



Think hygienic production – design is everything

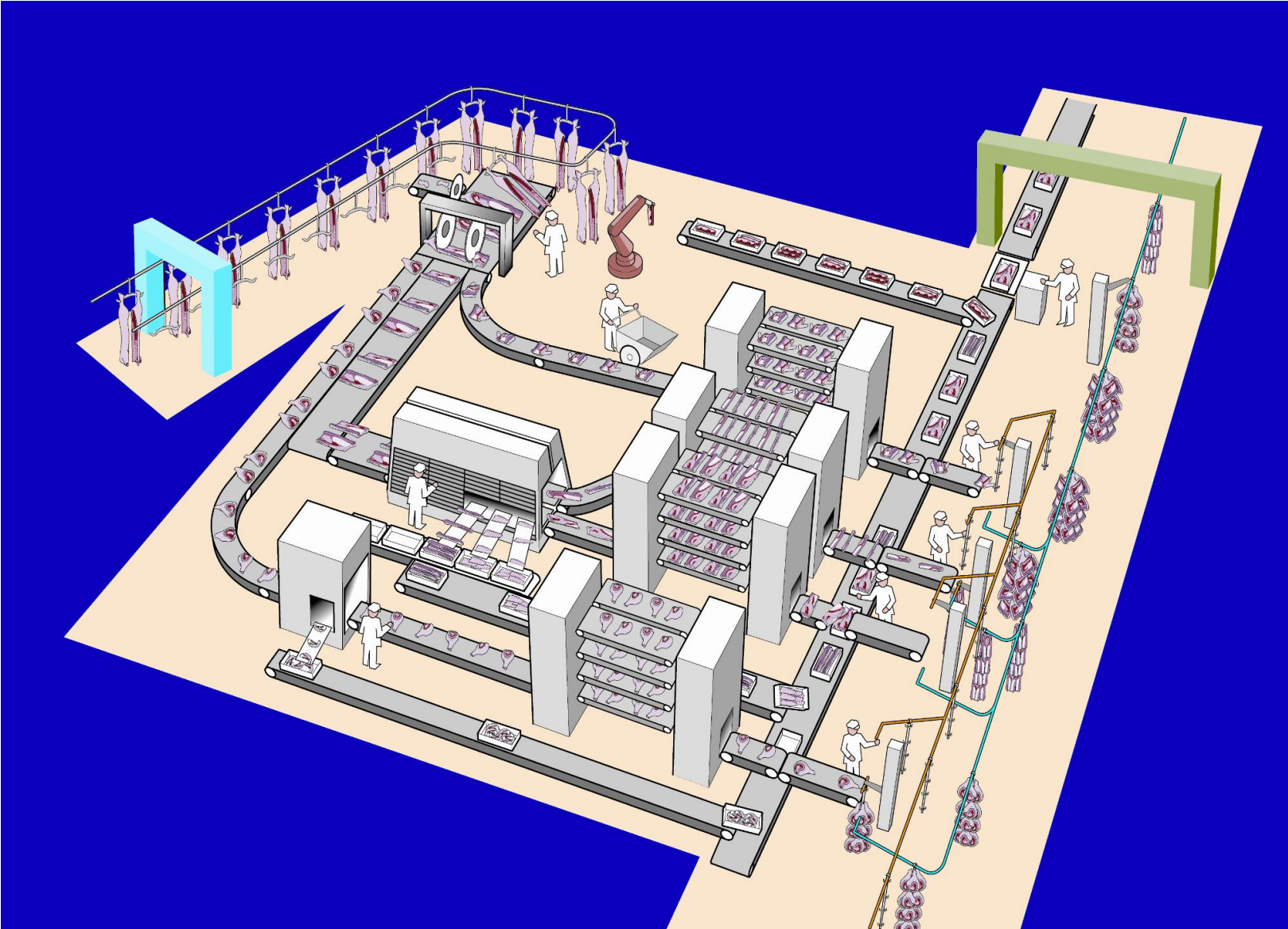
Director Food Safety, Lene Meinert, PhD



Hygienic production

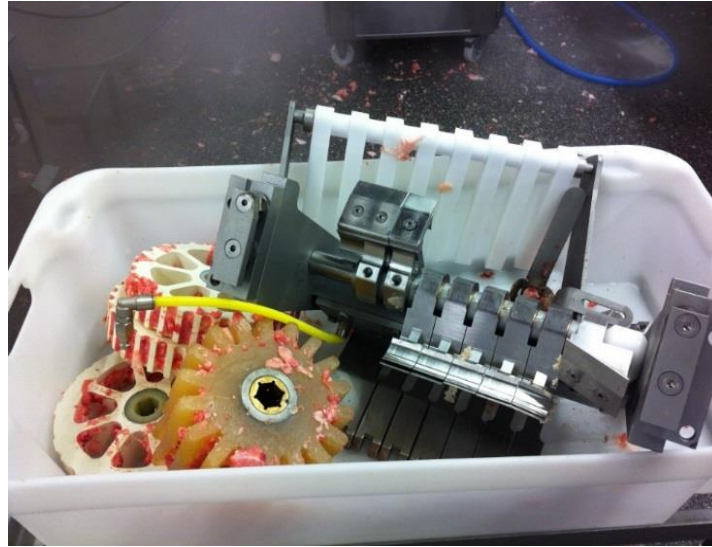
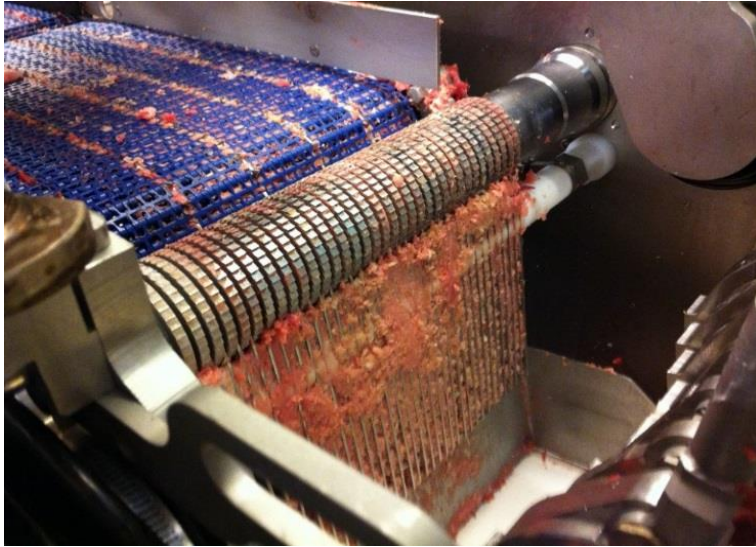


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NO! Mindset

Focus on the technological solution, then...



One way to do it:
DMRI test of prototype

- Stop/test
- Refine the design
- Lessons learned



3D derinding machine for loins

Good hygienic design

- Ensures good cleaning of the equipment
- Decreases the risk of growth and contamination of (harmful) microorganisms
- Promotes good production hygiene, which is the cornerstone of food safety



Cleaning is not just about food safety

A worker in a white uniform and hairnet is cleaning a metal surface in a factory setting, spraying water from a hose. The worker is wearing a white short-sleeved shirt, a white hairnet, and a blue apron. They are holding a blue hose and spraying water onto a metal grate. The background shows industrial equipment and pipes.

- Shelf life (global export)

BUT

- Costs: Money as well as time
37 million €/year in the Danish meat industry
- Equipment: Wears out and breaks down
- Environment - water and chemicals

The basics of cleaning

The background image shows an industrial cleaning facility. On the left, there is a large, dark, cylindrical structure, possibly a tank or part of a conveyor system, which appears to be covered in a thick layer of white, foamy cleaning agent. In the center and right, there are various pieces of industrial equipment, including pipes, a metal table with a perforated top, and overhead lighting fixtures. The overall scene is dimly lit, with the primary light source being the overhead fluorescent lights.

Cleaning agents

Time

Temperature

Mechanical actions

The basics of cleaning

The background image shows an industrial cleaning facility. On the left, there is a large, dark, cylindrical structure, possibly a tank or part of a conveyor system, with a rough, textured surface. In the center and right, there are metal frames and tables, some of which appear to be part of a conveyor belt system. The floor is wet and reflective. The ceiling has various pipes, conduits, and fluorescent lights. The overall scene is dimly lit, with the primary light sources being the overhead fluorescent lights.

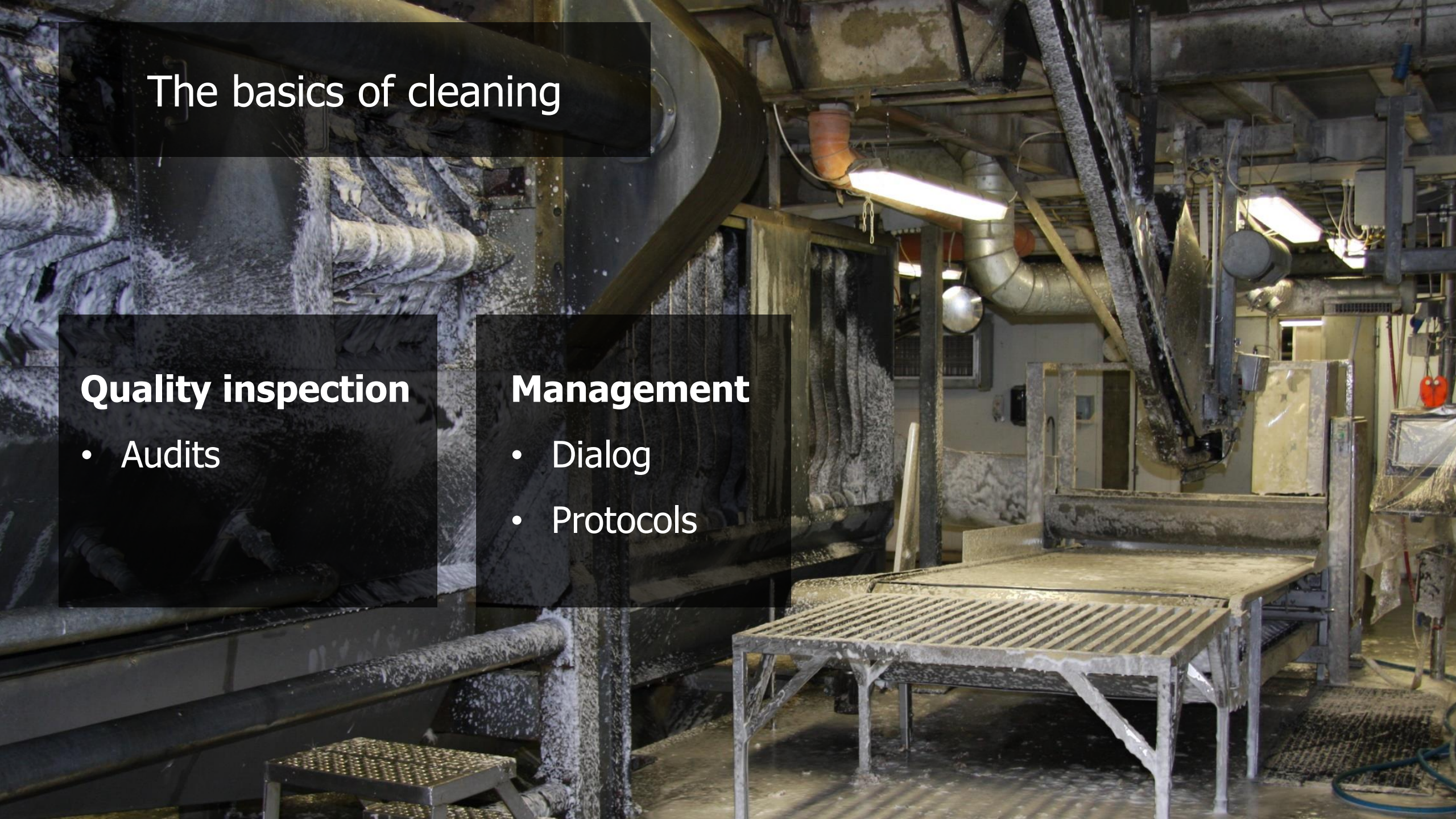
Cleaning agents

Time

Temperature

Mechanical actions

The basics of cleaning



Quality inspection

- Audits

Management

- Dialog
- Protocols

Cleaning by tradition

A photograph of a meat processing plant. In the center, a large stainless steel machine is visible, with a white container hanging from a chain. The background shows more industrial equipment and a tiled floor.

Interesting

Production efficiency throughout the production line is continuously optimised – not cleaning

Is it due to

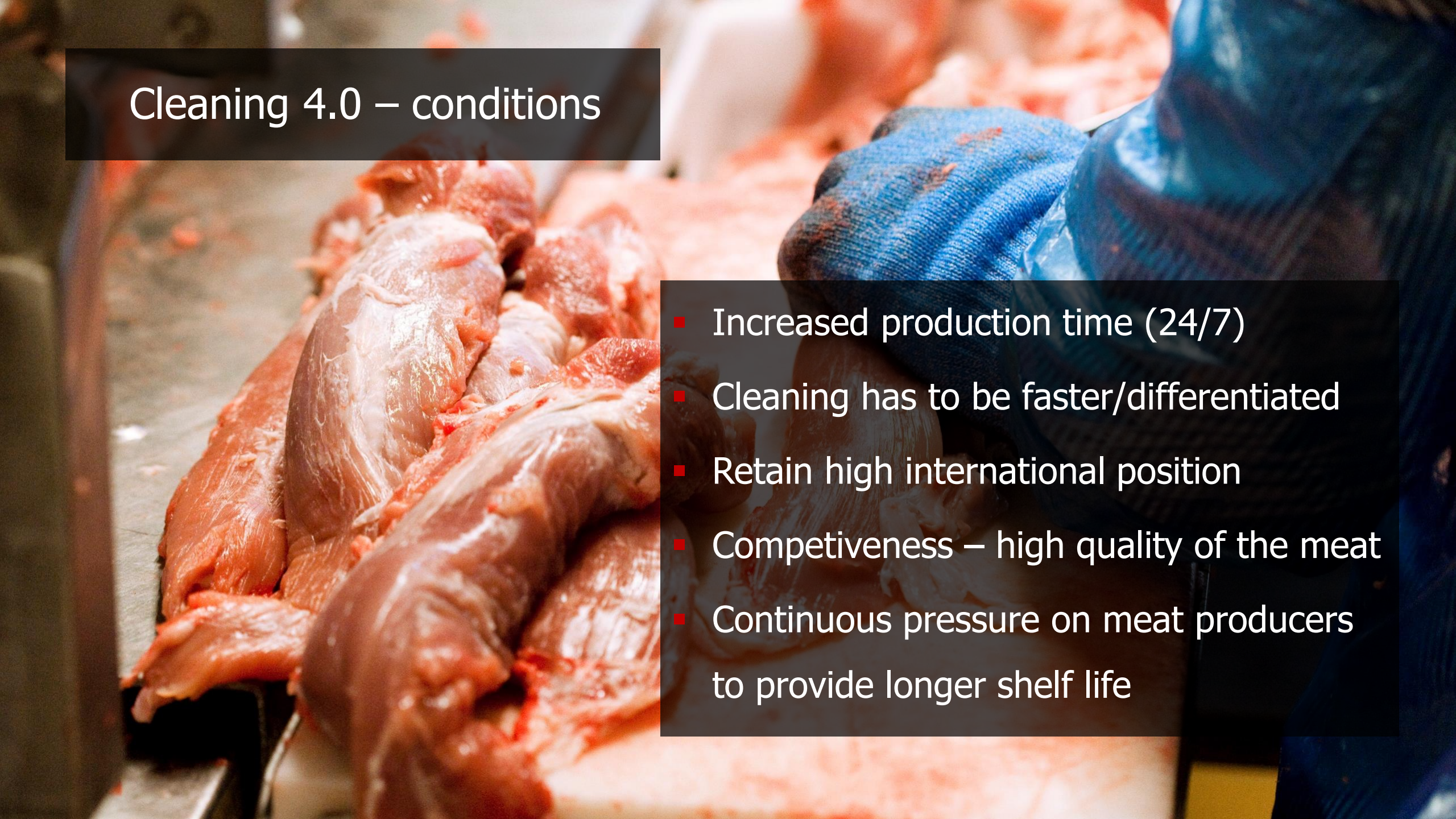
Legislation?

Customers?

Traditional cleaning and disinfection in the meat industry for years

1. Prepare equipment for cleaning
2. Initial rinsing/scrubbing
3. Foam
4. Rinsing
5. Disinfection
6. Rinsing
7. Drying (time and energy)

Cleaning 4.0 – conditions



- Increased production time (24/7)
- Cleaning has to be faster/differentiated
- Retain high international position
- Competiveness – high quality of the meat
- Continuous pressure on meat producers to provide longer shelf life

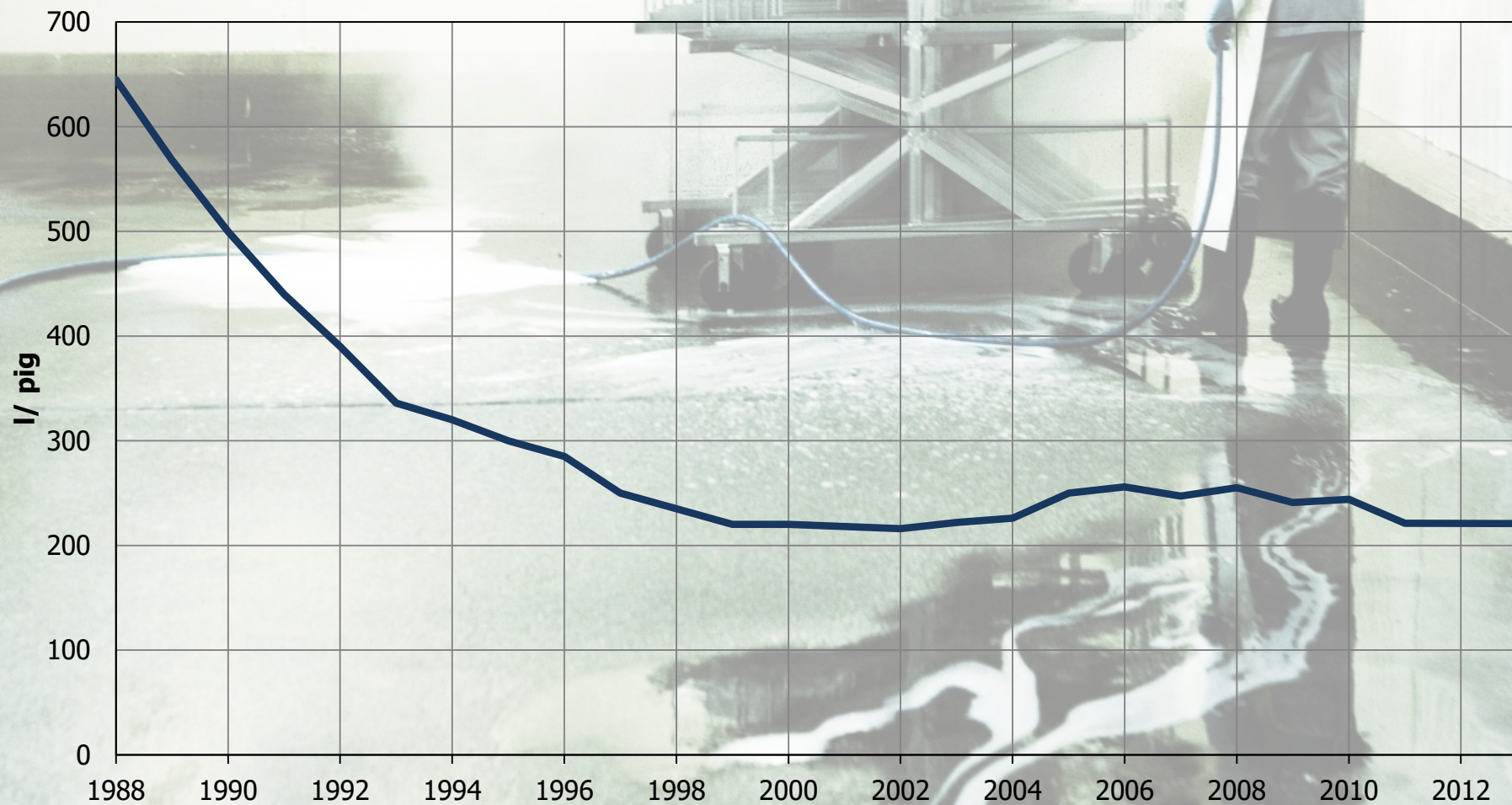
Cleaning 4.0 – how to get there

A person wearing a full-body protective suit, including a hood and gloves, is seen from behind, cleaning a large, complex industrial metal structure. The person is holding a long, white, rectangular object, possibly a cleaning tool or a piece of equipment. The structure is made of many interconnected metal beams and pipes, forming a multi-level framework. The background shows a large, open industrial space with a concrete floor and white walls. The lighting is bright, creating a high-contrast scene.

- Re-thinking and improving efficiency in traditional daily cleaning
- Support improved utilisation of the production facilities
- Less repairs due to damage caused by cleaning
- 20% reduction in the consumption of water, energy and chemicals

Water consumption today


**Pig slaughter
Water consumption l/pig**



Water consumption 4.0



- Cleaning amounts to 25% of the total water consumption
- 80% is used for initial rinsing
- The goal is to save water of drinking quality
- “Fit for use” water applications – characterize water quality, risk analysis
- Legislation opens up for the reuse of water



DMRI ideas and results

A close-up photograph of two black-handled knives with silver blades resting in a white plastic container. The container is partially filled with water, and the blades are submerged. The background is a dark, textured surface.

It needs to look clean, and it needs to work

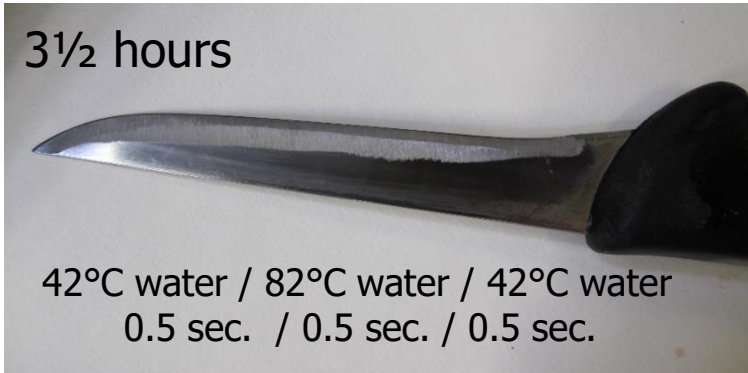
Disinfection of knives without chemicals

Water system:

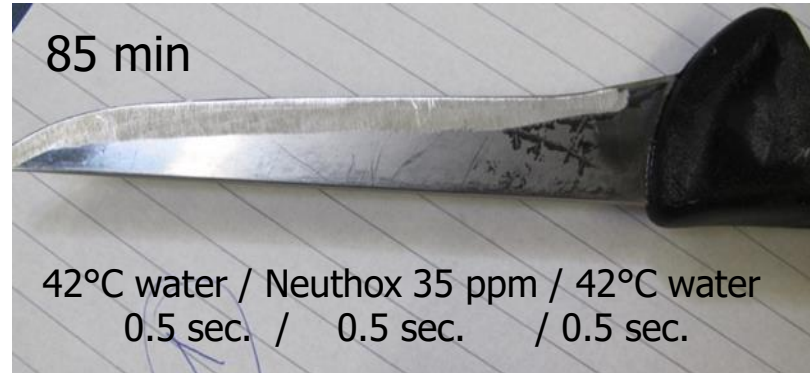
- Initial rinsing at 42°C
- Sterilize at 82°C
- Final rinse (cooling) at 42°C

It needs to look clean, is coating the answer?

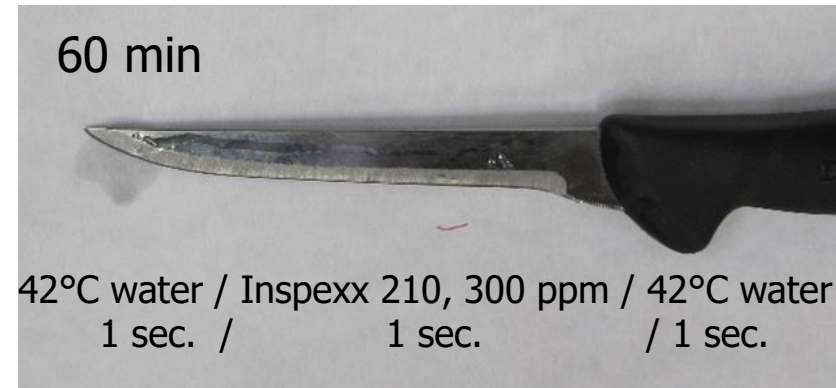
3½ hours



85 min



60 min



It needs to look clean



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Sterilise with 82°C hot water



- Rinse with water at 42°C
- Sterilise with 82°C hot water
- Chill with water at 42°C

Robot for loosening
the backbone

Differentiated cleaning

A photograph of a worker in a meat processing plant. The worker is wearing a blue hairnet, red ear protection, and a blue and white striped shirt. They are standing next to a large piece of meat on a conveyor belt. The background shows other pieces of meat hanging from hooks.

- Different requirements in different areas
- Development of procedures for in-process cleaning
- Establishment of frequency cleaning as “daily” cleaning

Frequency cleaning

- In-process cleaning
- Cleaning of critical spots
- Simple removal of meat residues
- Wiping surfaces



Daily cleaning – microbial baseline



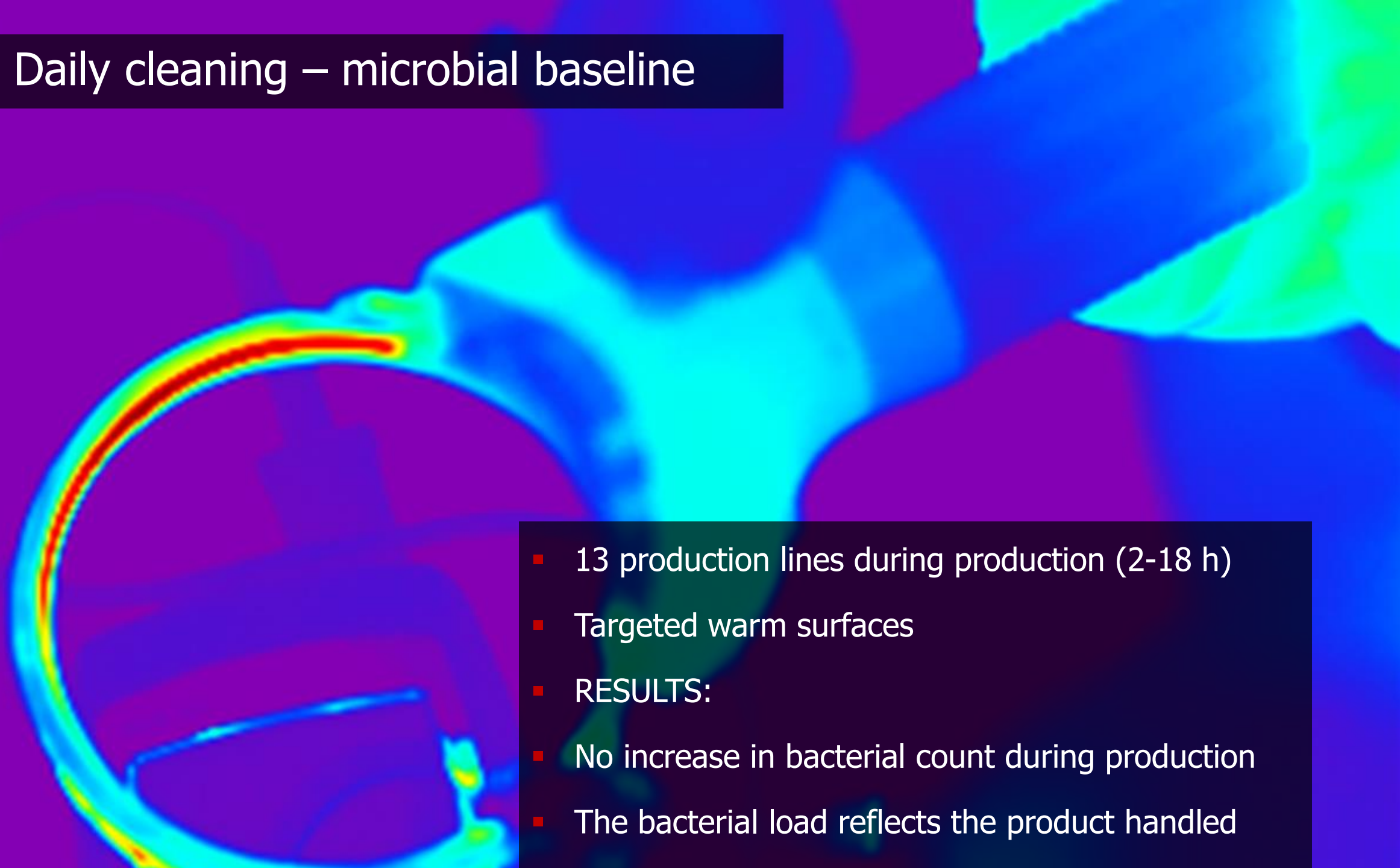
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Wizard knife - trimmings



Daily cleaning – microbial baseline



- 13 production lines during production (2-18 h)
- Targeted warm surfaces
- RESULTS:
- No increase in bacterial count during production
- The bacterial load reflects the product handled

Bacteria growth on surfaces



- Simulating continuous production (no cleaning stops)
- Conveyor belt, no product flow
- Thin and thick layer of meat residues
- Inoculate with pathogens or spoilers

Microbial growth on surfaces



- Growth initiated in 0-23 hours
- Significant growth after 1-2 days
- Growth depends on:
 - pH 5.4 (loin) - pH 6.3 (fore end)
 - Drying (survive, inactivate) – new problem
 - In-process cleaning needed

Production time and shelf life of cooked meat products



Simulating continuous production – effect of bacteria count

- Sampling of cooked meat during a production of 100 h
- Normal procedure: cleaning surfaces during production (IPA-cloth)
- Test of frequency cleaning on critical spots



Production time and shelf life

Using frequency cleaning

- Significantly reduced the number of bacteria naturally present on the meat at the time of packing
- Provided extended shelf life

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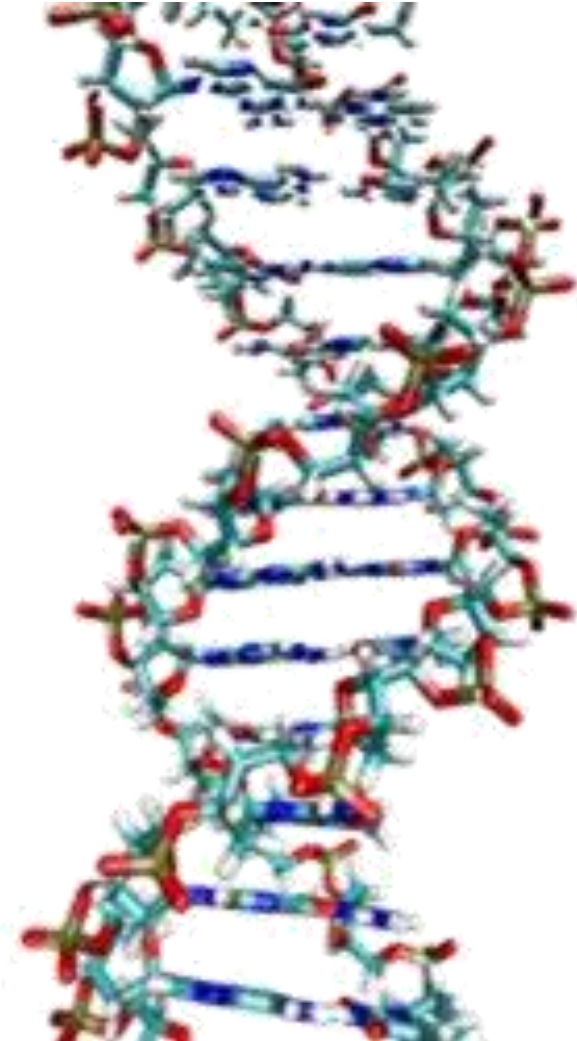
DMRIpredict.dk



Process control – the future



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Perspectives

- Identify routes of contamination (spoilage 16S, pathogens WGS)
- Bacterial make-up in production environment and products (16S)
- Control the process (e.g. fermentation)



Take home messages

- The rethinking of cleaning is needed
- Water consumption reduced by reuse
- Frequency cleaning can prolong production hours
- Know your critical (hot) spots



Thank you for your attention

See you during the tour of DMRI