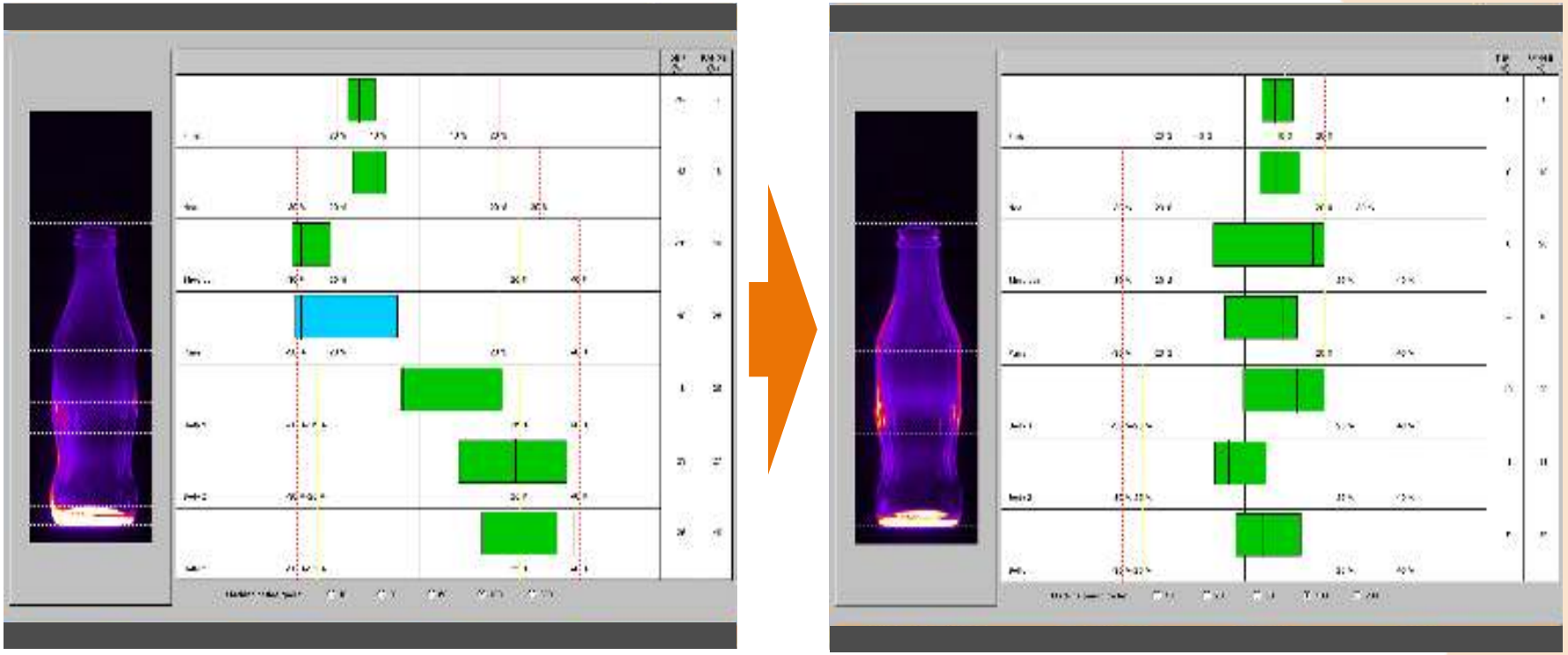




Due to the shorter length the glass distribution changes.

The sensor GA sees the gob condition changing.
An automated lubrication of deflector would prevent this from happening.
More consistency/predictability would be the result.

From uncontrolled to controlled glass distribution



The sensor IR sees the glass distribution changing. Operator will not act upon it as the bottle still within customer specification.
With an automated algorithm it is very easy to optimize/control the glass distribution. The bottle will be stronger and potential for weight decrease is huge.

Example automation: Vertical Glass Distribution

Potential for weight decrease is huge

What is available today?

Sensors

Bottle/cavity variations
- Inspection
- Container geometry
- Glass distribution
- Position on belt/stuckware/downware

Gob loading variations
- Speed/Lenght
- Time of arrival
- Position
- Orientation/shape/falling angle

Temperature variations
- Mould
- Plunger/neckring
- Parison

Gob Forming
- Temperature/shape
- Weight

Automation

Gob weight control

Ware spacing control

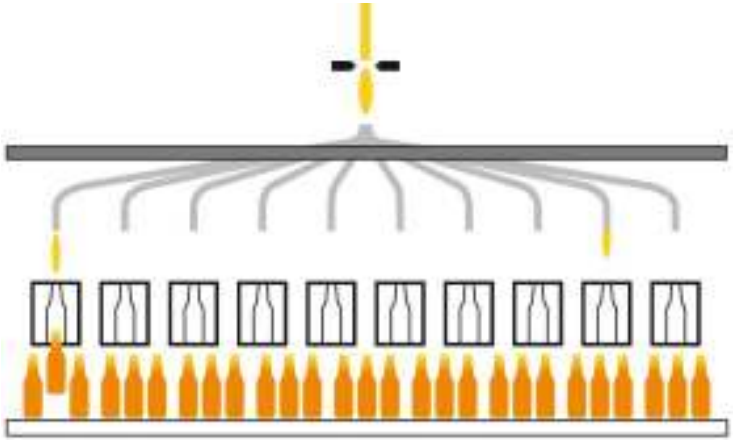
Mould temperature control

(Plunger) process control

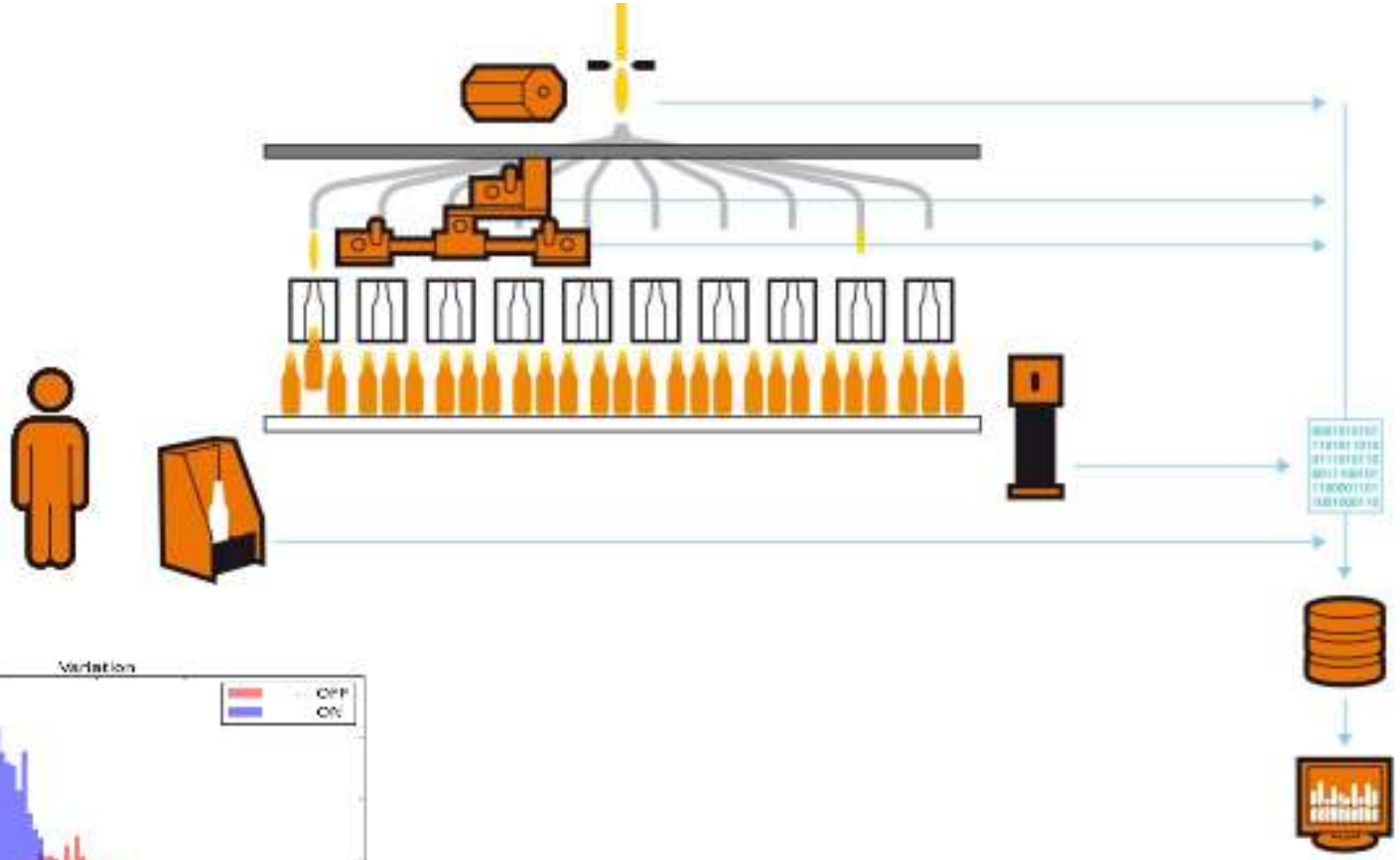
Vertical glass distribution control

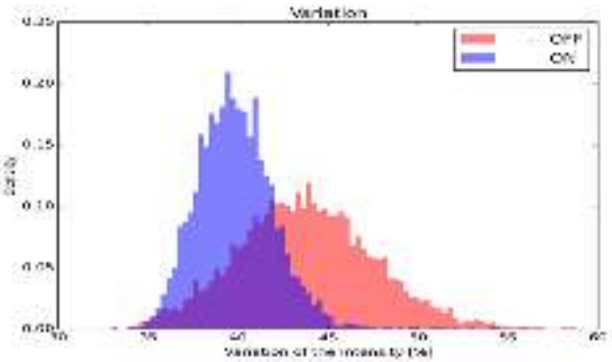
In general we (our industry) are very conservative

Glass forming today: Industry 2.0



Improved forming process control (→ efficiency, glass thickness, defects)





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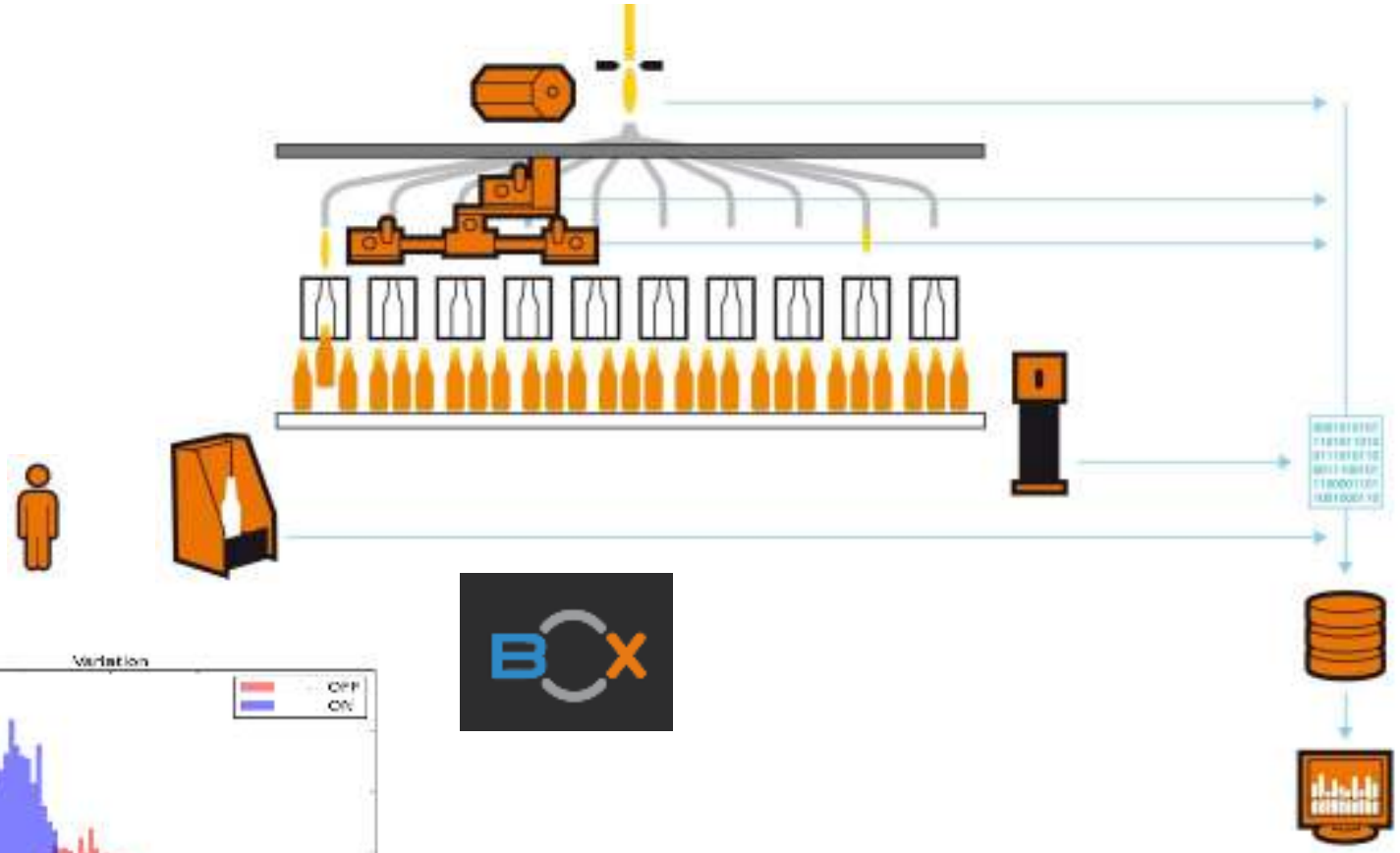

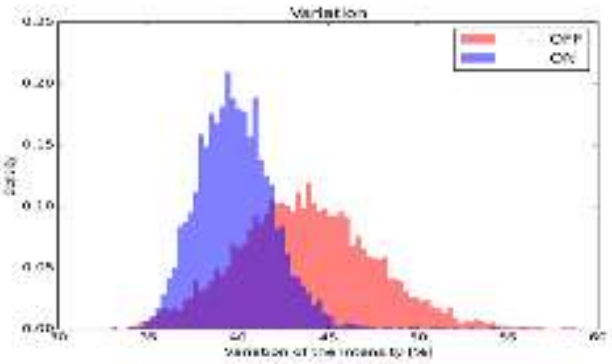

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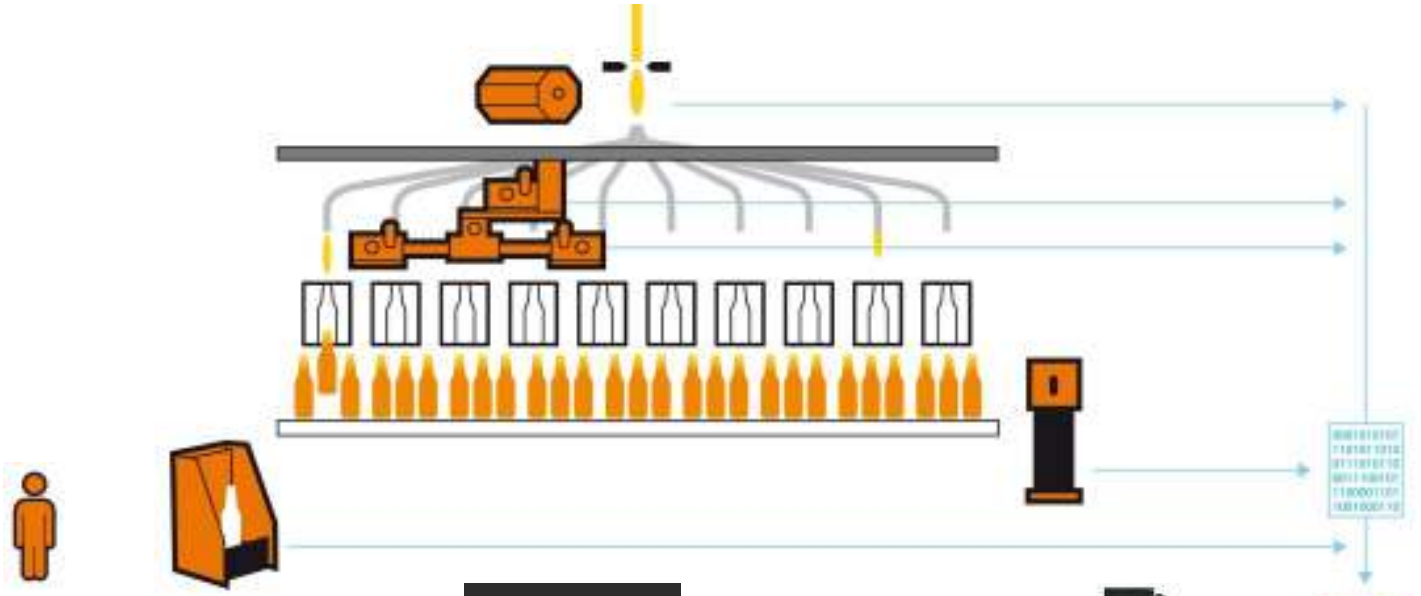
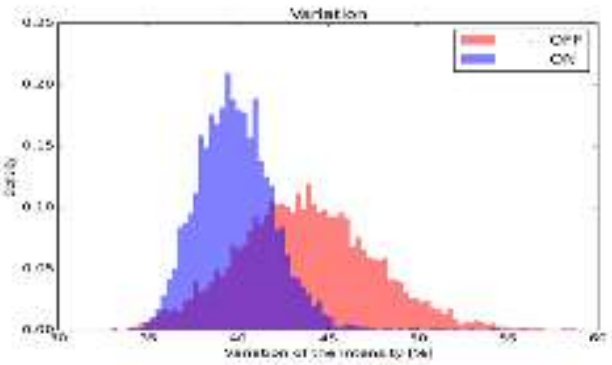
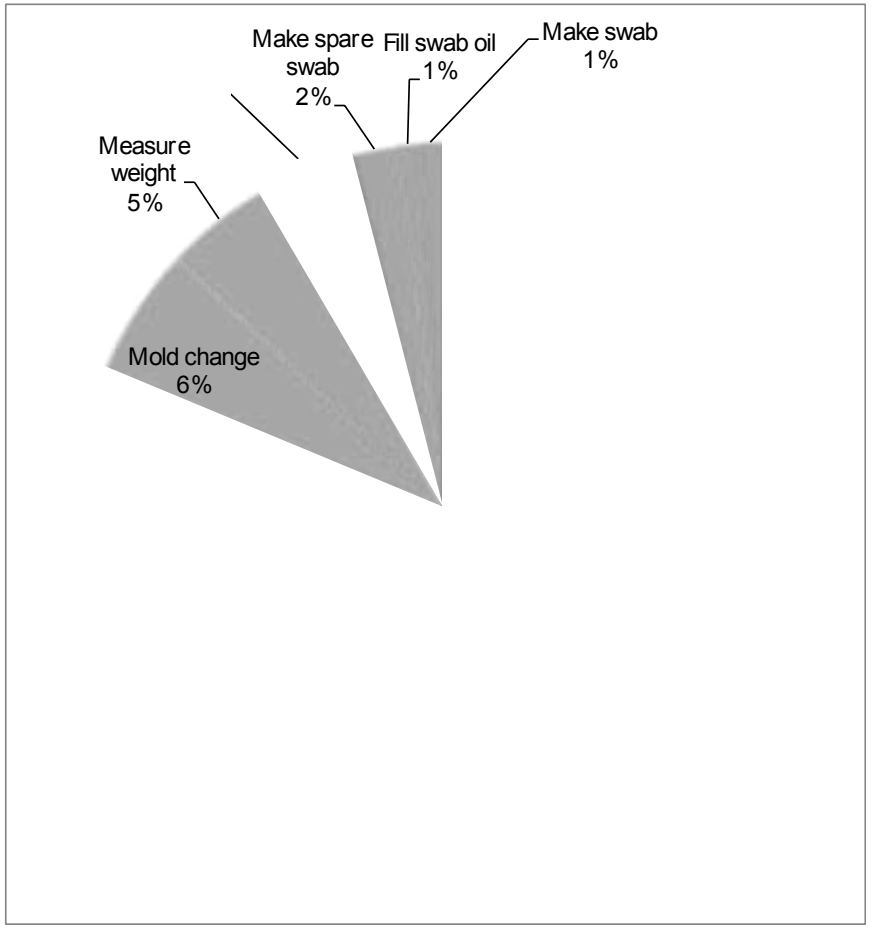




Operator task will change



Time distribution tasks hot end operator

- Sensors, automation and robots will replace/change (most) functions of the hot end operator
- Leading to much better output (efficiency/quality & weight/speed)
- Reducing the operational costs (TCO)
- Sustainability of glass as packaging material

Huge savings potential!

Lighter and stronger containers…..
produced with (almost) zero defects…..
at higher speed…..
with minimal human dependency.

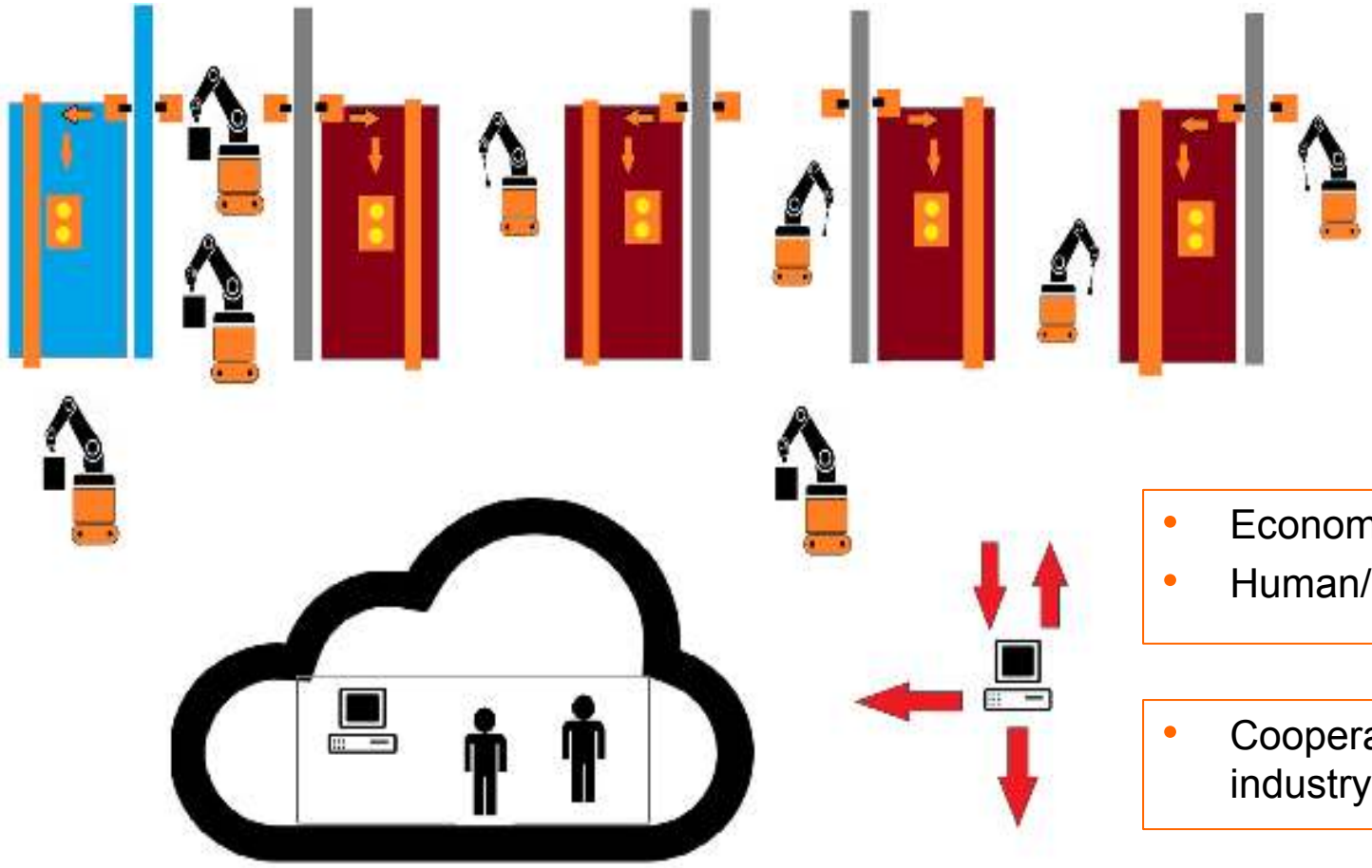
Next steps

- Continuous improvement on exisiting sensors, automated control loops, robot functions
- New automated control loops, robot functions

- Integration of systems (/data)

- Smart use of data

The dark factory



- Economical aspects
- Human/labour/safety

- Cooperation within the industry

Thank you for your attention

Bright ideas. Better glass.

xpanvision