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STERILIZATION
CONGRESS
Celebrating Sterilization Science
The Hague - The Netherlands 30 October - 2 November 2019
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12 RESPONSIBLE CONSUMPTION AND PRODUCTION
How circular economy technology contributes to sustainable instrument management
B.J. van Straten, T. Horeman
WFHSS 1 November 2019

Research for circularity as model for cost-saving and sustainable Instrument Management

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Circularity for sustainable surgery:

1. Recycling of basic materials from disposed surgical instruments.

2.Minimizing instrument replacement by using modular design methods that extend the life cycle of instruments.

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Disclosure

SuperSeton

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Tulipa

Van Straten Medical
Production, repair, supply and fixation of medical instruments.

Active in 26 countries.

Surge-On medical

Medinorm Medizintechnik GmbH
Co-founded by J. van Straten in 1984
Production of wound drainage systems.

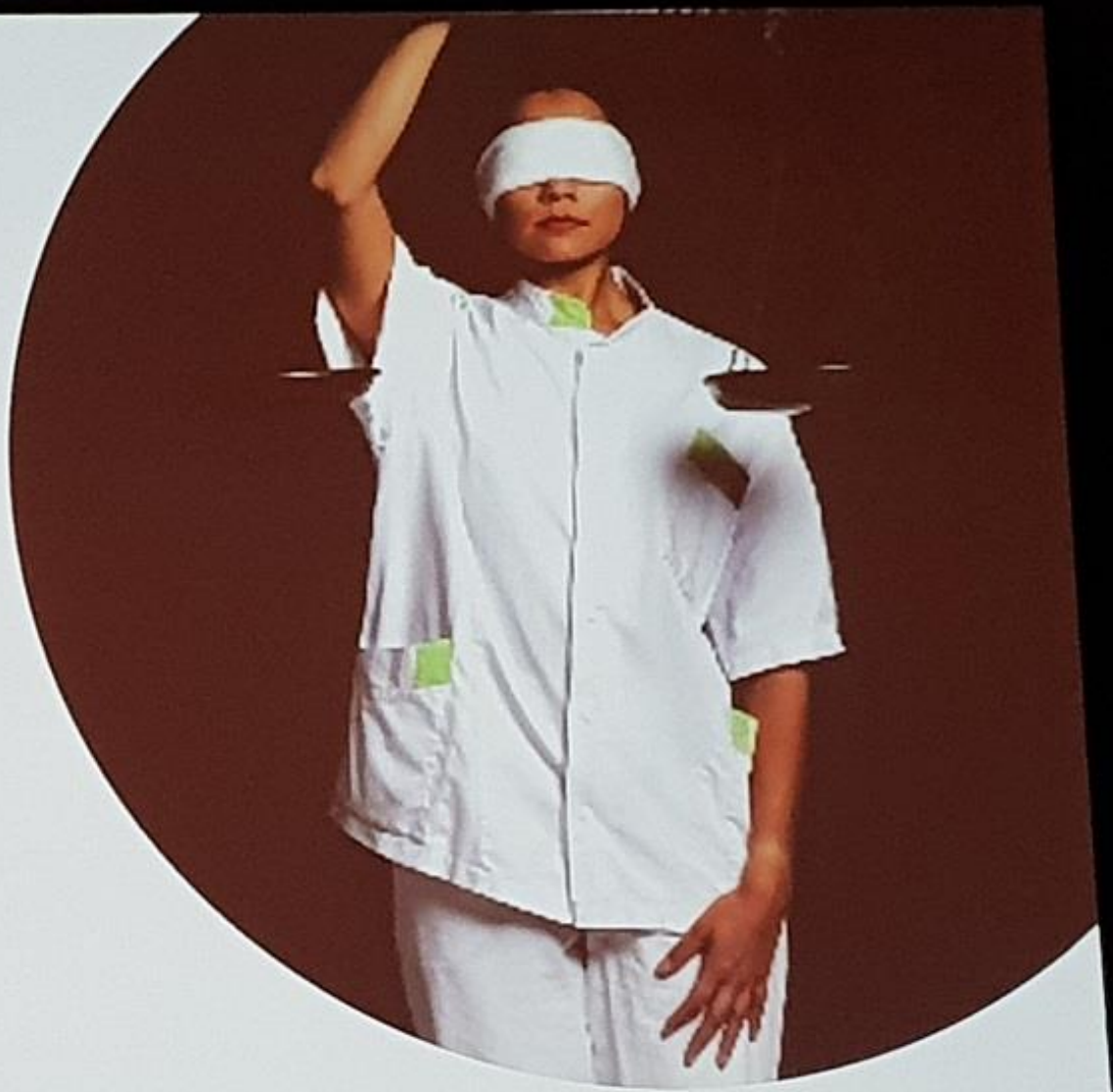
VAN STRATEN MEDICAL
'Providing Value To Life'

Study Objective

To identify how healthcare can benefit from a circular approach with sustainable instruments.

Research Questions

- How can circularity and circular economy models contribute to sustainable healthcare?
- How will circularity contribute to society and protection of our natural resources?

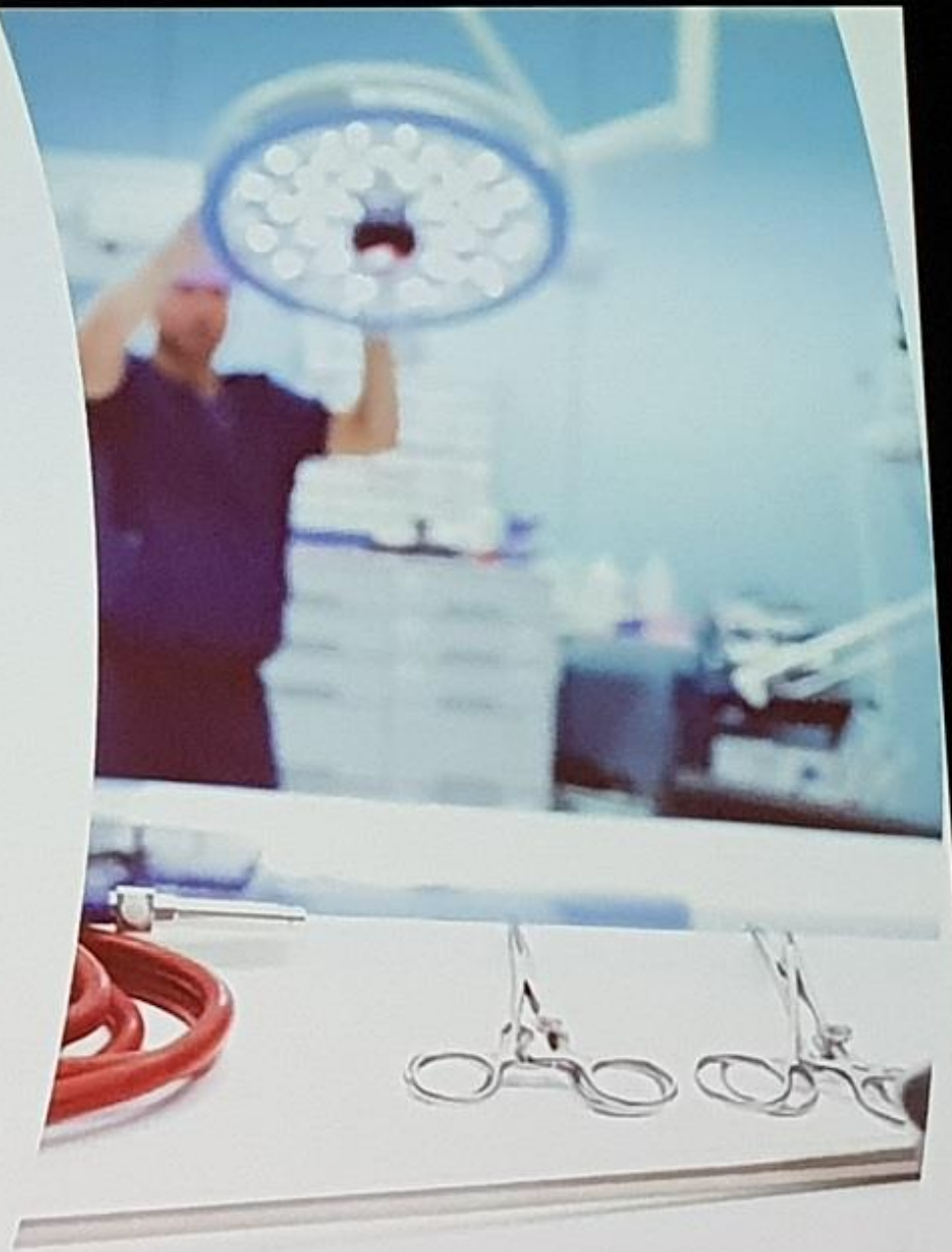


Relevance

The earth's population in 1800 counted 1 billion, having taken all of human history to reach that number. Only 2 centuries later, the global population is 6 billion, half of which lives in cities.[1]

The world's population has touched a mark of 7.3 billion in 2015 and could attain growth level of 9-12 billion before the year 2050.[2]

If the growth of the demand from the growing population continues at this rate, by 2030 with a global population of 10 billion people, two Earths will be needed to satisfy all of the population's demands.



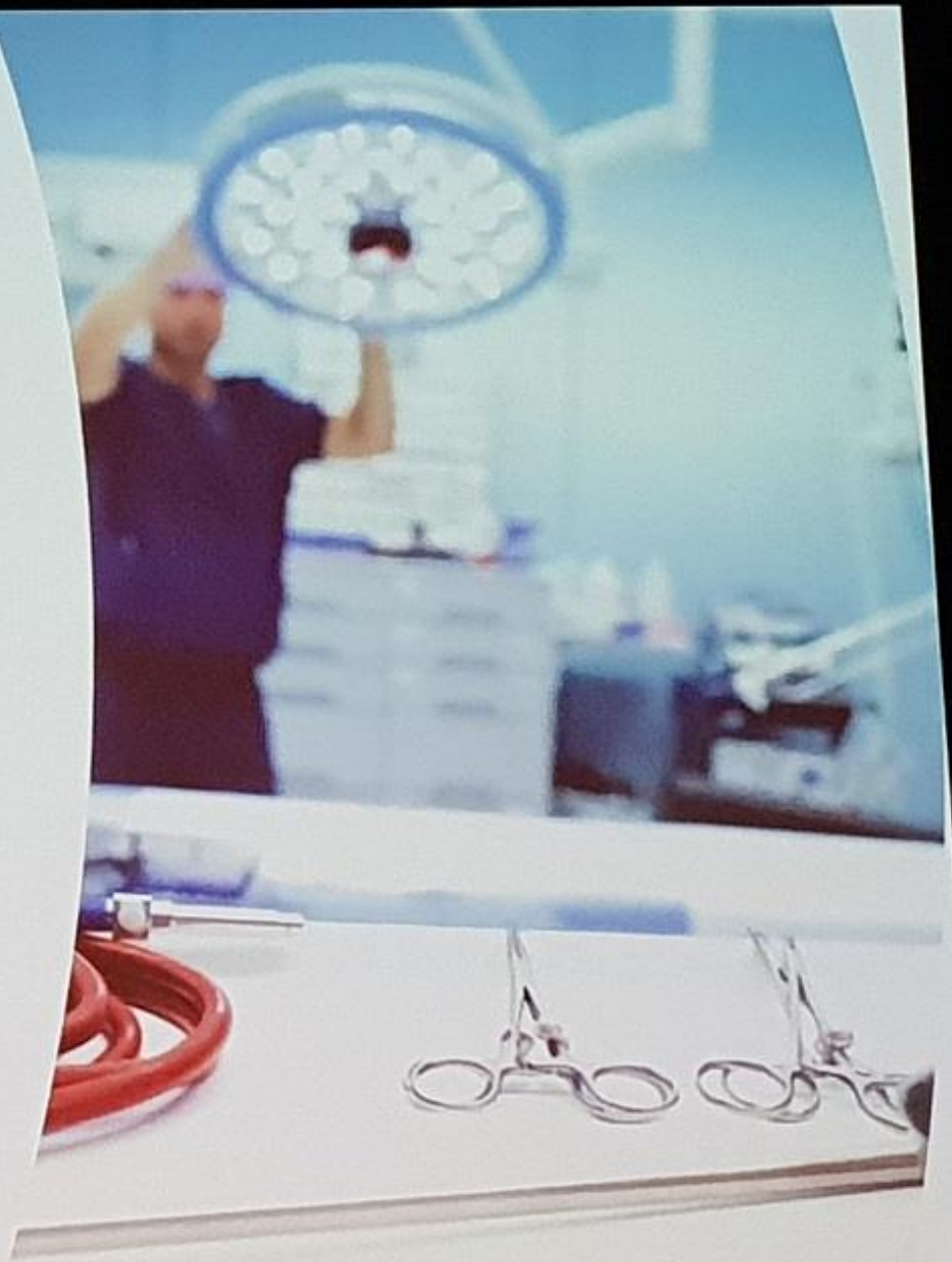
1. Mittal, Rahul. (2013). IMPACT OF POPULATION EXPLOSION ON ENVIRONMENT. Weschool Knowledge builder - the national journal.

2. Uniyal, Shivani & Paliwal, Rashmi & Saun, Bhumija & K. Sharma, R. (2017). Human Overpopulation:. 10.4018/978-1-5225-1683-5.ch001.

Relevance

Generating waste in society is increasing

- In 2018, the Netherlands exported 6.847 thousand tonnes of recyclable metal waste only. That is 3 percent more than in 2010.[3]
- 25.000 tons of Dutch waste was exported to Indonesia only in 2018, compared to 1.000 tons in 2017.[3]
- Metal-ore extraction and metal production increased three-fold from 1970 to 2010. The steepest increase occurred from 2000 to 2010.[4]

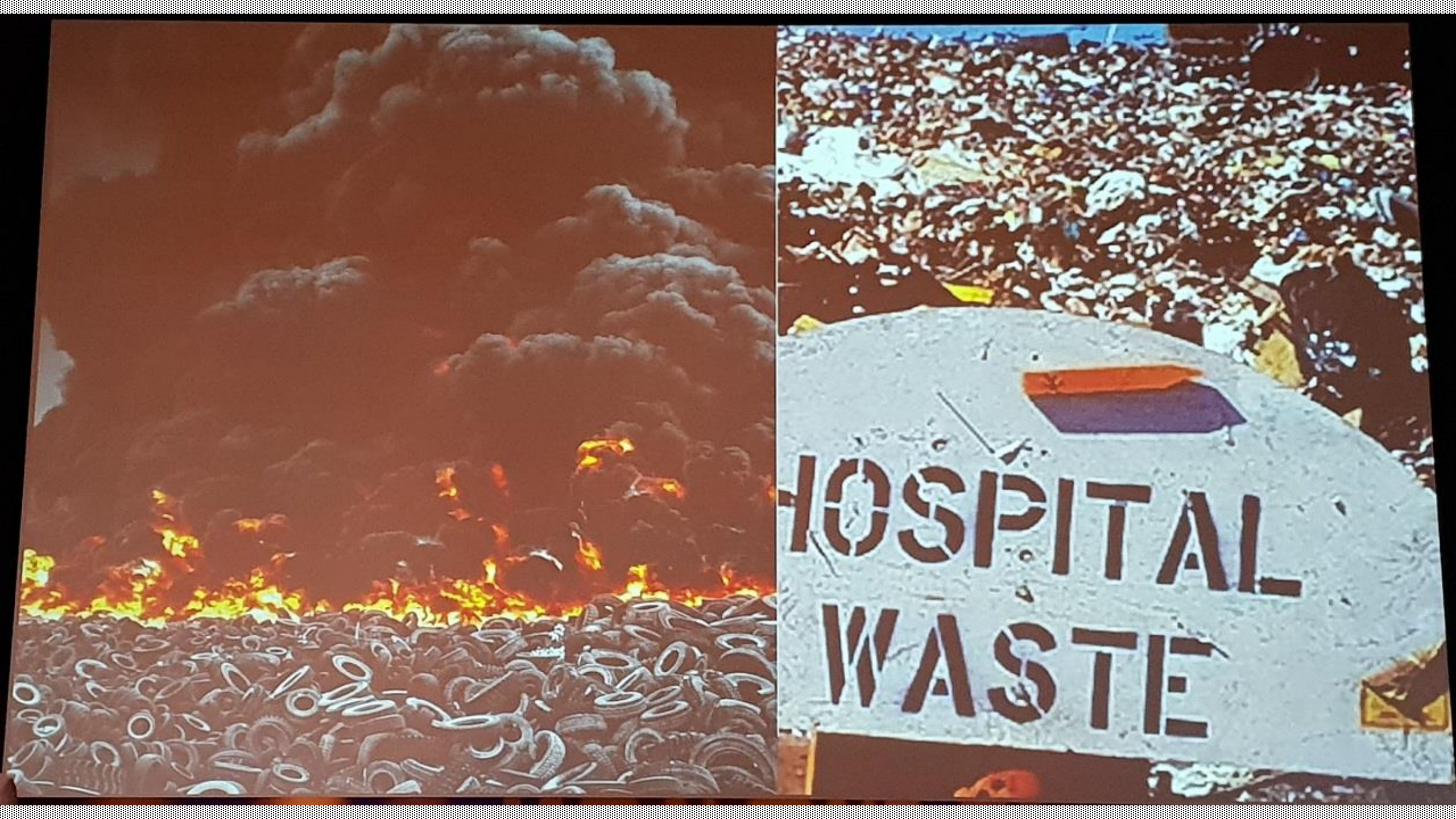


3. Central Bureau of Statistics (CBS), Ministry of Infrastructure and Water Management, waste figures at national level, 2019 - https://www.cbs.nl/nl-nl/maatwerk/2019/11/export-van-afval -

4. Bringezu, S et al. (2017). Assessing global resource use: A systems approach to resource efficiency and pollution reduction (A Report of the International Resource Panel)

From our planet's point of view,
there's no throwing garbage out.
Because there is no "out".

We need to change awareness around mass consumption and our throw-away mentality.


HOSPITAL
WASTE

Alternative: the Circular Economy

- The Circular Economy has gained significant interest around the world. Circularity meaning an economic system in which waste is minimized or even completely reused.[3]

- Waste minimized. this can be achieved through long-lasting design, **maintenance, repair, reuse, remanufacturing, refurbishing, recycling, and upcycling**[1]. This is in contrast to a linear economy which is a 'take, make, dispose' model of production.[4]

3. Geissdoerfer, Martin et al. (2017). "The Circular Economy – A new sustainability paradigm?". Journal of Cleaner Production. 143: 757–768.

4. Towards the Circular Economy: an economic and business rationale for an accelerated transition. Ellen MacArthur Foundation. 2012. p. 24.

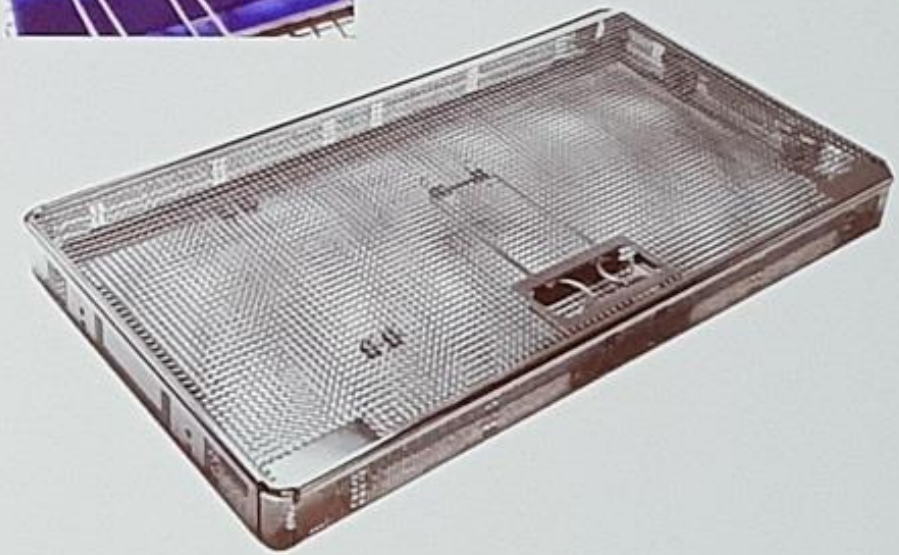
Methods

- In 2018 and 2019 different scientific experiments as well as actual business cases were carried out where hospital waste was used as raw material for new medical products.

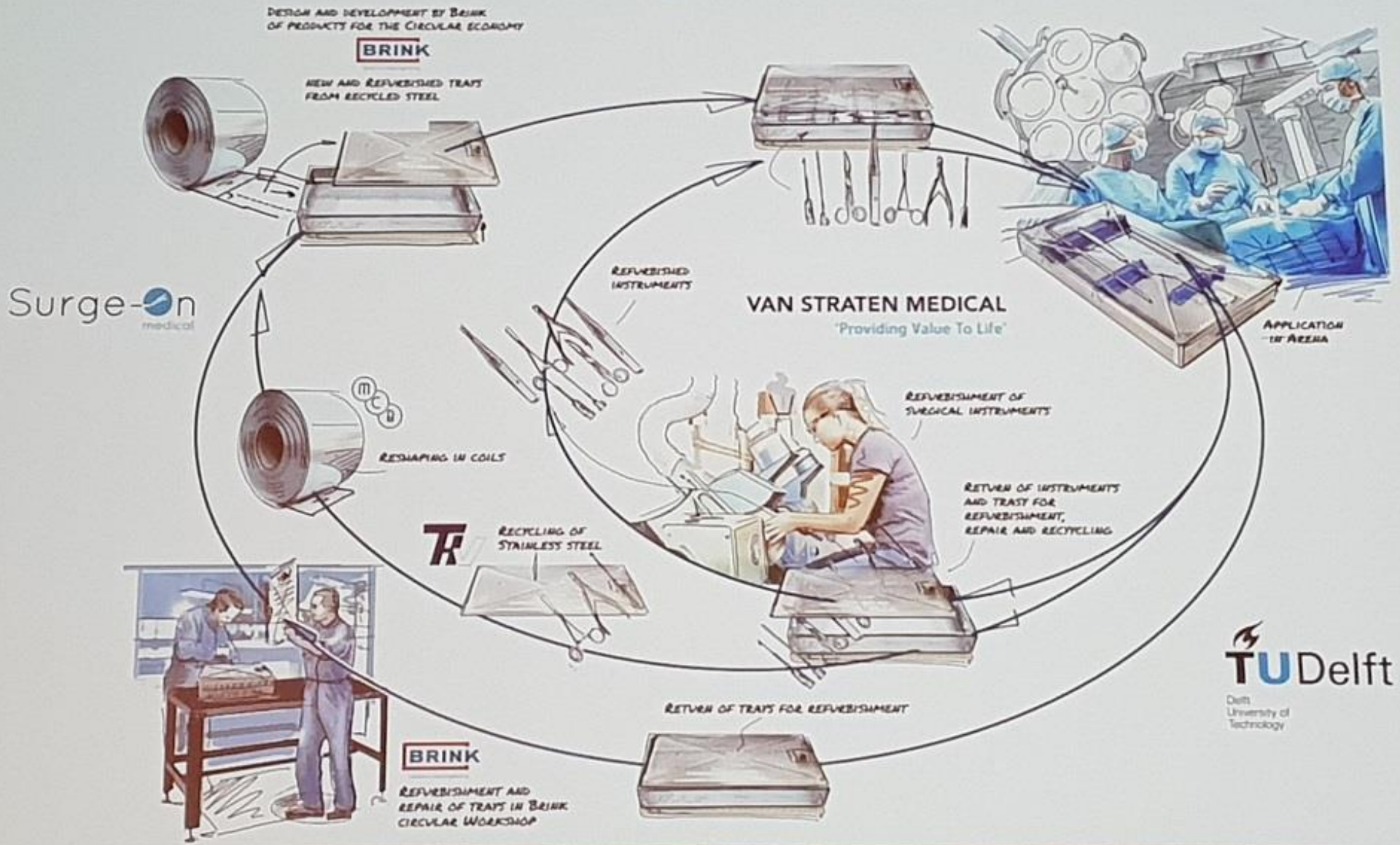
- Surgical instruments were collected, repaired and refurbished into new manufacturing's condition.

- Non-repairable instruments, used disposable instruments and other stainless-steel waste was collected and melted into metal sheet (plates).

- Metal sheet plates were used for the manufacturing of components for mesh baskets and FlexClean Medical flushing tools.

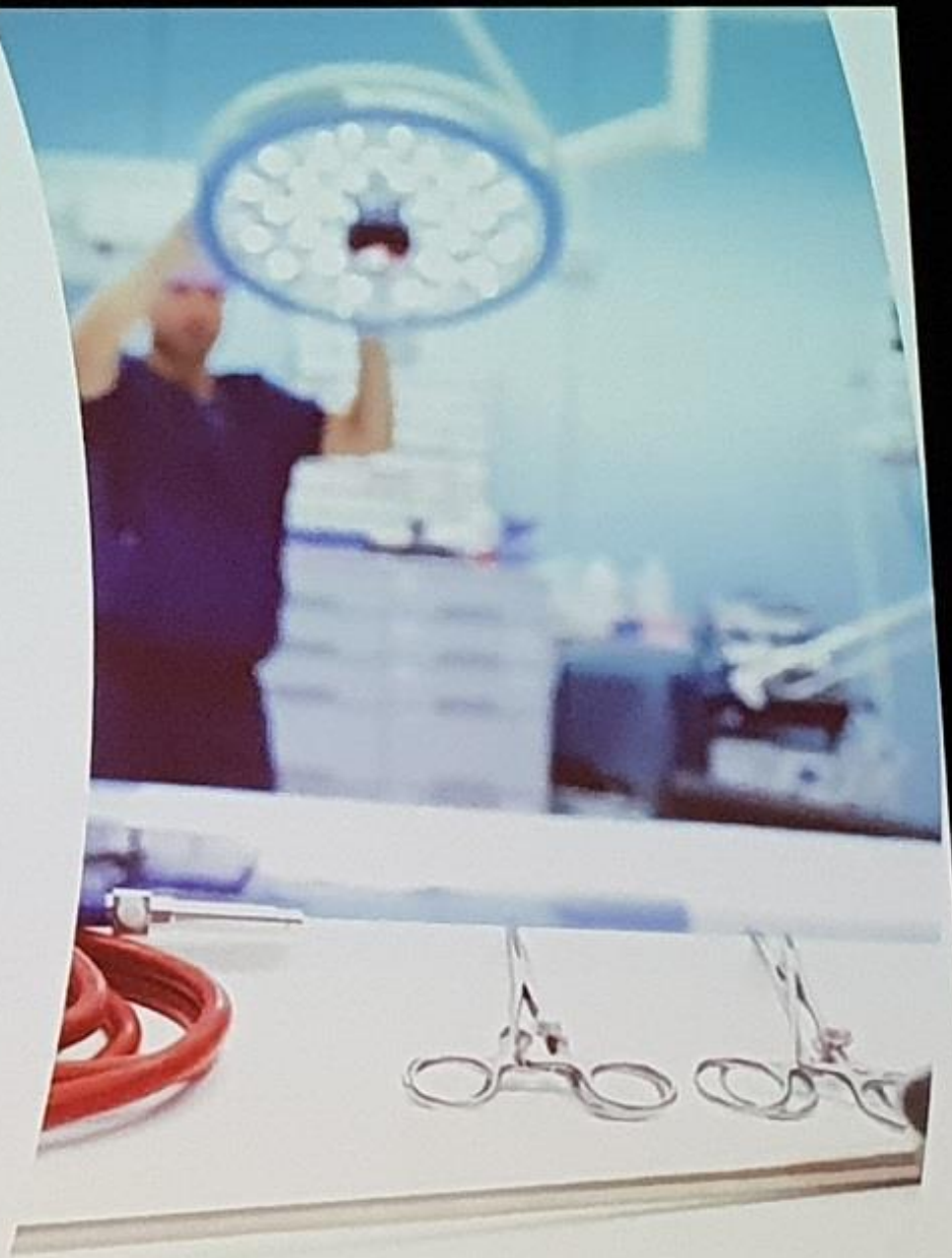


Methods Circular Instrument Management; an experiment with 4 hospitals



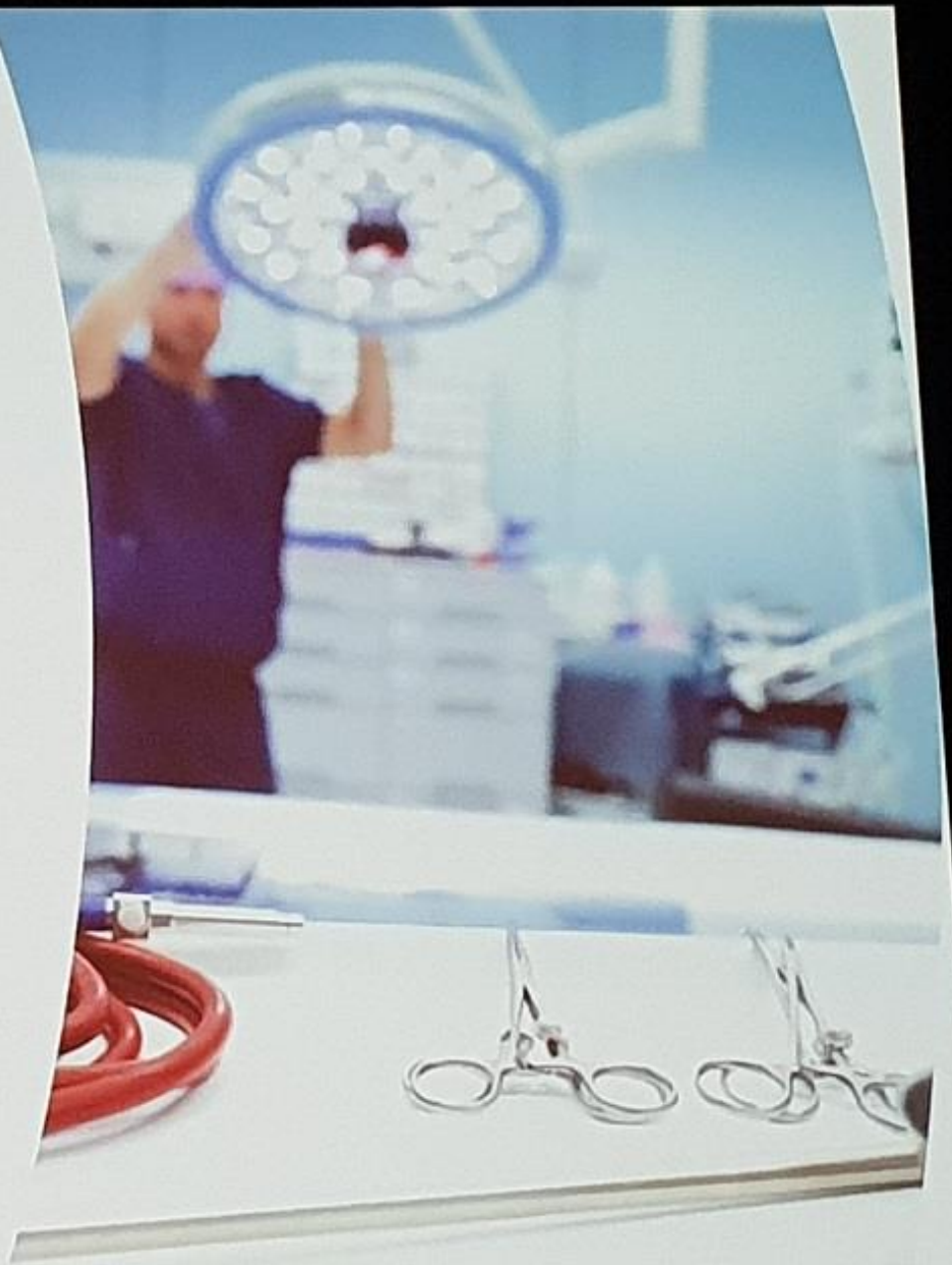
Results

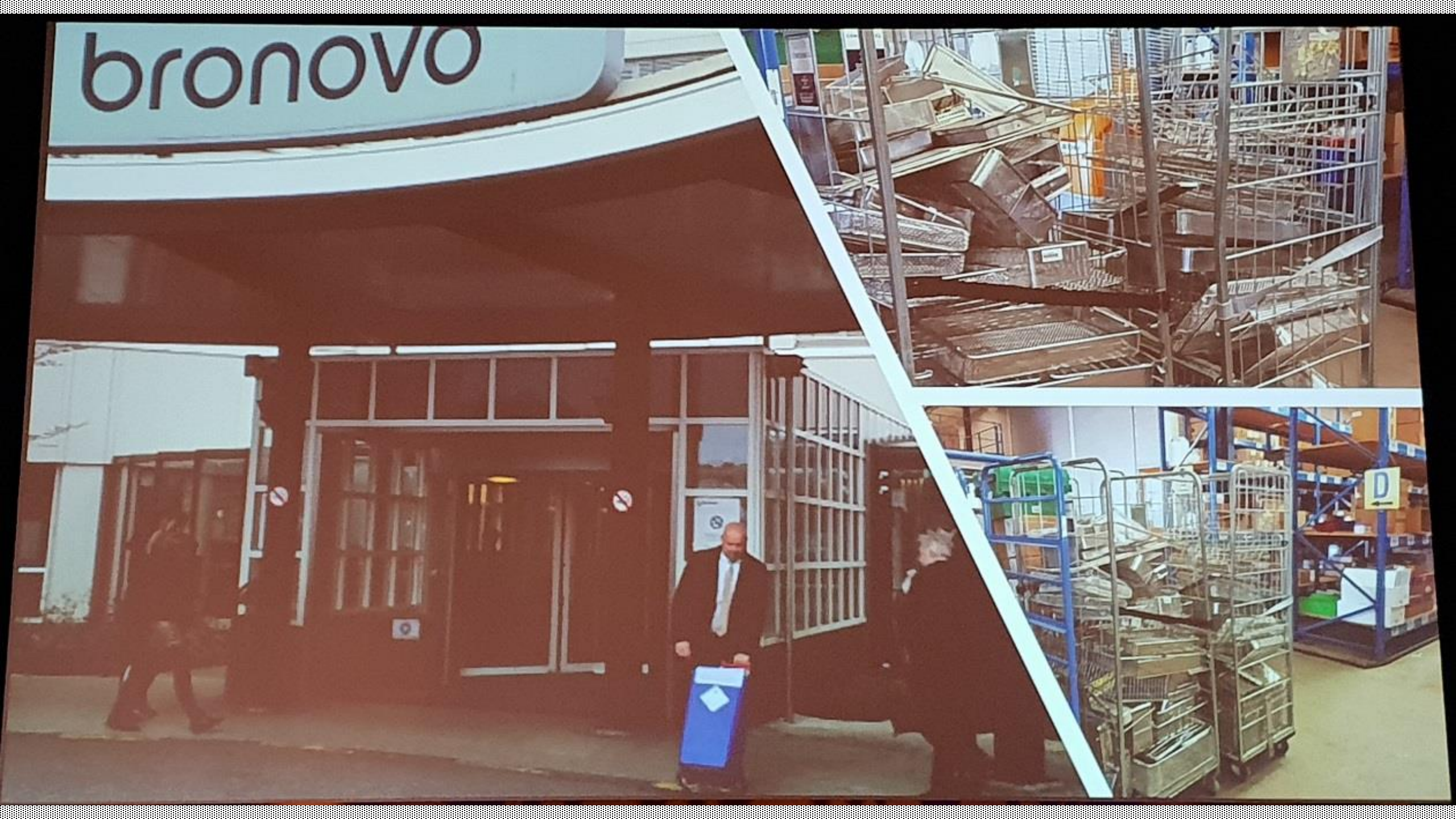
- More than one ton of rejected instruments were collected from four different hospitals during a period of 24 months.
- Some instruments needed to be separated on material specification.
- 95% of the waste consisted stainless steel that was completely recyclable.
- The remaining 5% consisted of plastic wrappings and protective caps, valves and aluminum labels/ tags.



Results

- From the 1.380 Kg, 50 Kg consisted of disposable stainless-steel instruments.
- 1.330 Kg was found to be surplus stainless-steel instruments and surplus mesh baskets.
- *The cleaning and handling costs of disposable stainless-steel instruments was calculated at 50 cents per Kg waste.*

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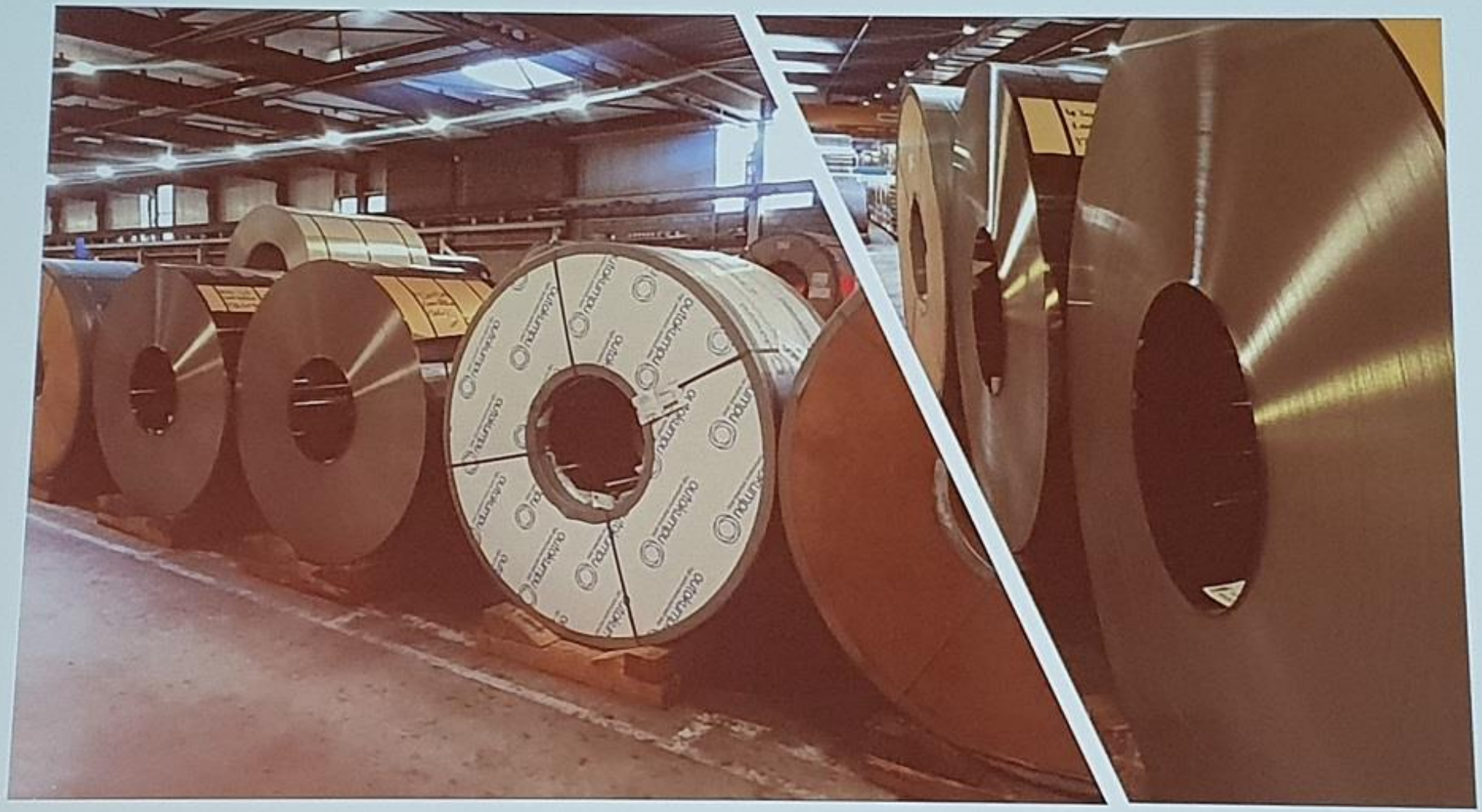
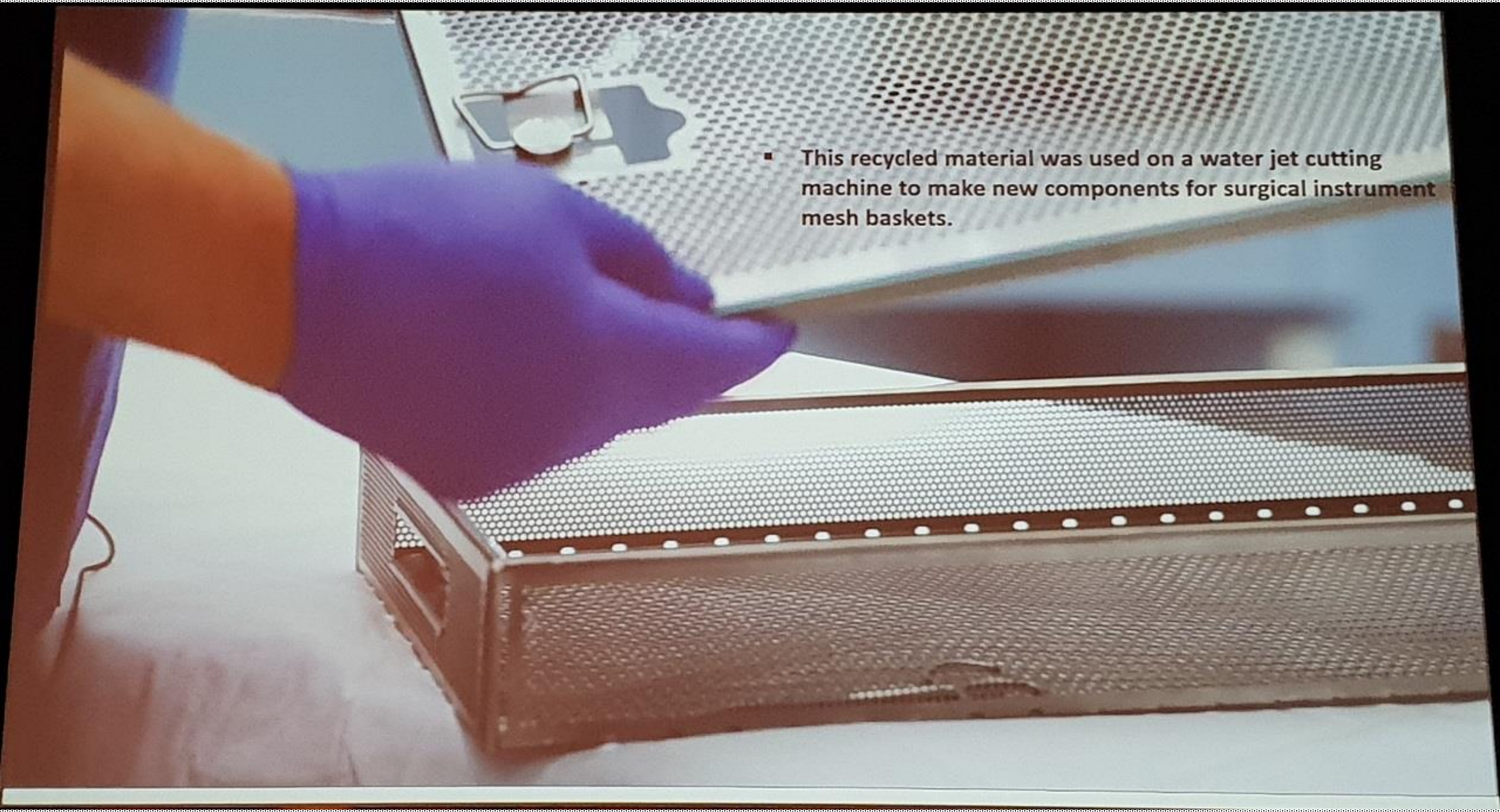
- 95% of the waste consisted stainless steel that was completely recycable.[6]

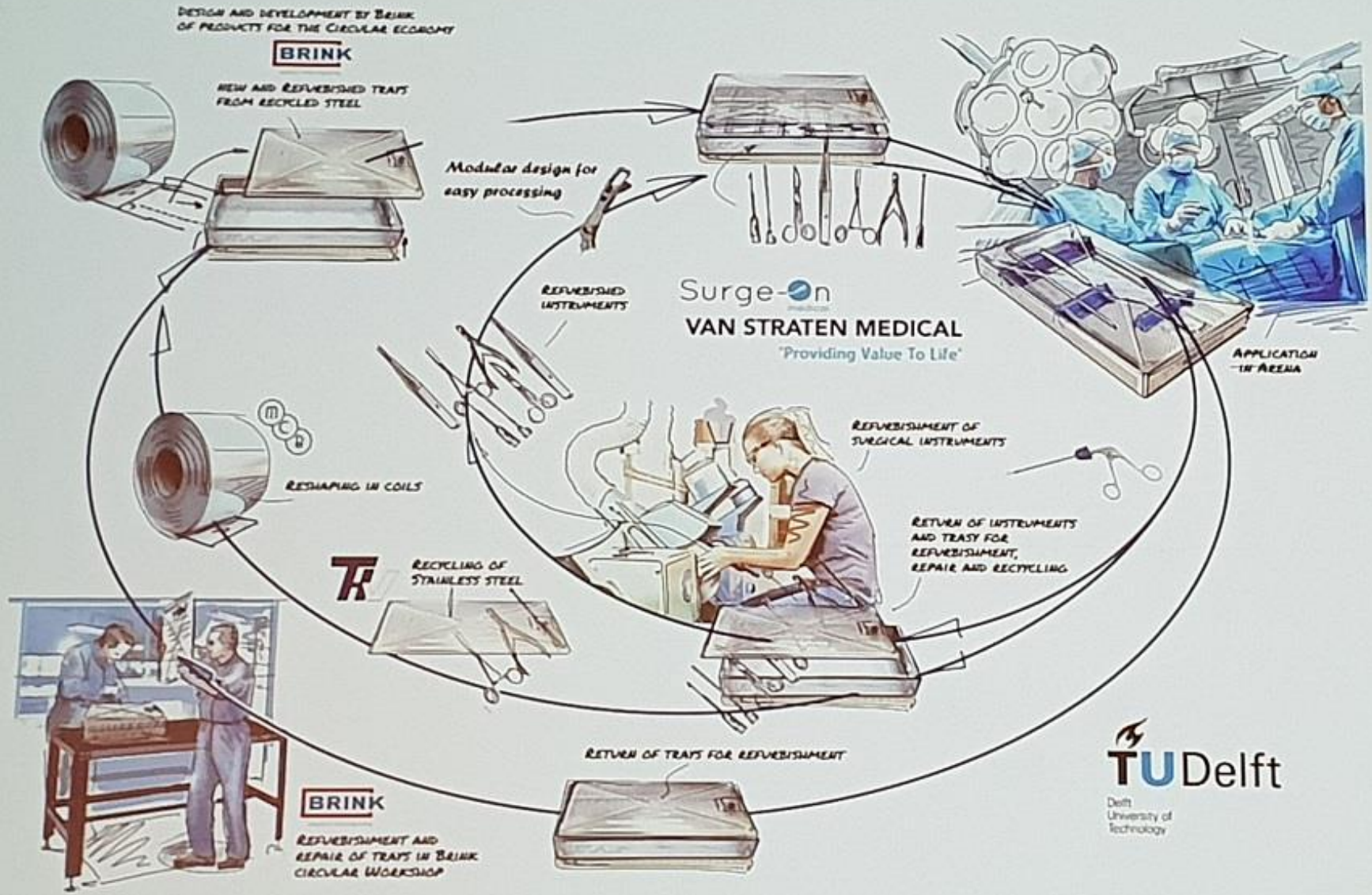
STAINLESS STEEL

MELTING




This recycled material was used on a water jet cutting machine to make new components for surgical instrument mesh baskets.

Modular designed instruments



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Modular design

→ Easy repair

→ Reusability

→ Materials recycling

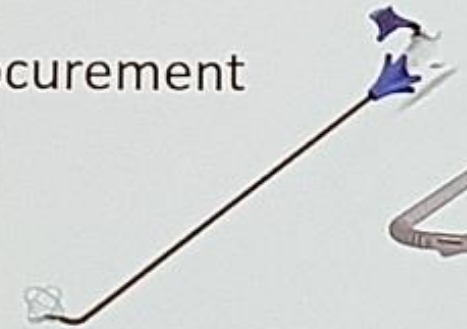
Most “advanced” laparoscopic instruments are (semi) disposable

Advantages:

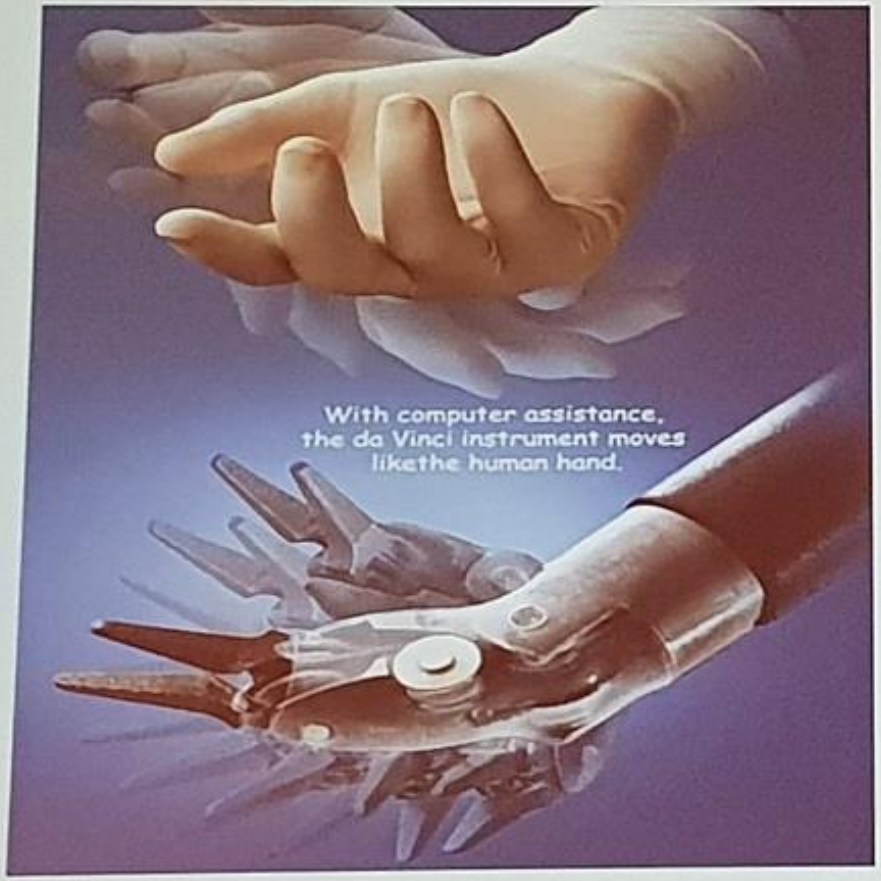
- No sterilisation costs
- Sterility is guaranteed
- No complex modular design

Disadvantages:

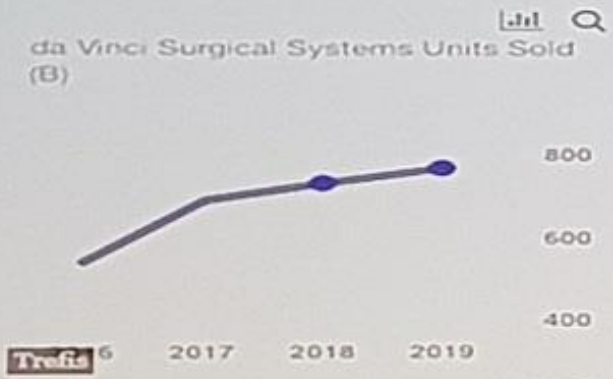
- Waste is expensive
- Environment
- Growing interest for sustainable procurement
- **Complex disposables are expensive**

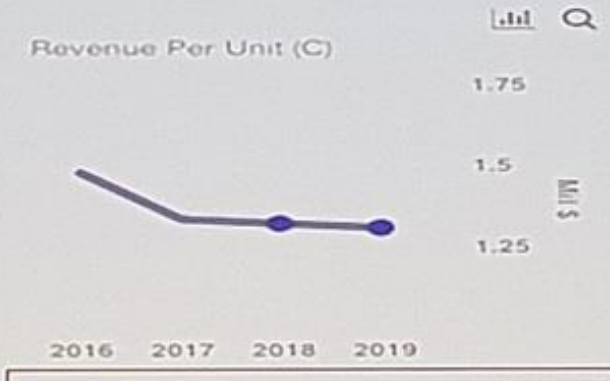


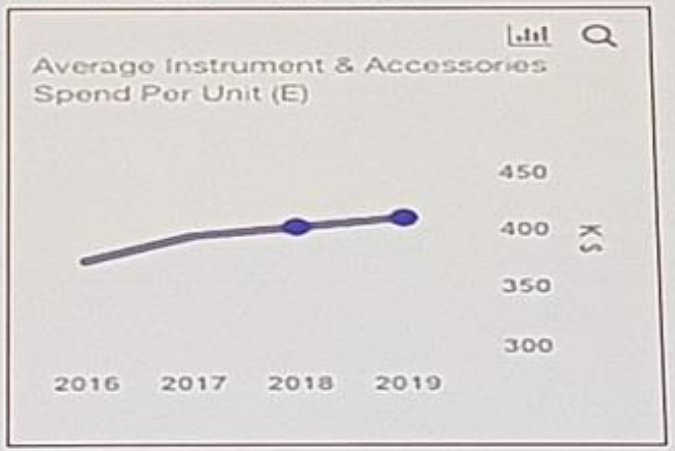
Example: sustainable steerable instruments



Problem: Current Surgical robot related costs







- Around 30 systems sold yearly → 50 Mil revenue
- Instruments 1500 x 400 → 600 Mil revenue

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[Forbes 2018]

Instruments designed for High profit markets

SI- Endowrist
Needle driver

SI- Endowrist Xi
Needle driver

TransEnterix
Needle driver

TU Delft

Instruments designed for High profit markets

SI- Endowrist
Needle driver

SI- Endowrist Xi
Needle driver

TransEnterix
Needle driver

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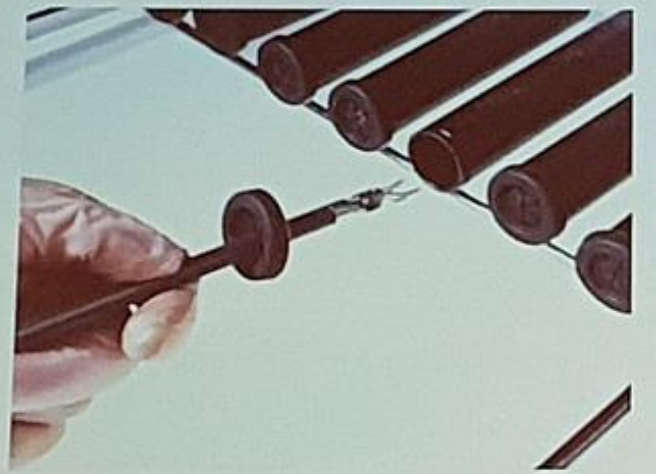
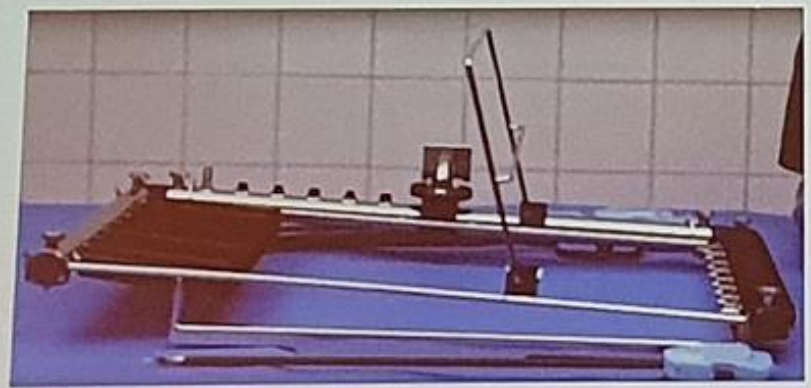
Instead focus on advanced cleaning

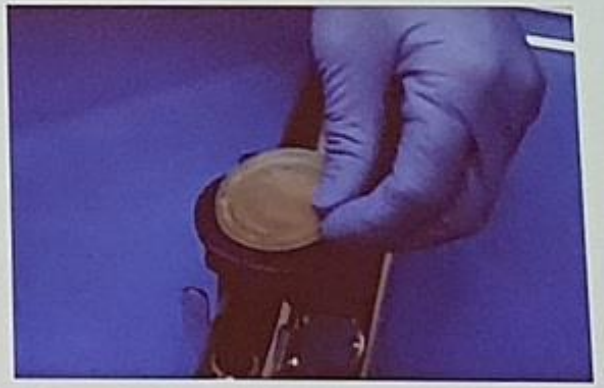


Special connection mounts for tip

Special connection mounts for base

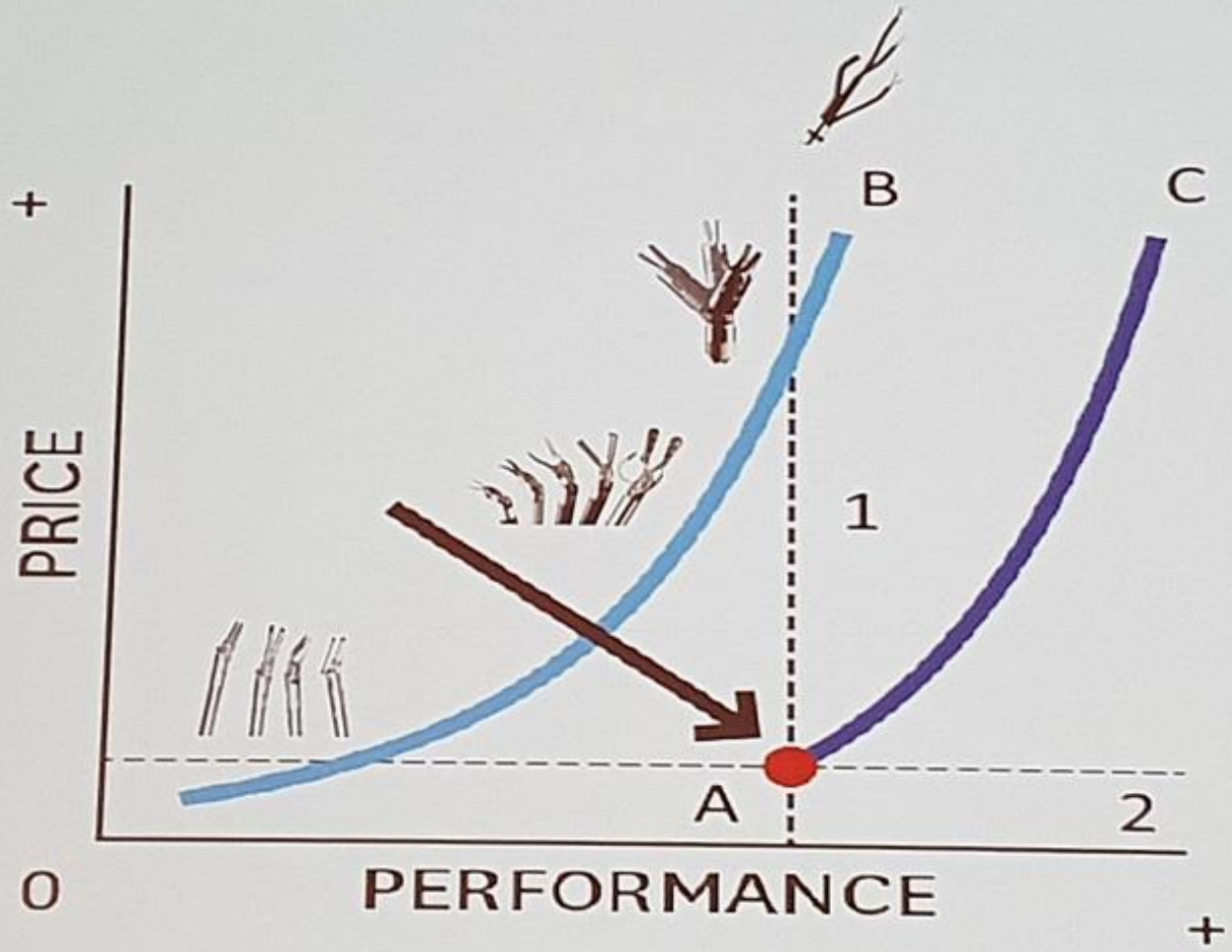


Special trays/methods for instrument positioning



Special methods to clean tray

Disruptive technology is needed



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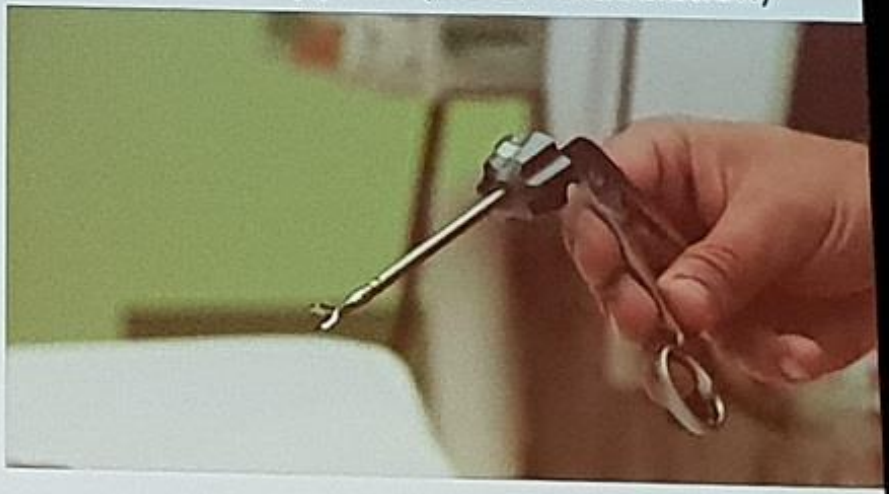
[Amos 2016]

Next step: Design for sustainable use

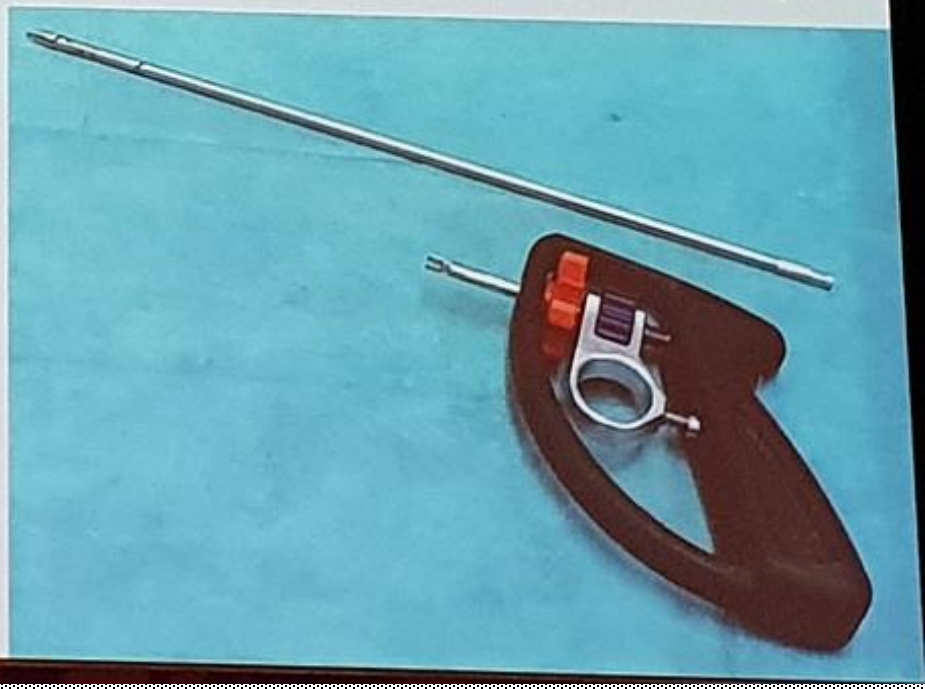
What can we do to facillitate the cleaning process and instrument recycling?

- Modular instrument with replaceable components
  - No “hidden” areas
  - Inspection of all components possible
- Conventional (simple) cleaning methods
  - Standard cleaning trays
  - Horizontal positioning
  - Flushing with Luer-lock

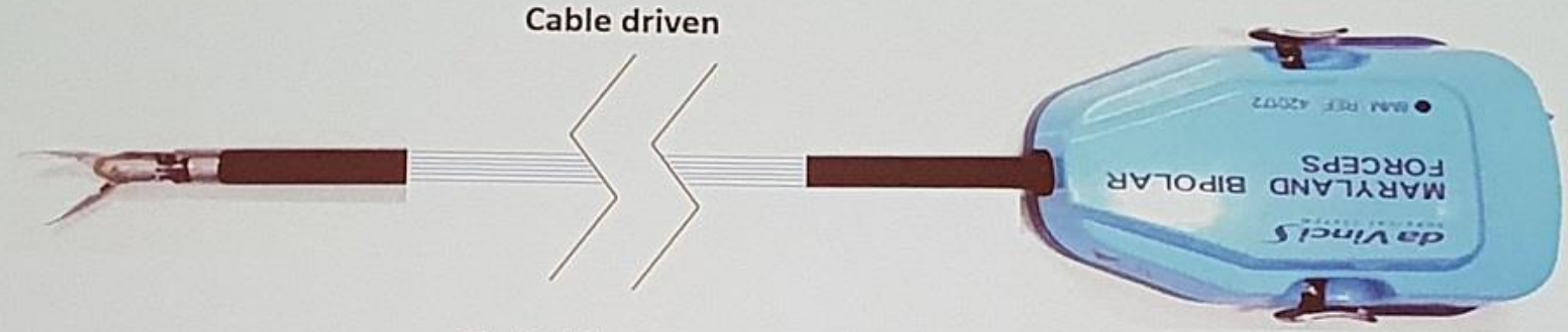
SATA Arthroscopy line (1 DOF articulation)

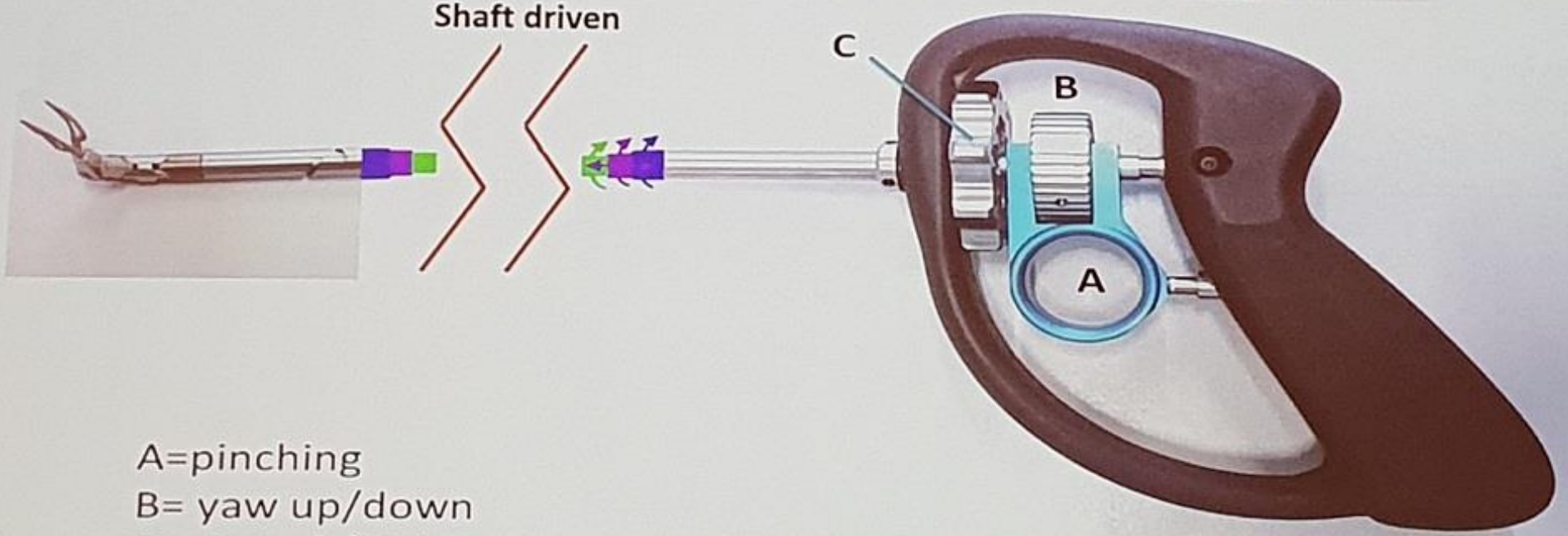


SATA Laparoscopy line (2DOF articulation)



Focus on cleanable instruments





A=pinching
B= yaw up/down
C= tip Left/Right

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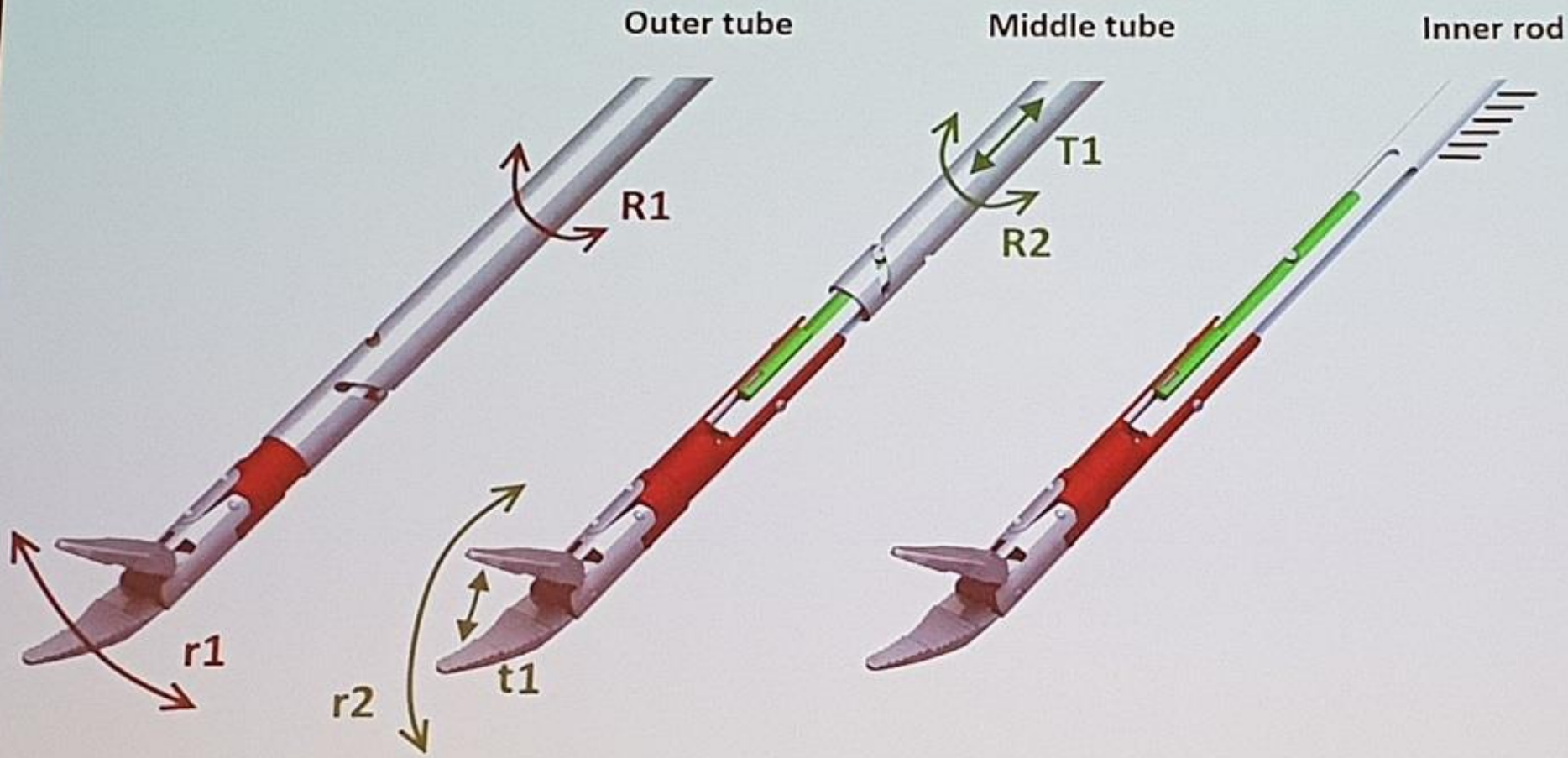
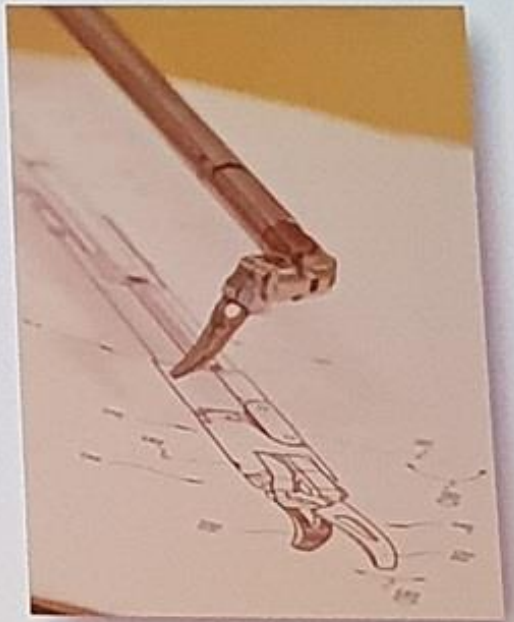
3 tubes for tip actuation, No cables



2 patents granted
2 patents PCT



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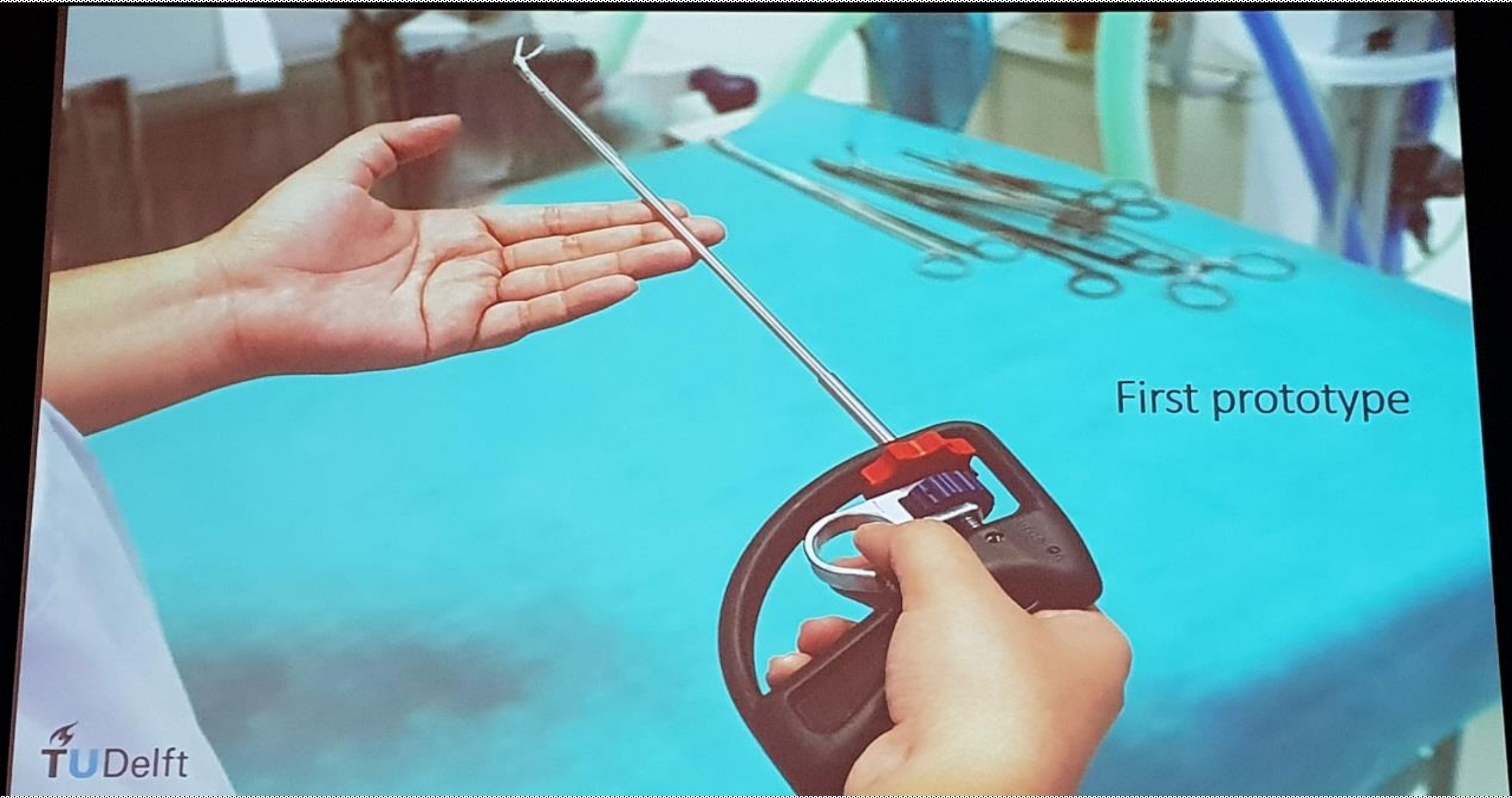
First prototype
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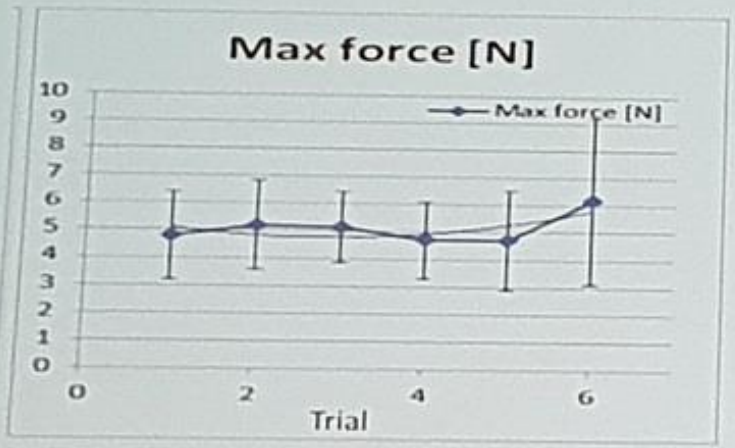
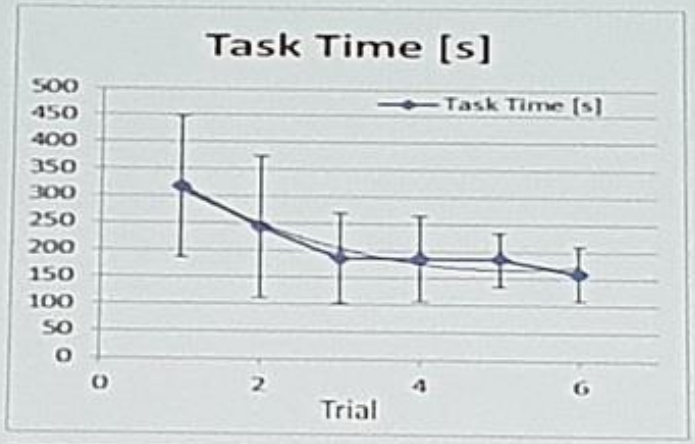
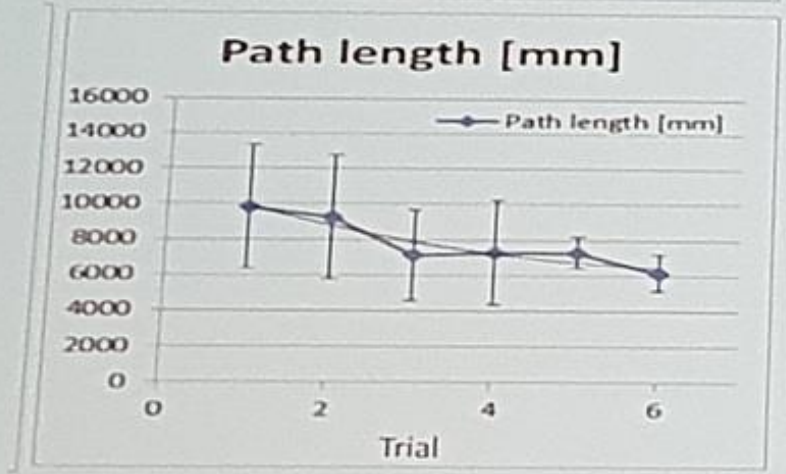
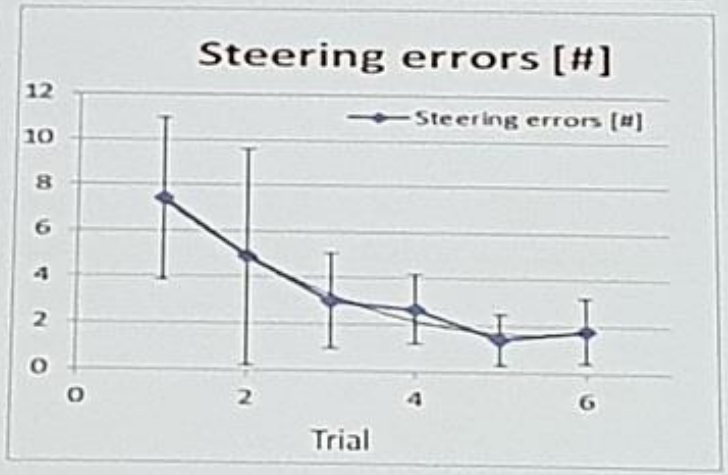
Box trainer Results

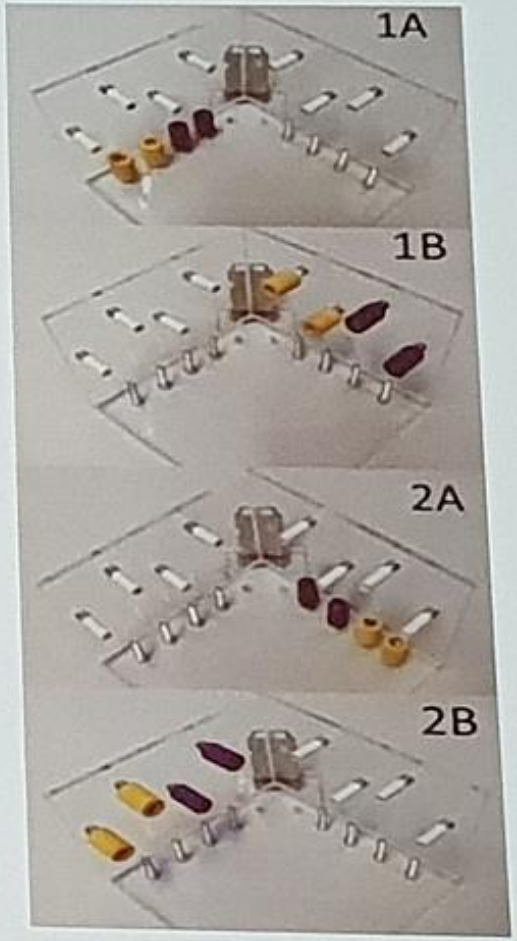








1 trial



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Results interpretation

Cost calculation example:

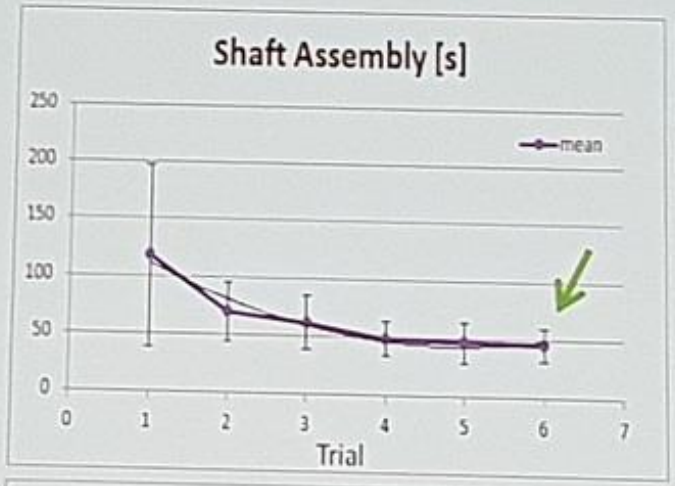
- Well trained CSD employee assembles in ~ **1 minute**

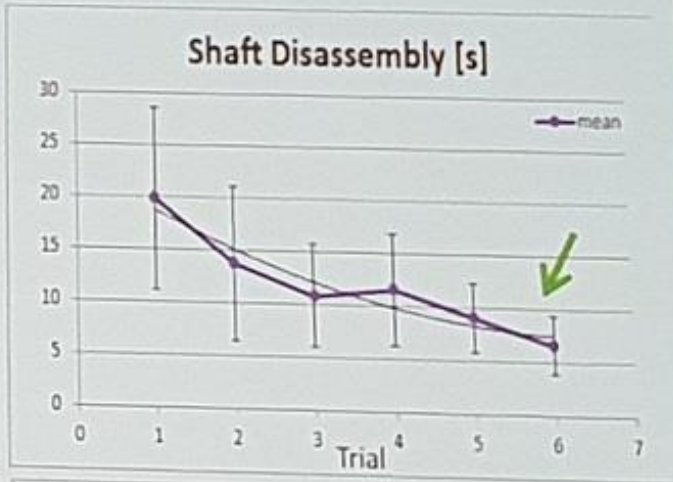
- Robot instrument (7k euro) 10 times reuse ~ 100 euro processing.

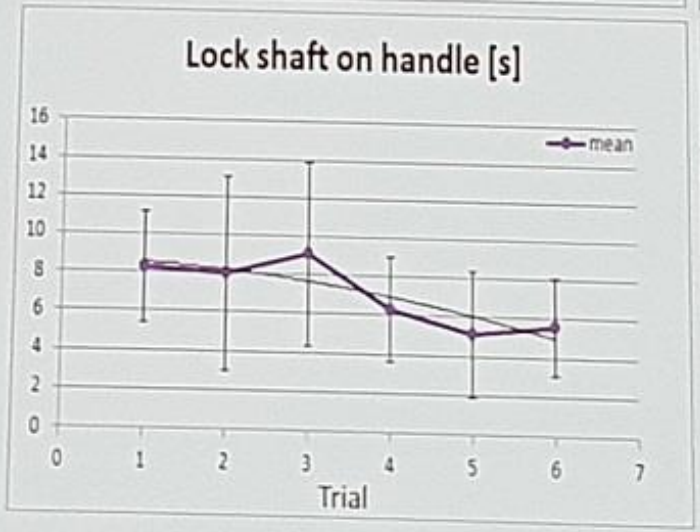
  → Total **60** procedures **42.600 euro**

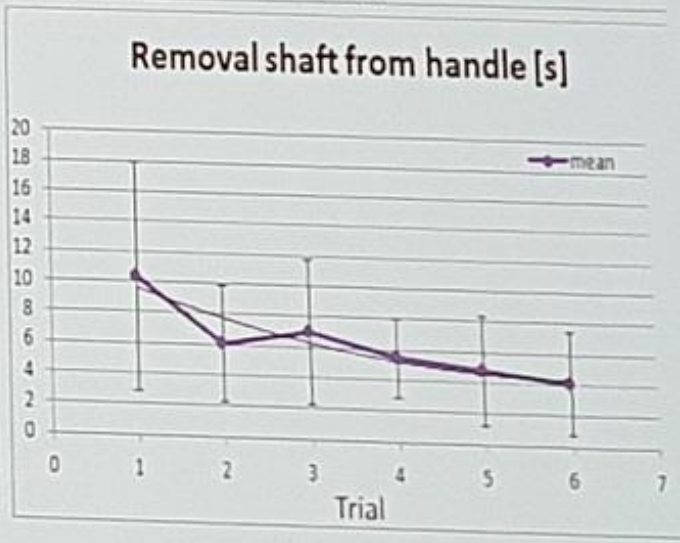
- SATA instrument (target 5k euro): 60 times reuse cost ~ 600 euro processing & 60 euro extra processing fee.

  → Total **60** procedures **5.660 euro**









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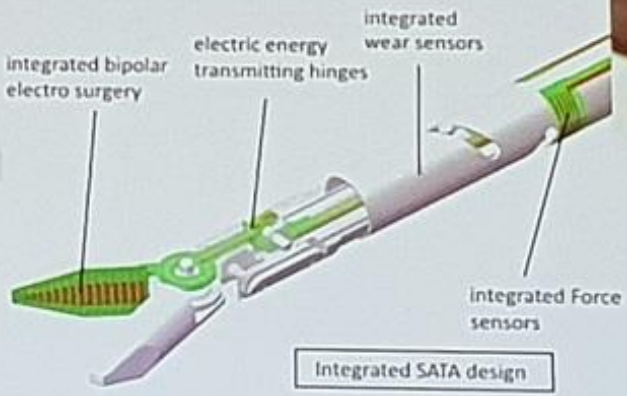
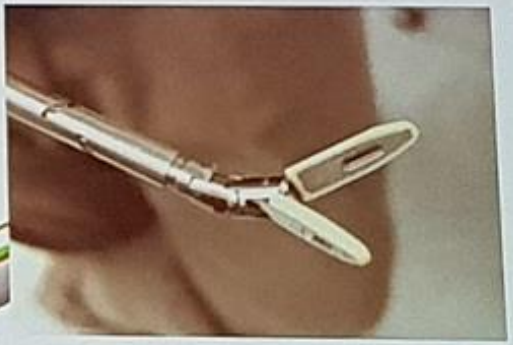
Latest developments and scientific programs

- Arthroscopy

- Laparoscopy





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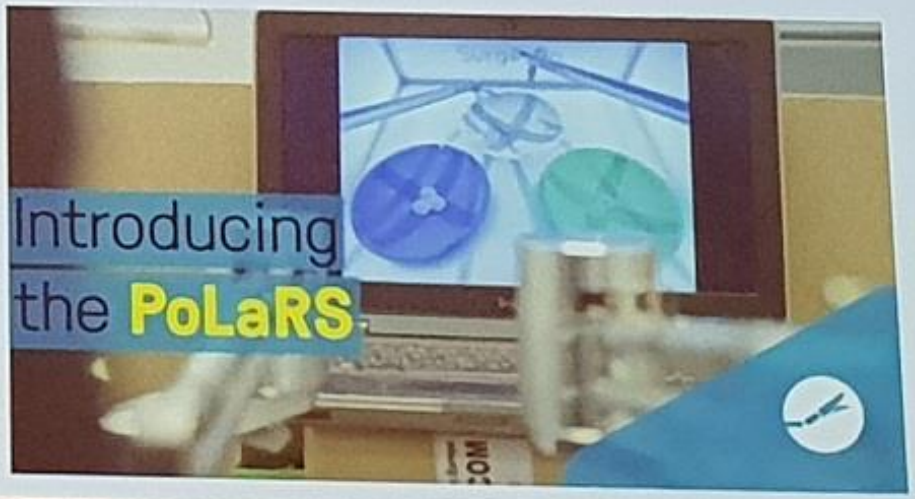
- PoLars Mastertrainer



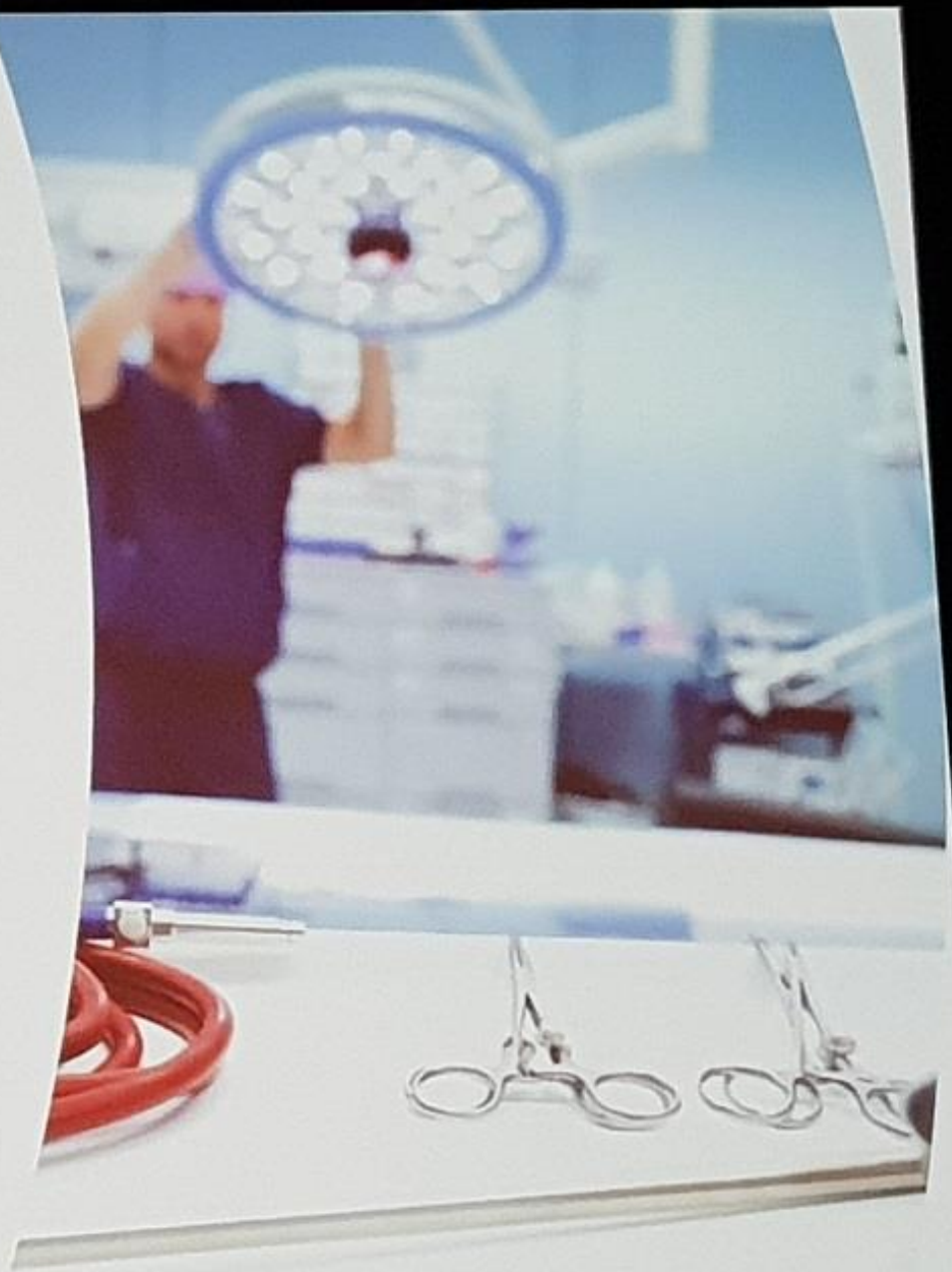
- **New research line Circularity for sustainable surgery**
- **SMART surgical instruments- collaboration India and The Netherlands for a.o. modular SATA based instruments**
- **RAPID – NIMIT program for Reusable modular catheters**

[Horeman, Van straten, Larsson, Robertson, Weij, Dankelman, Schilder, Klok, *MISIT-CSS group* ,TU-Delft (2019)]

Conclusion

The outcome indicates that circular models for reprocessing of surgical waste can be feasible as sustainable solution.

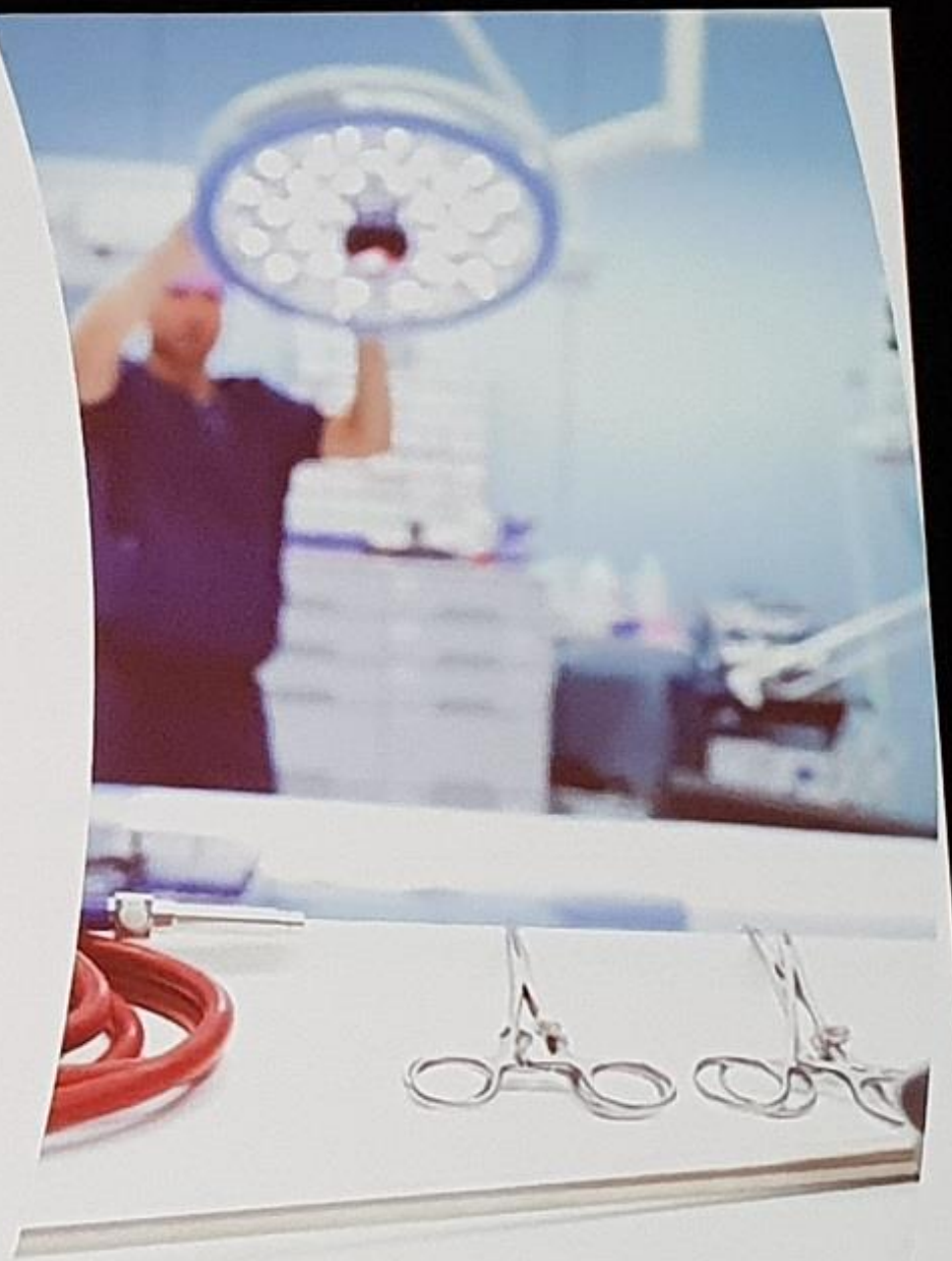
- Collecting and recycling of stainless steel waste seem economically feasible.
- Modular advanced endoscopic instruments are feasible in terms of waste and cost reduction.



Take home message

- In order to support recycling and circular reprocessing, hospitals should collaborate and allow collection of hopital waste for recycling.

- Expect a change on the OR/CSD towards more sustainable and smarter instruments



Thank you for your attention

- Follow our research on LinkedIn and Facebook:
  Tim Horeman & Bart van Straten.