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# 9th EORNA Congress

16-19 May 2019

The Hague, The Netherlands

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## “ON THE MOVE”

9th EORNA Congress

The Hague, The Netherlands

16 - 19 May 2019

12 RESPONSIBLE  
CONSUMPTION  
AND PRODUCTION



How circular economy technology contributes to  
sustainable instrument management

B.J. van Straten, T. Horeman

EORNA 18 May 2019

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



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# Disclosure

SuperSeton  
business, single, service

 TU Delft

Delft University of Technology

 Tulipa

Amsterdam

Den Haag



Surge-on  
medical



**Van Straten Medical**

*Founded by J. van Straten in 1975*

*Production, repair, supply and fixation of medical instruments.*



*Active in 26 countries.*



**Medinorm Medizintechnik GmbH**

*Co-founded by J. van Straten in 1984*

*Production of wound drainage systems.*

**VAN STRATEN MEDICAL**

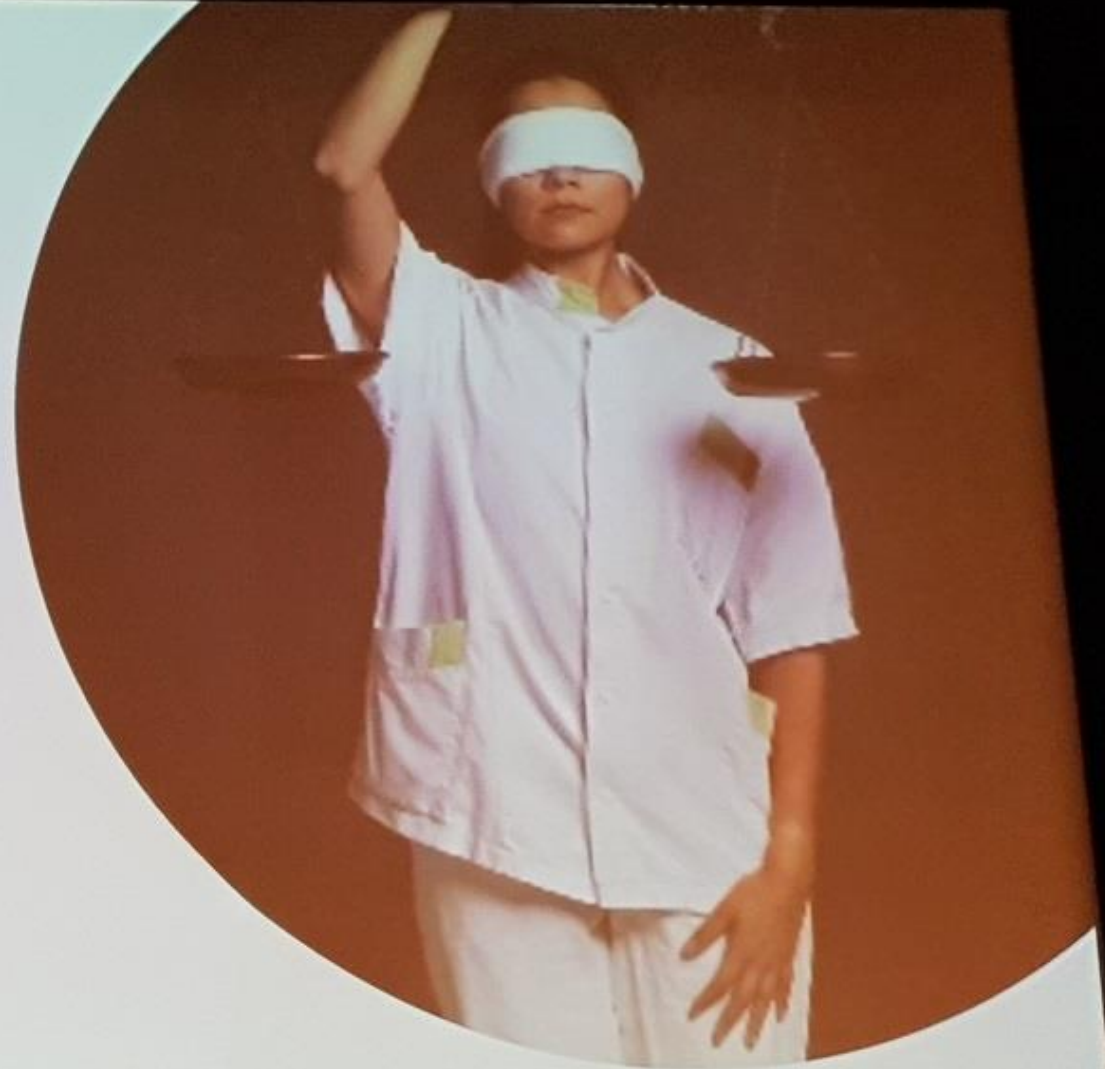
*'Providing Value To Life'*

# *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.<sup>1</sup>*

*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.<sup>2</sup>*

*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.



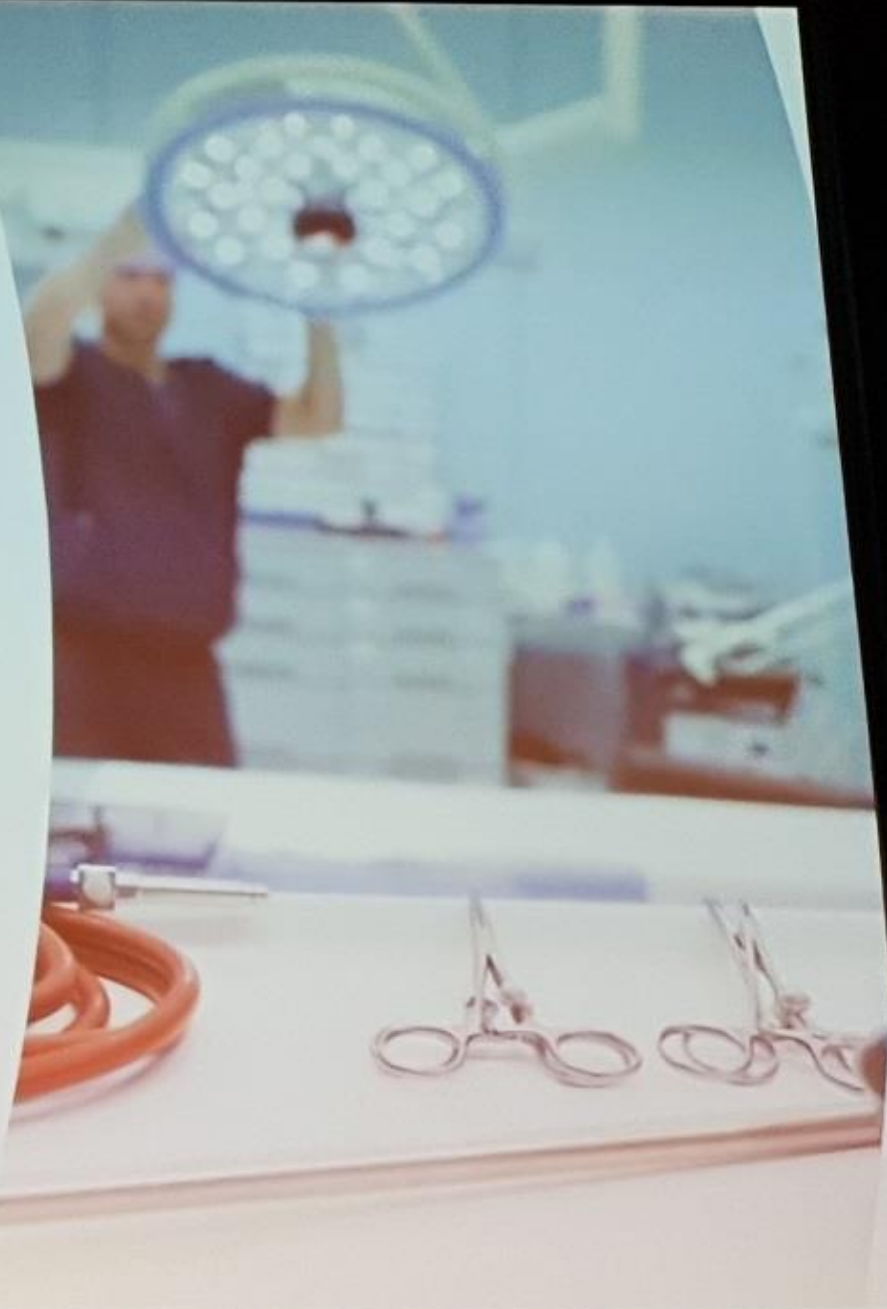
# Relevance

Generating waste in society is increasing

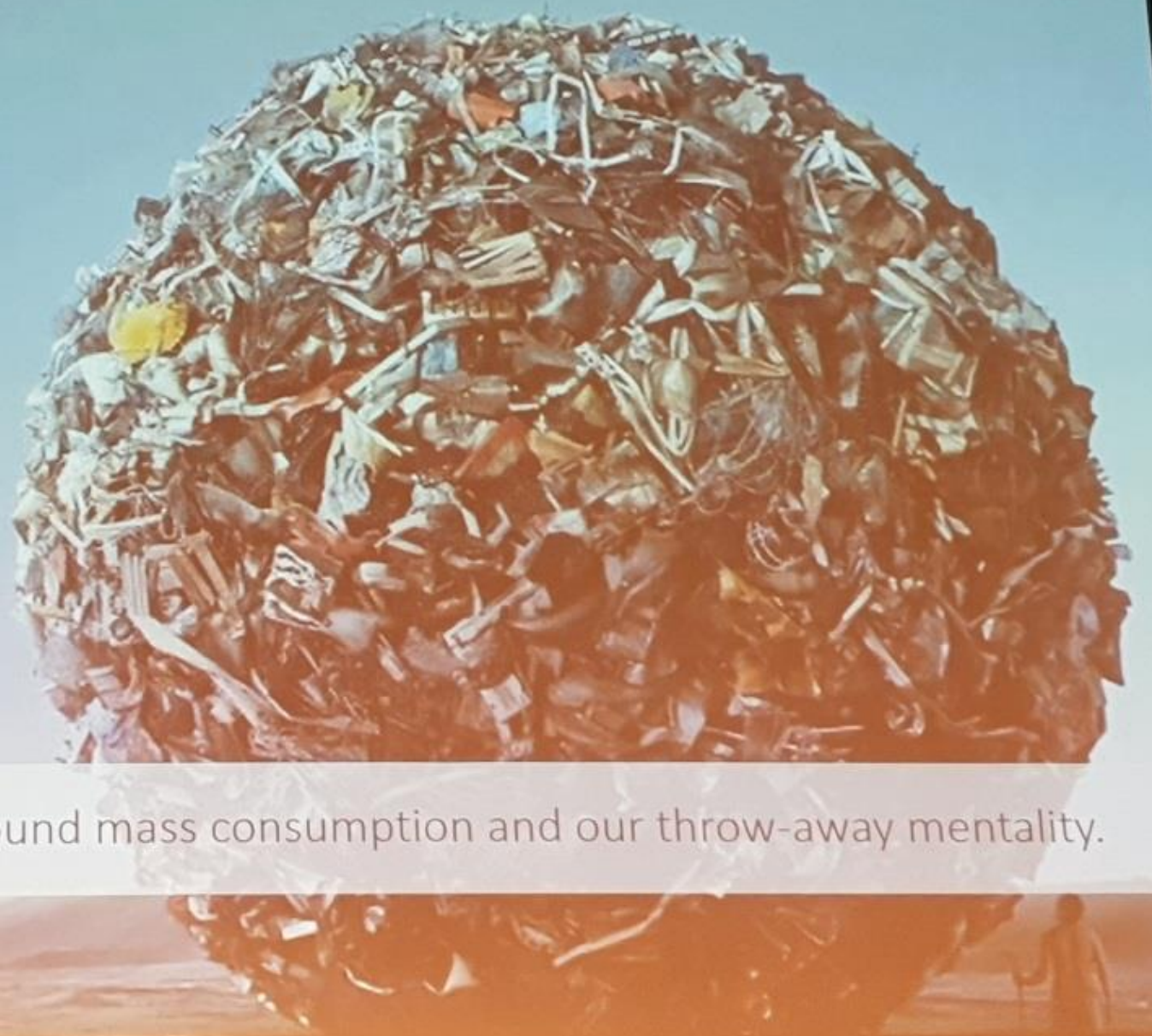
- In 2018, the Netherlands exported 6.847 thousand tonnes of recyclable metal waste only. That is 3 percent more than in 2010.<sup>3</sup>
- 25.000 tons of Dutch waste was exported to Indonesia only in 2018, compared to 1.000 tons in 2017.<sup>3</sup>
- Metal-ore extraction and metal production increased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

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)

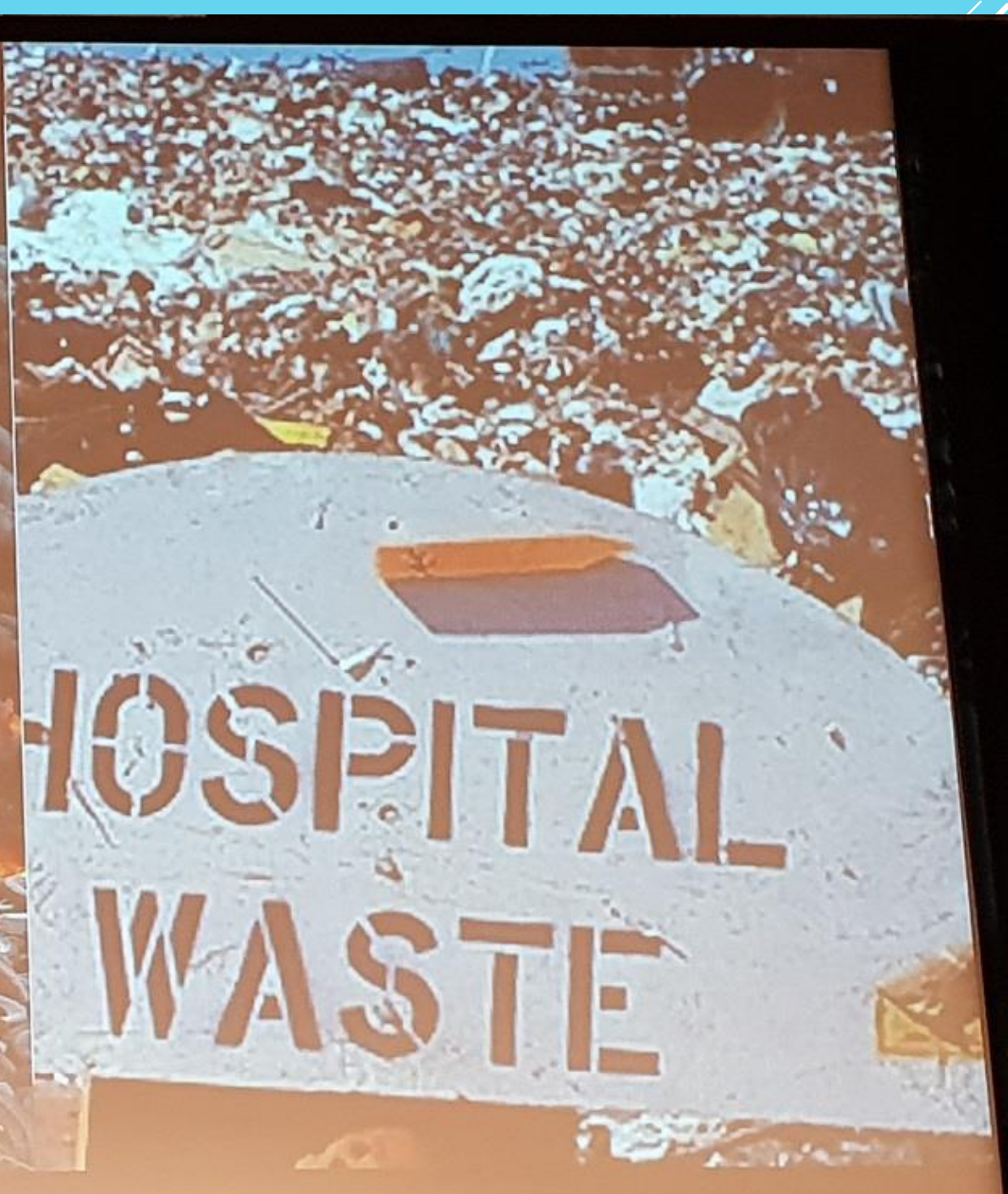
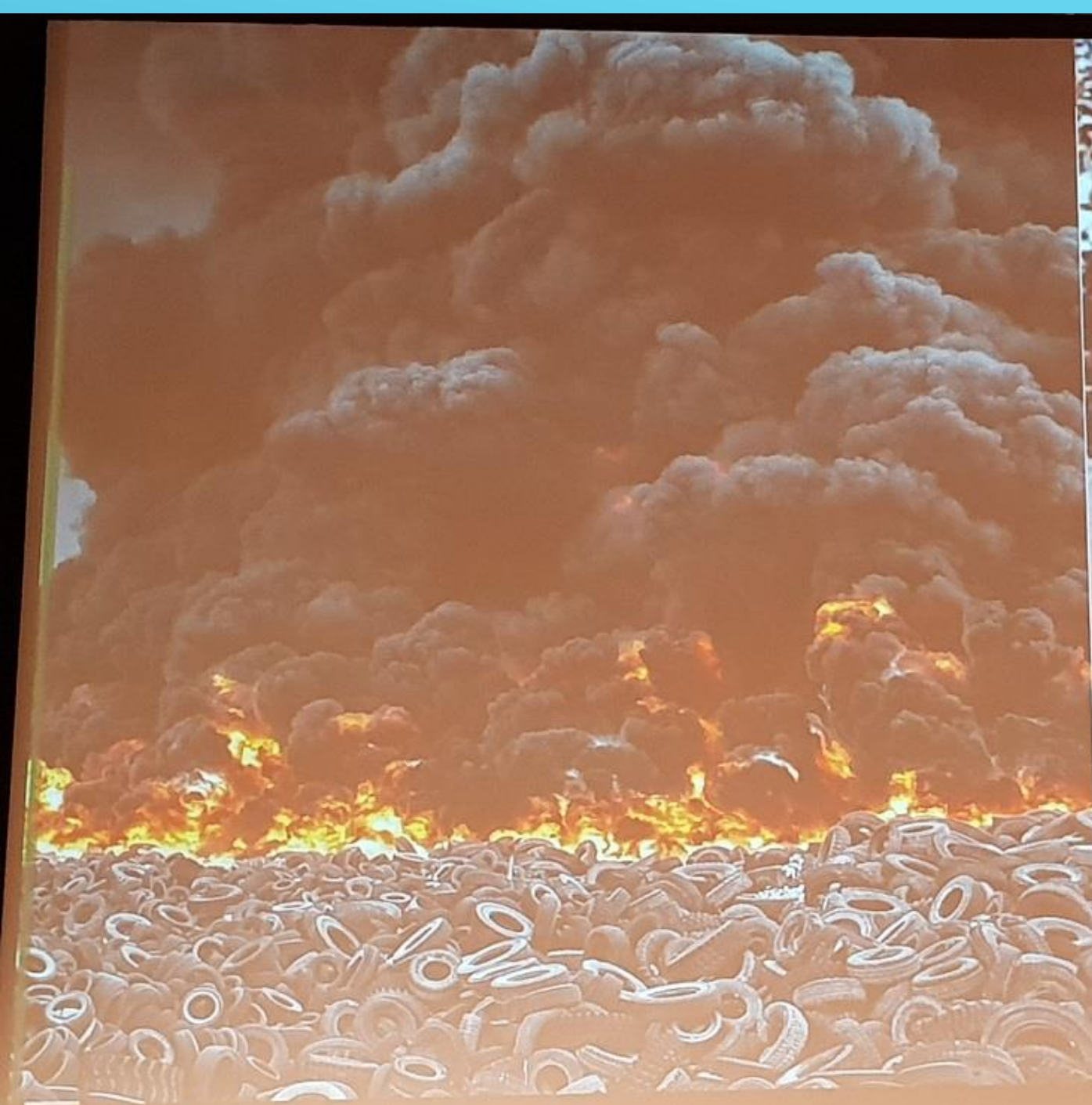


From our planet's point of view,  
there's no throwing garbage out.  
Because there is no "out".



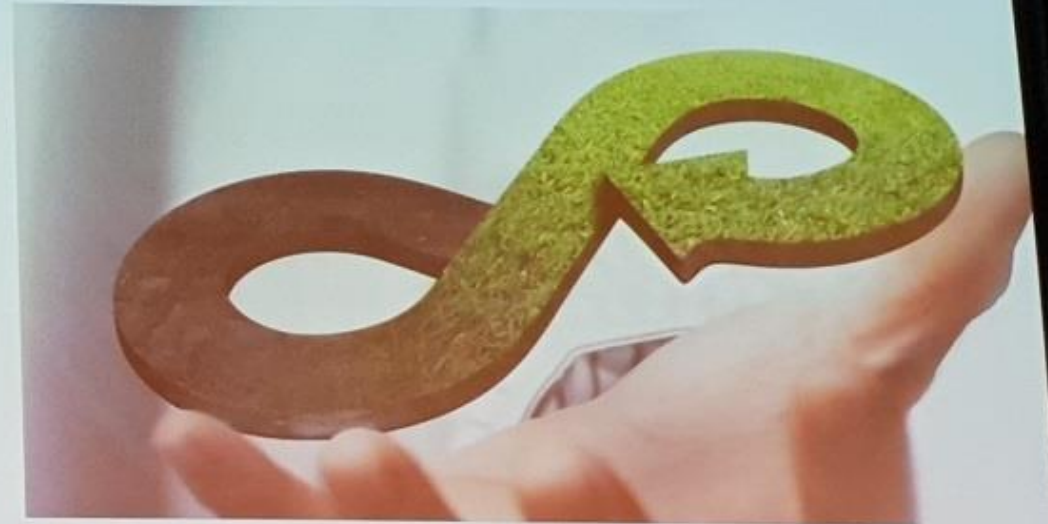
We need to change awareness around mass consumption and our throw-away mentality.





# 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.<sup>3</sup>
- Waste minimized. this can be achieved through long-lasting design, **maintenance, repair, reuse, remanufacturing, refurbishing, recycling, and upcycling**<sup>1</sup>. This is in contrast to a linear economy which is a 'take, make, dispose' model of production.<sup>4</sup>

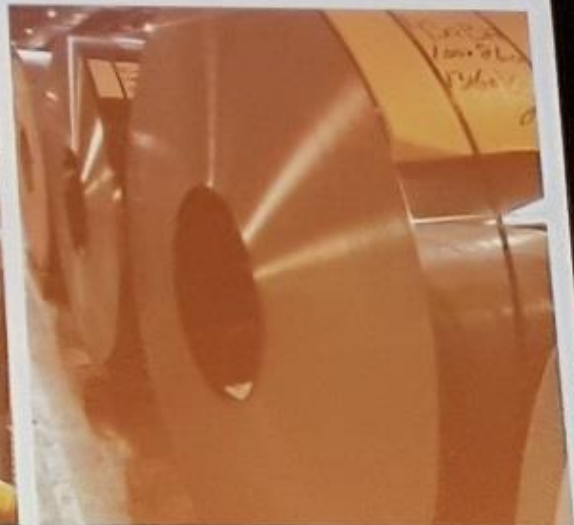


<sup>3</sup>. Geissdoerfer, Martin et al. (2017). "The Circular Economy – A new sustainability paradigm?". *Journal of Cleaner Production*. 143: 757–768.

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

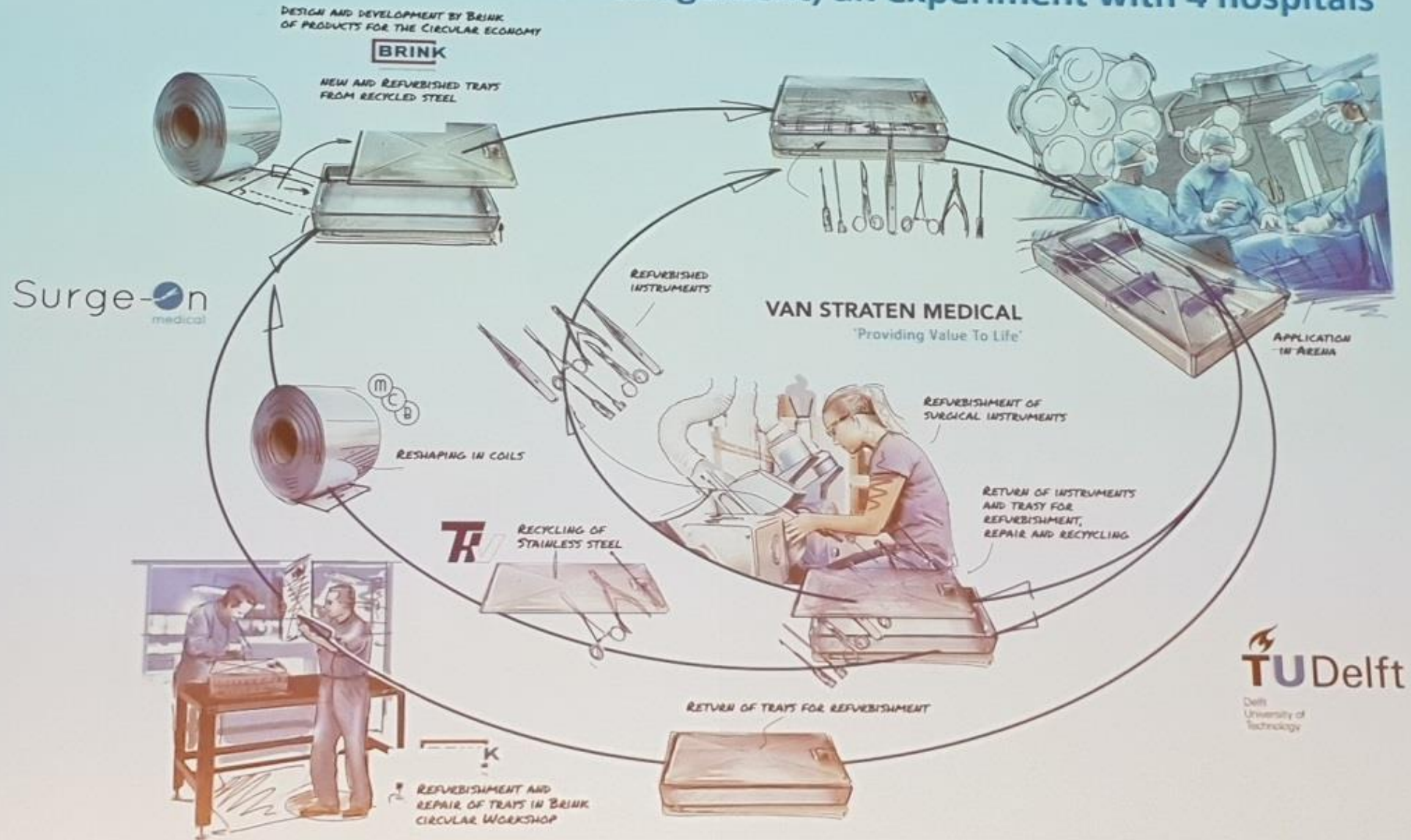
## Methods

- 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).
- These 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.

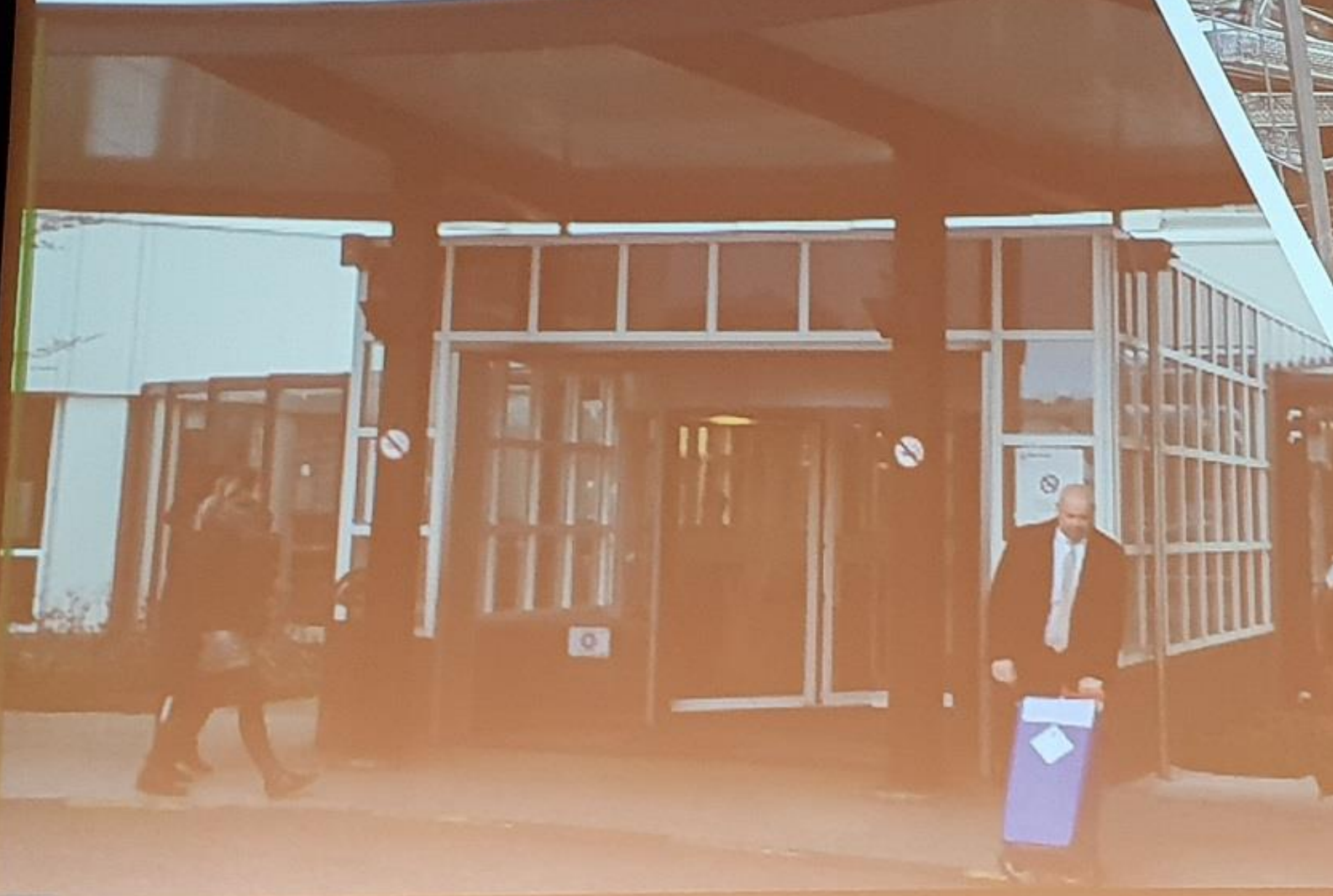


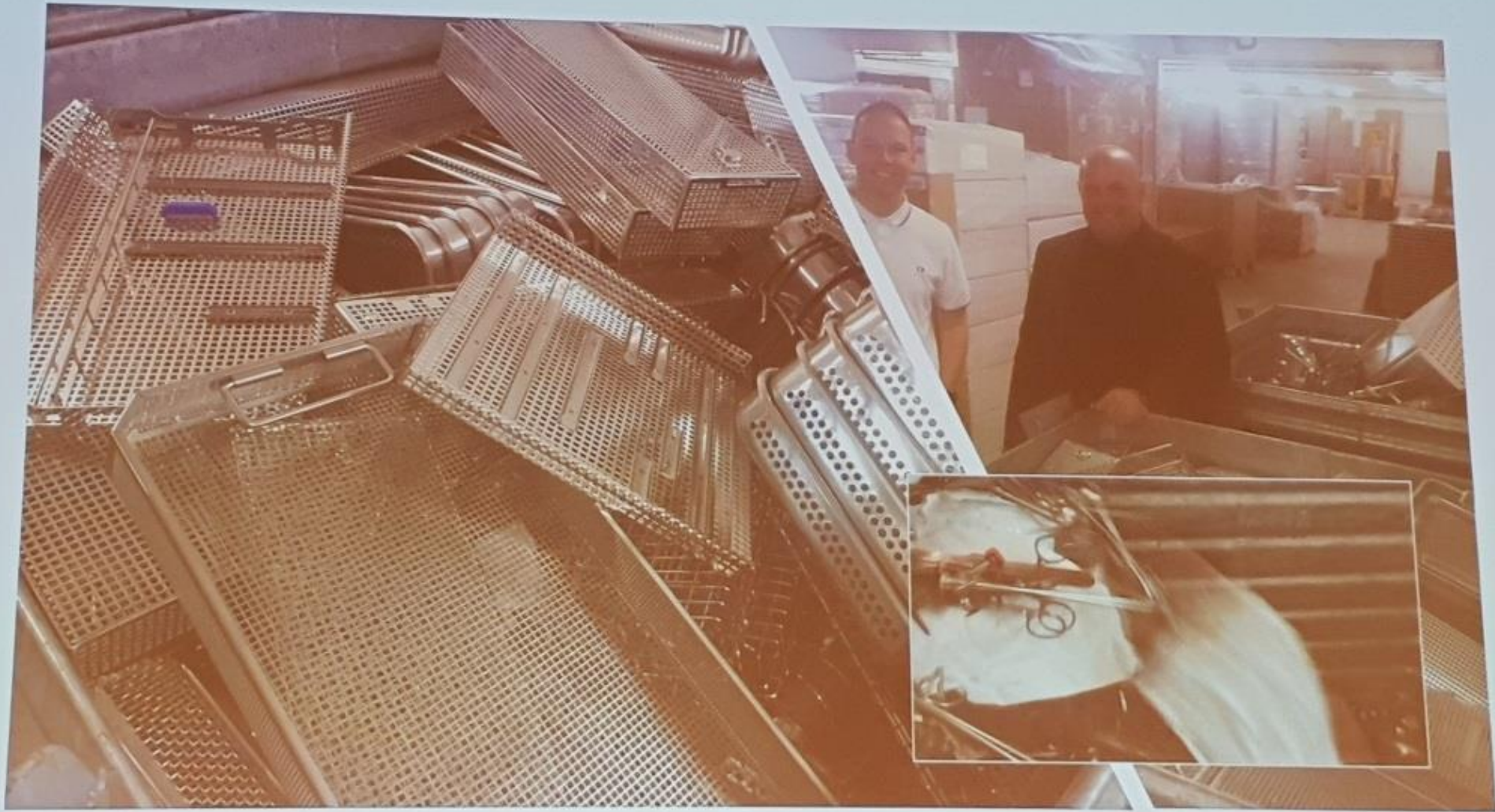
## *Results*

- From the 1.380 Kg, 50 Kg consisted of disposable stainless steel instruments.
- 1.230 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.



bronovo



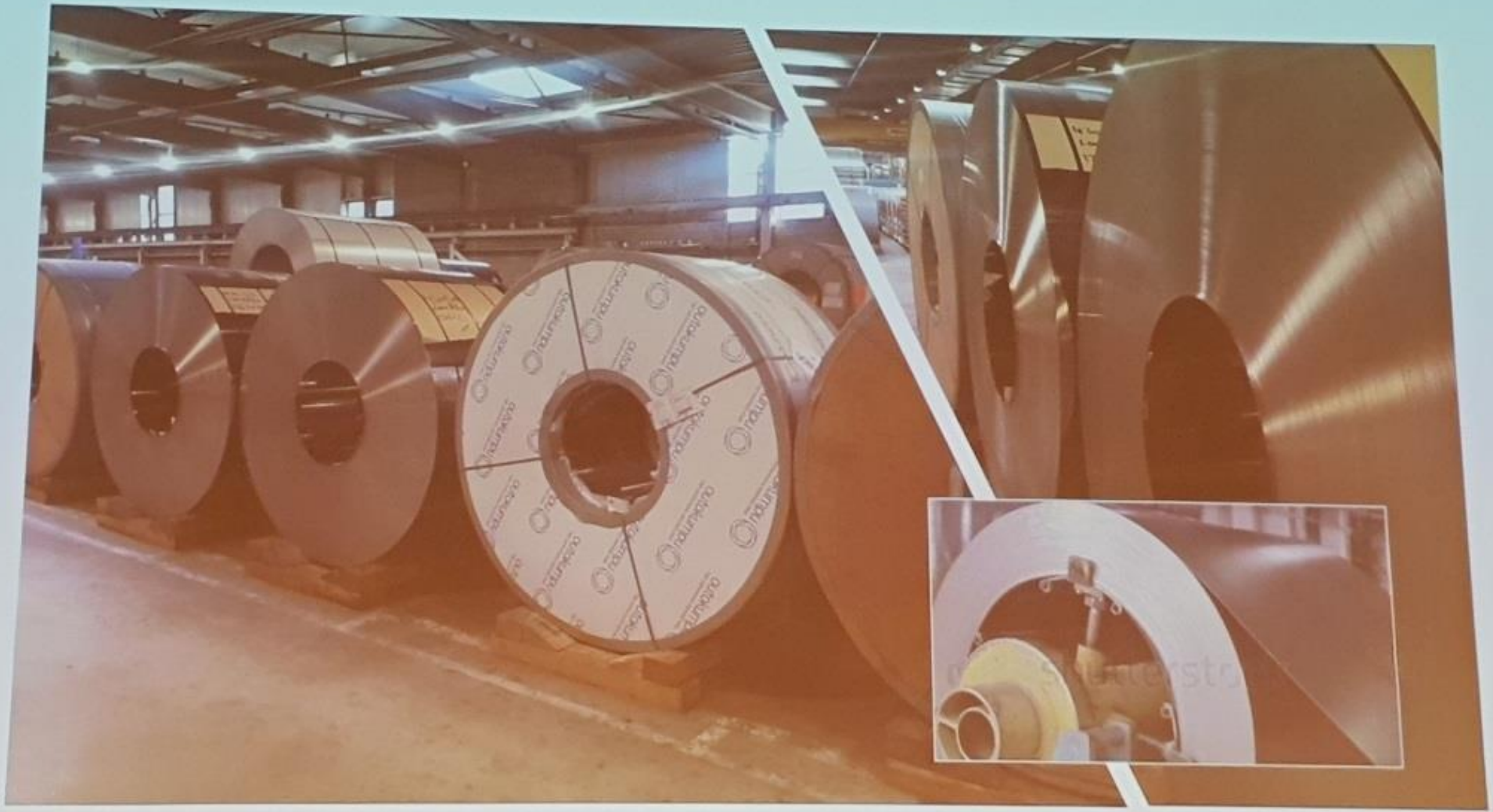


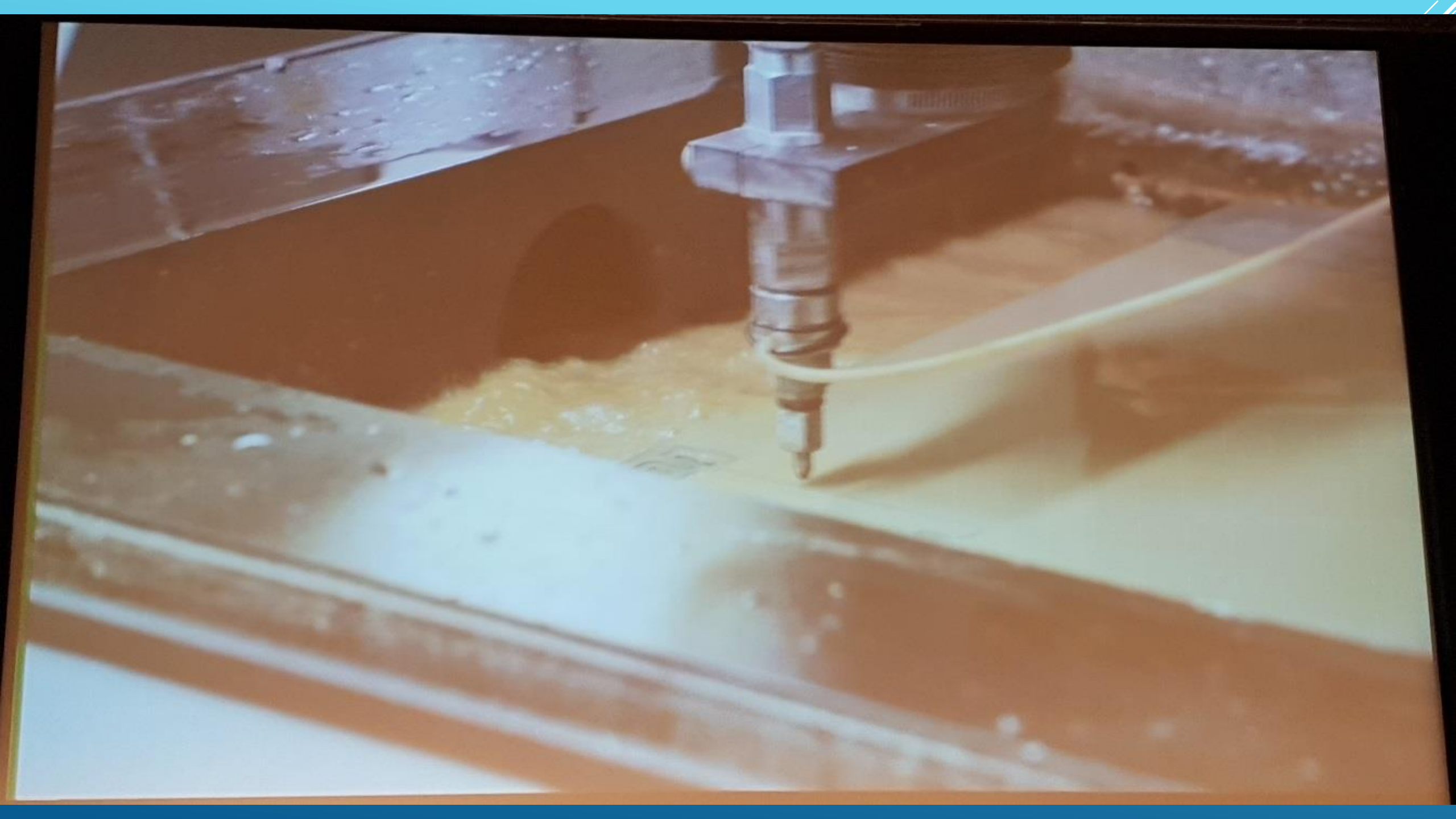
- 95% of the waste consisted stainless steel that was completely recyjnklable.<sup>6</sup>

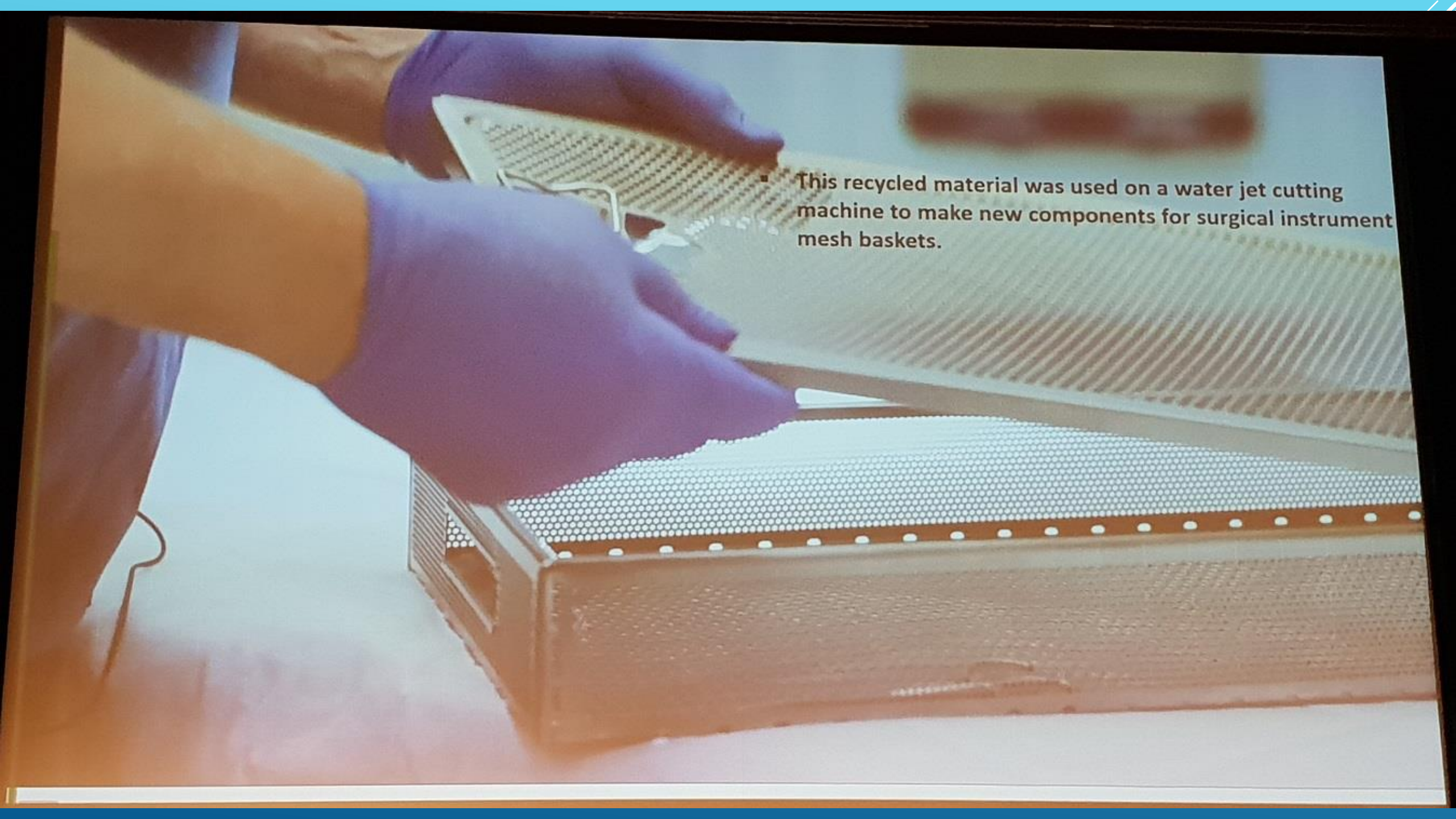


STAINLESS STEEL  
MELTING









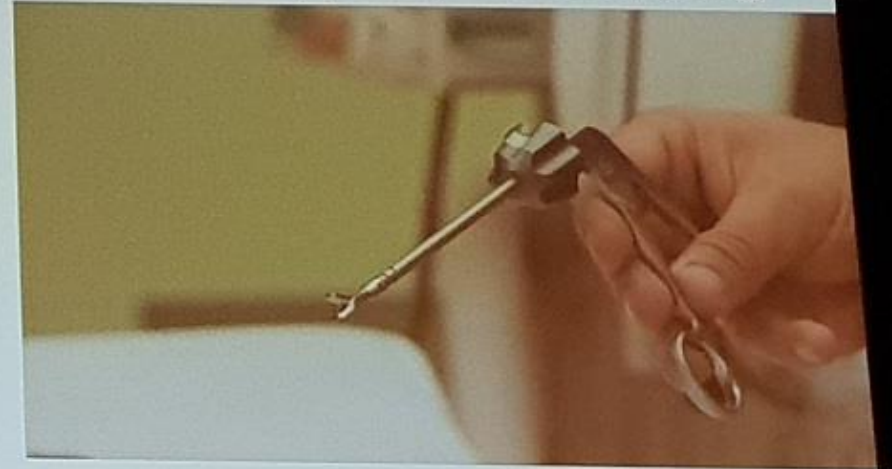
▪ This recycled material was used on a water jet cutting machine to make new components for surgical instrument mesh baskets.

## *Next step: Design for sustainable use*

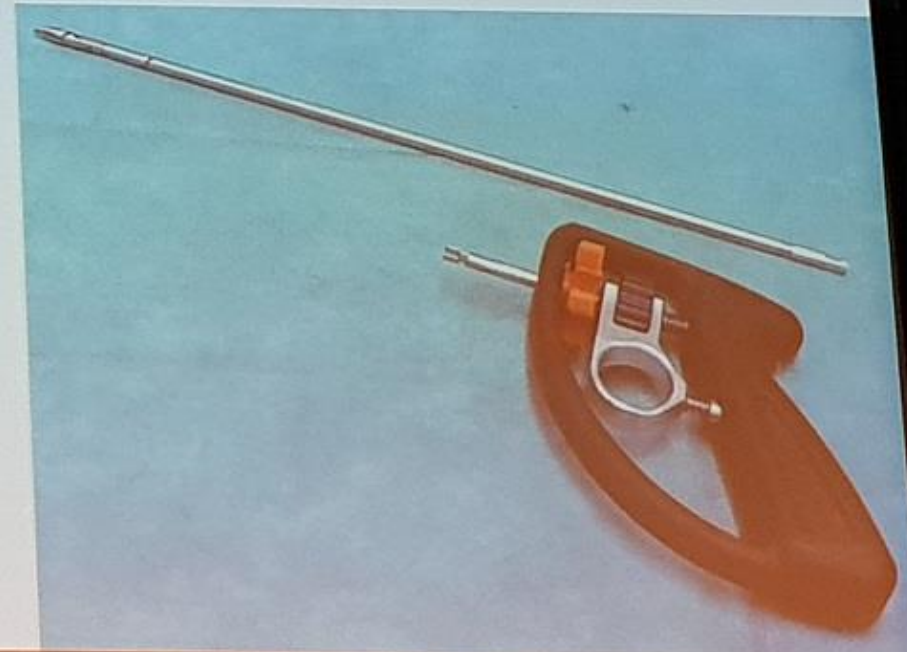
*What can we do to facilitate the cleaning process and instrument recycling?*

- Modular instrument with replaceable components
  - No “hidden” areas
  - Inspection of all components possible
- Conventional (simple) cleaning methods

SATA Arthroscopy line (1 DOF articulating)



SATA Laparoscopy line (2DOF)



# Example: sustainable steerable instruments

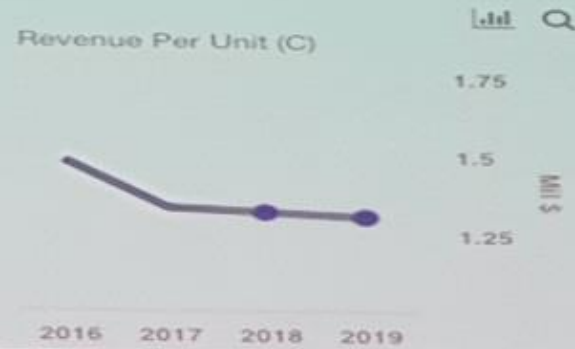


# Problem: Current Surgical robot related costs

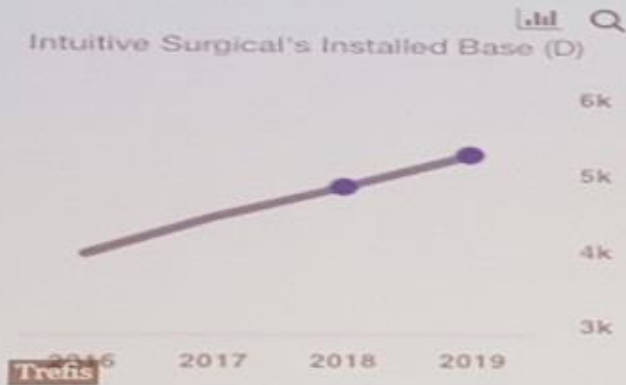
da Vinci Surgical Systems Units Sold (B)



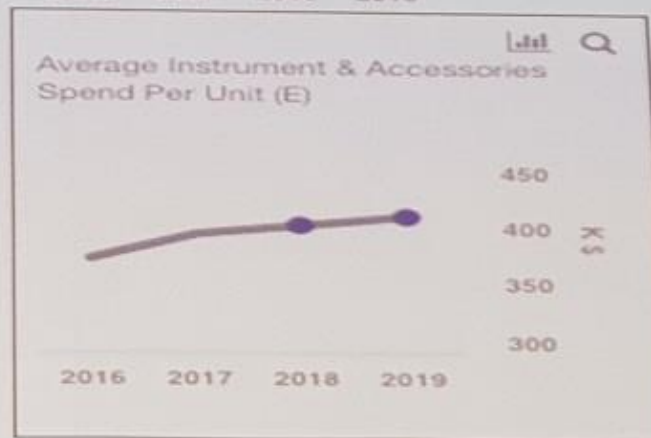
Revenue Per Unit (C)



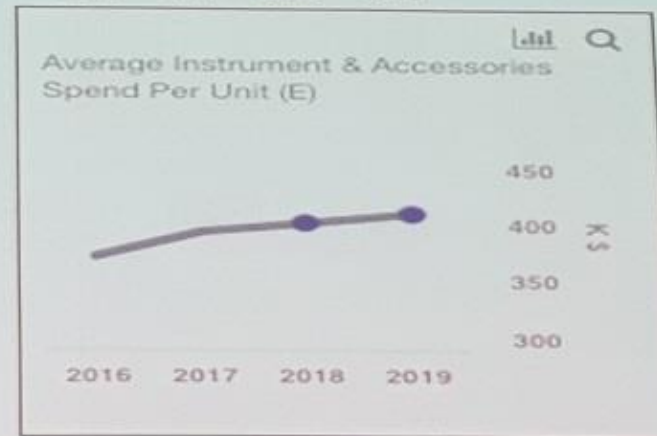
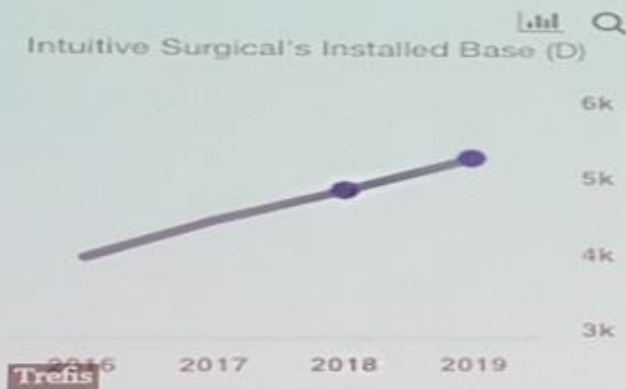
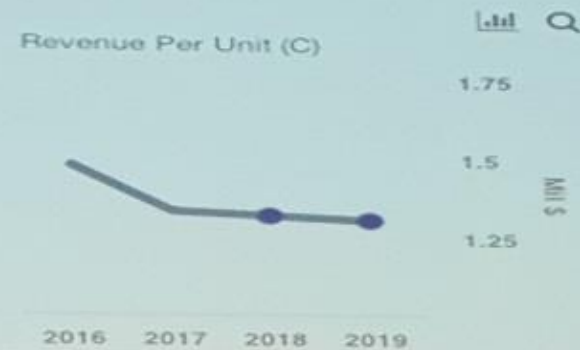
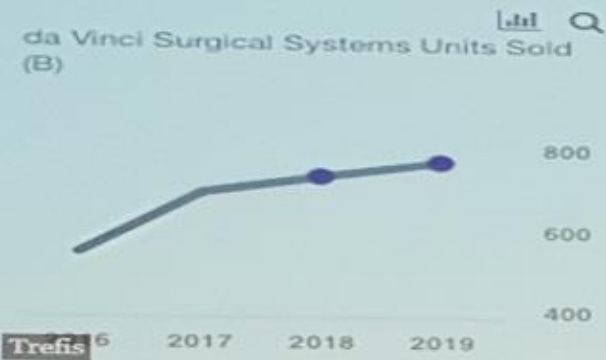
Intuitive Surgical's Installed Base (D)



Average Instrument & Accessories Spend Per Unit (E)



# Problem: Current Surgical robot related costs



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





# Instruments designed for High profit markets



SI- Endowrist  
Needle driver



SI- Endowrist Xi  
Needle driver



TransEnterix  
Needle driver



&



&



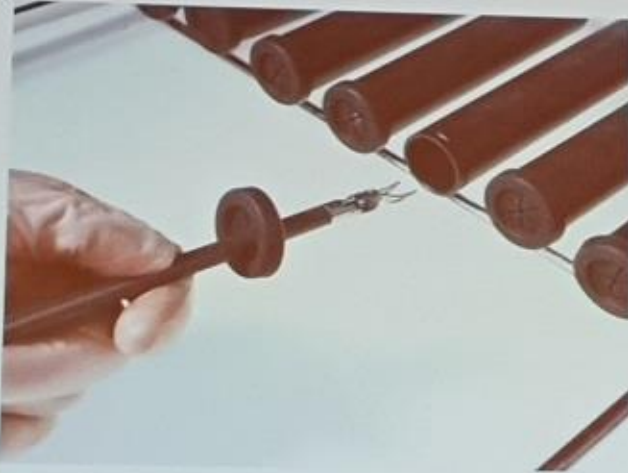
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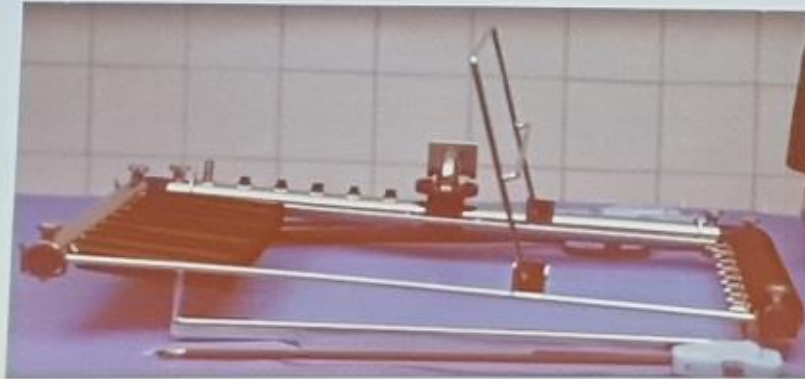
# Instead focus on advanced cleaning



Special connection mounts for tip



Special connection mounts for base

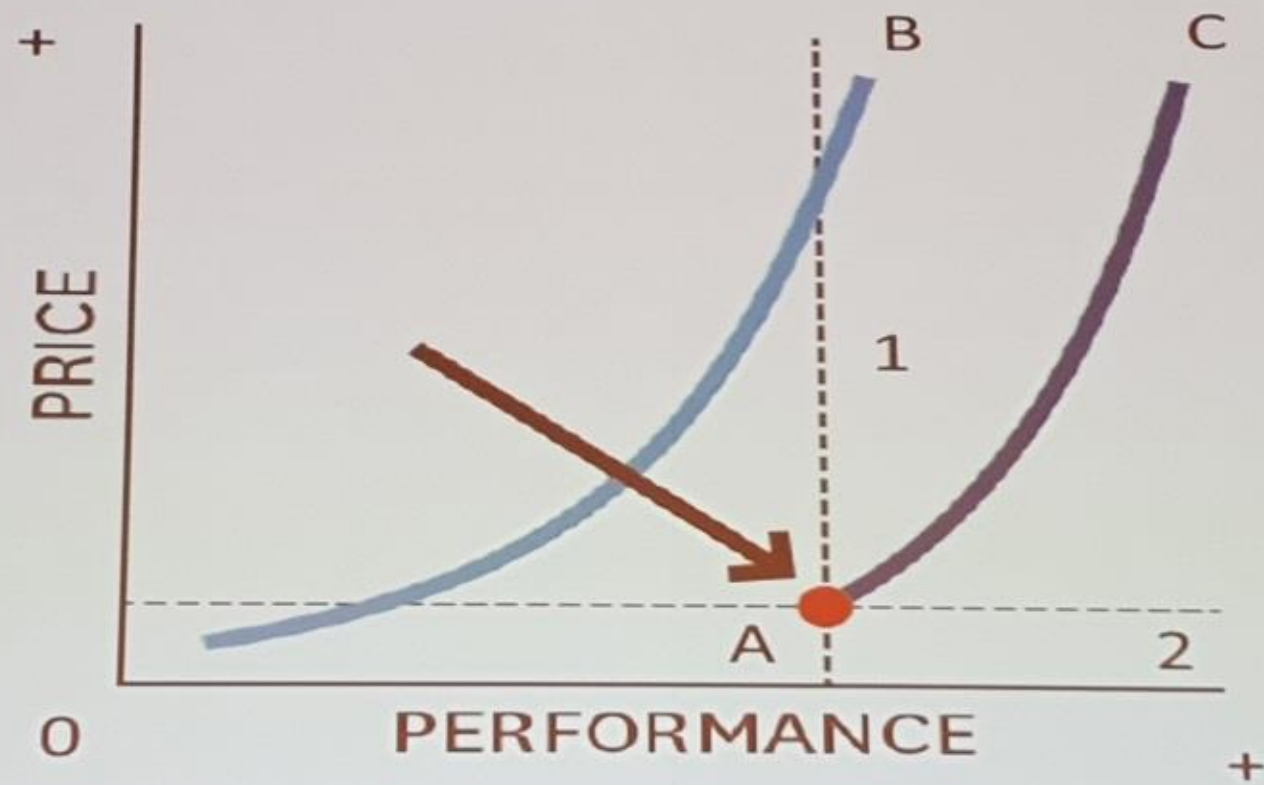


Special trays/methods for instrument positioning

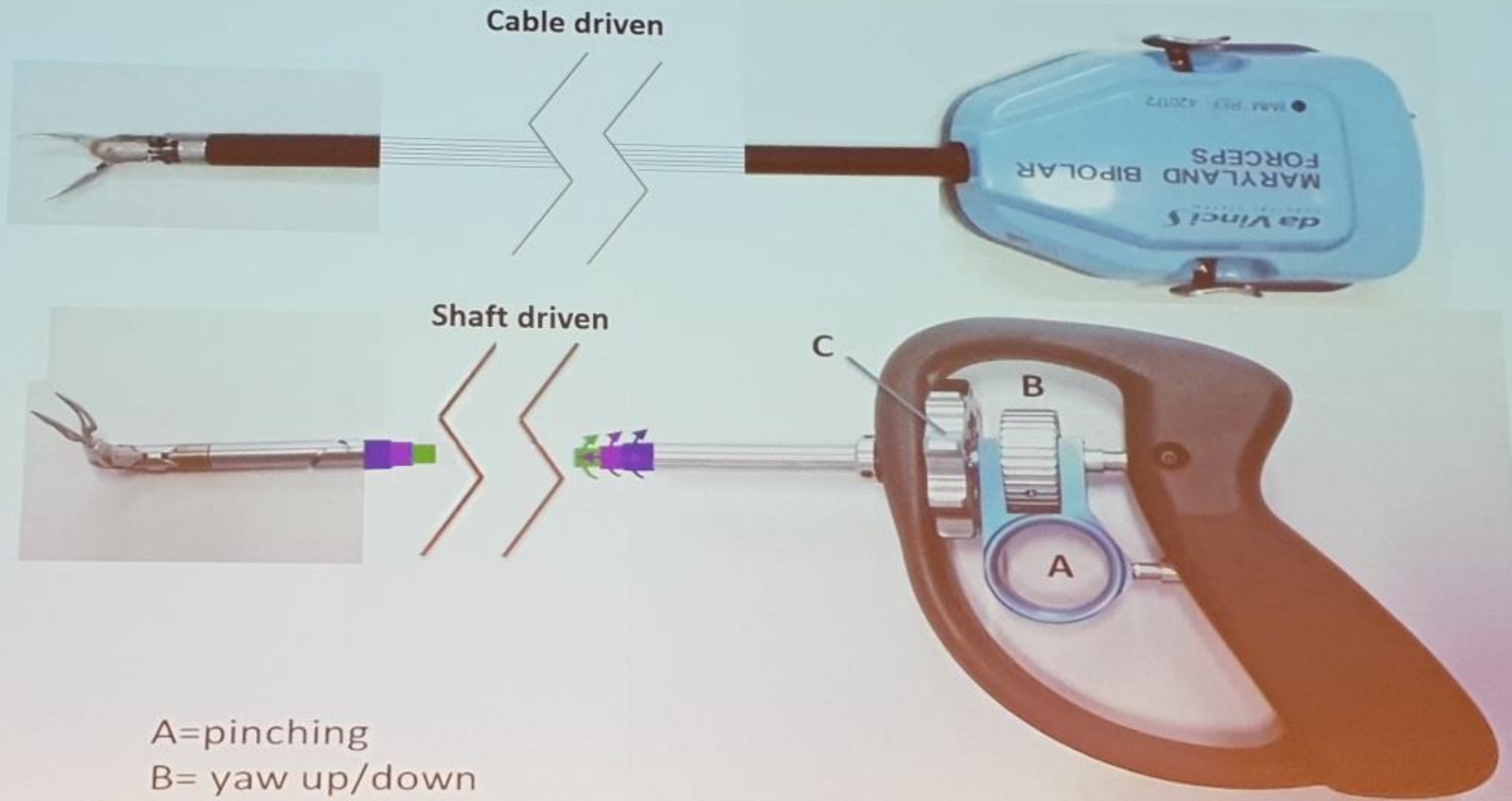


Special methods to clean tray

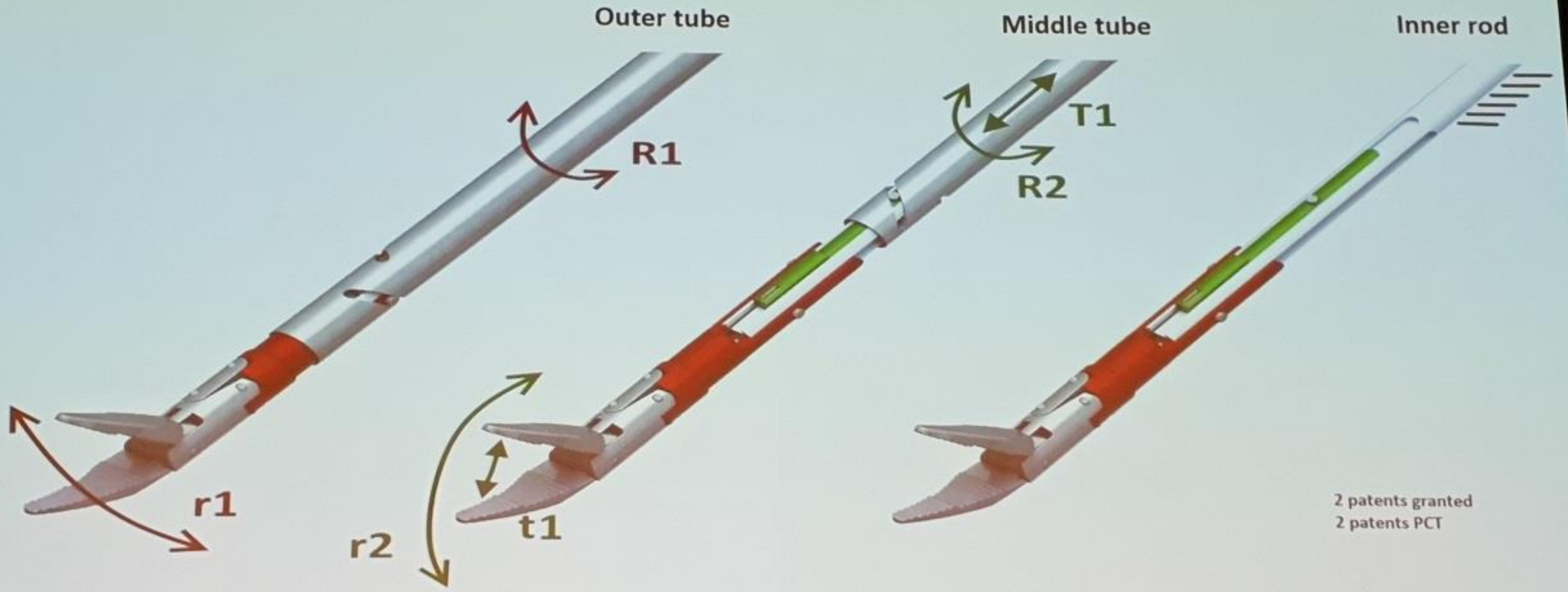
# Disruptive technology is needed



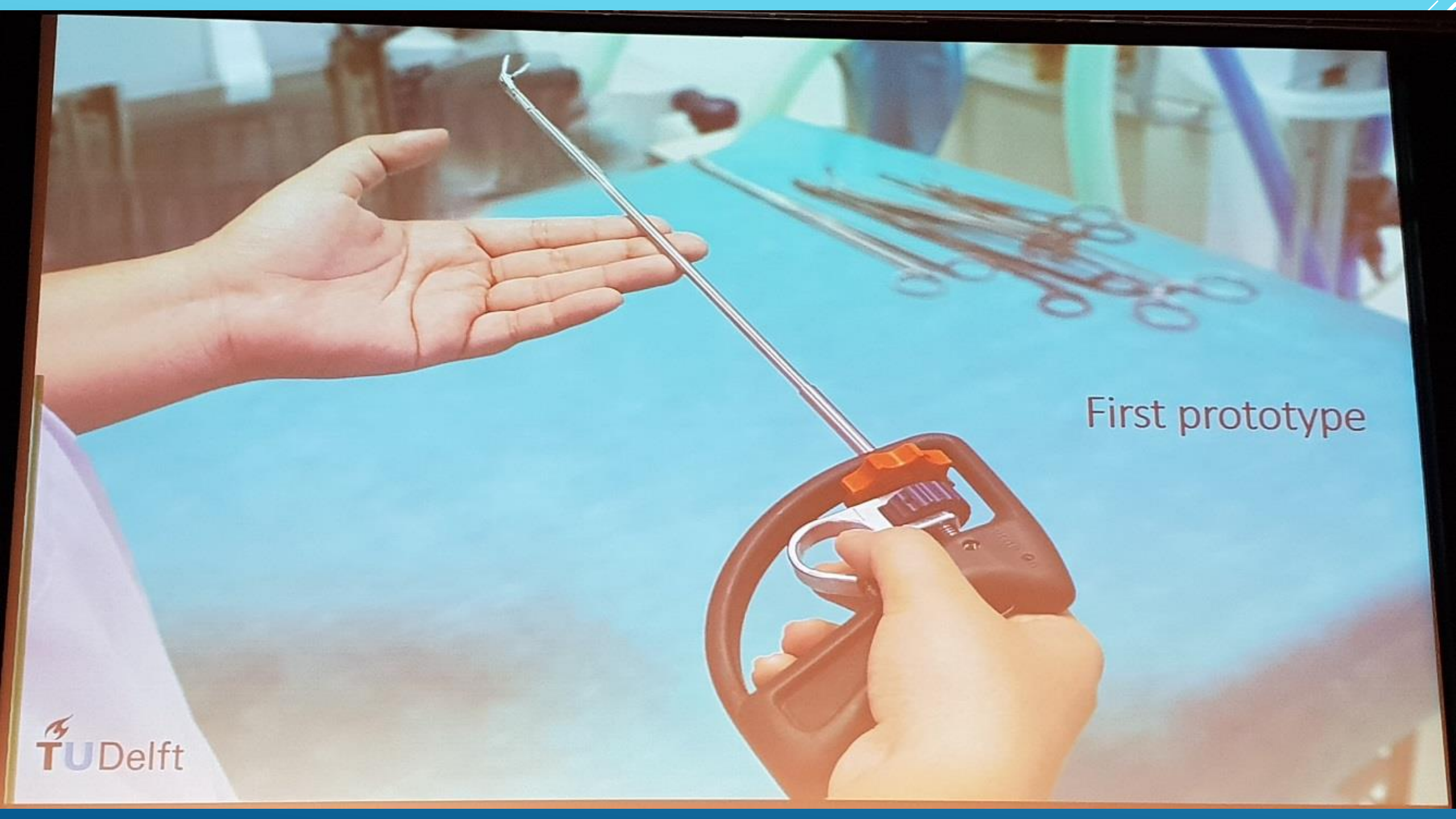
# Focus on cleanable instruments



# 3 tubes for tip actuation, No cables



2 patents granted  
2 patents PCT

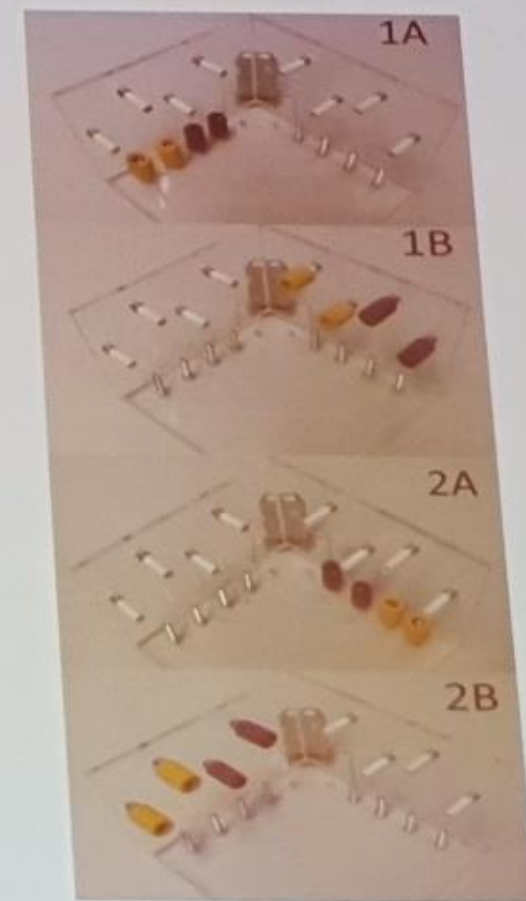
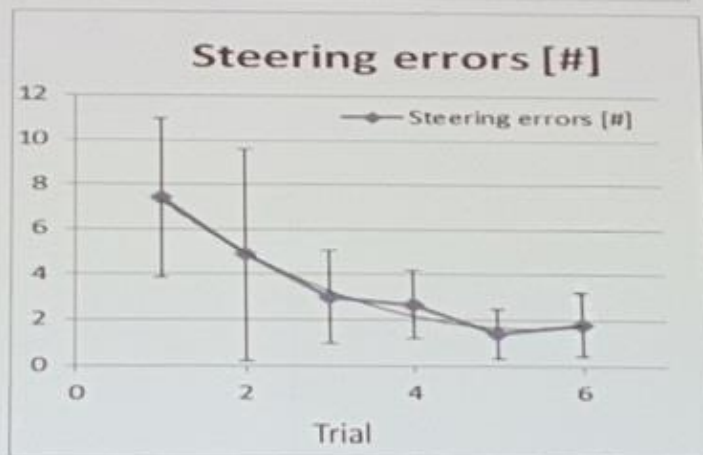
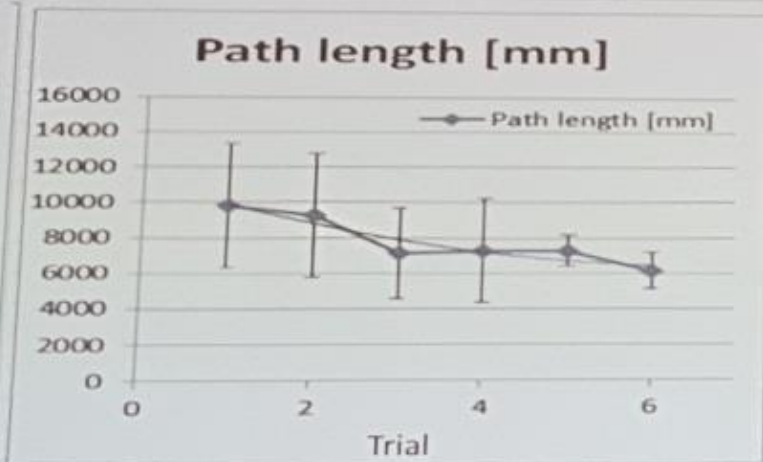
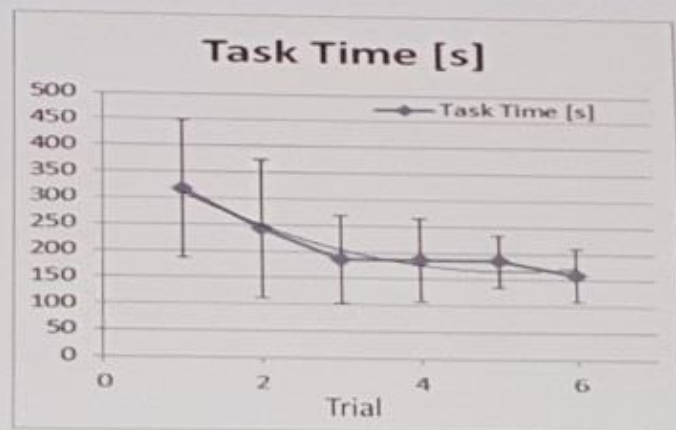
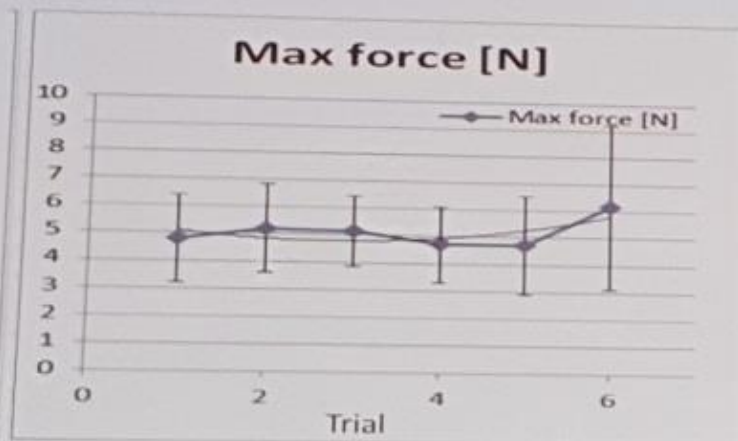


First prototype

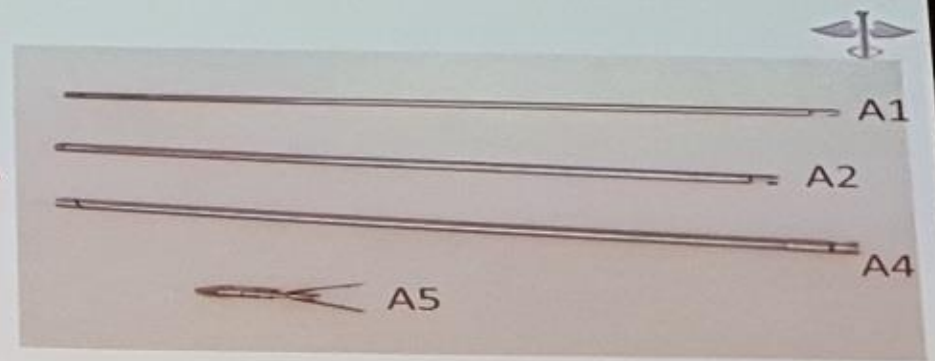
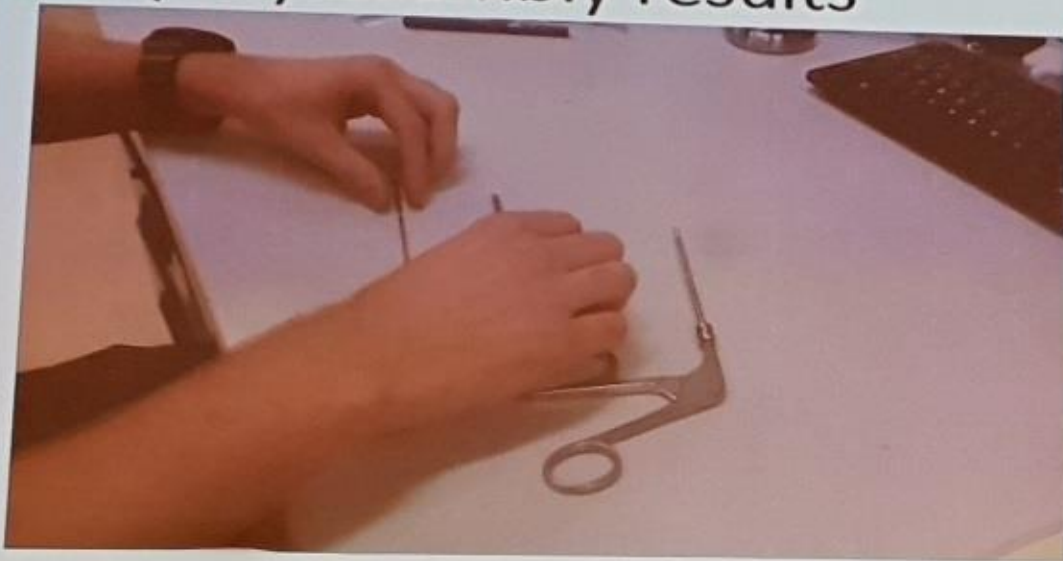


# Box trainer Results

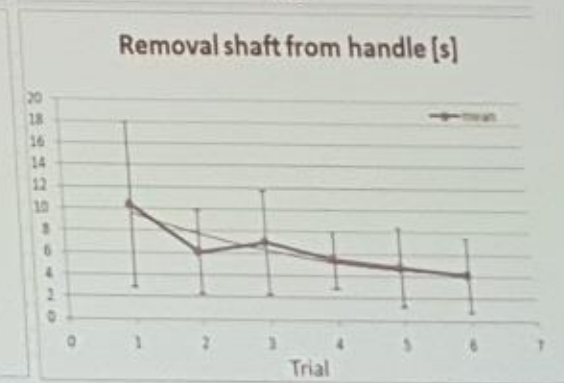
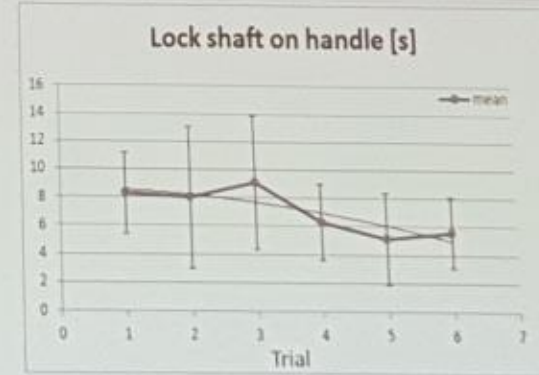
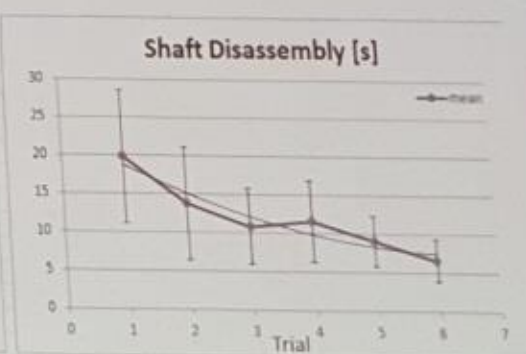
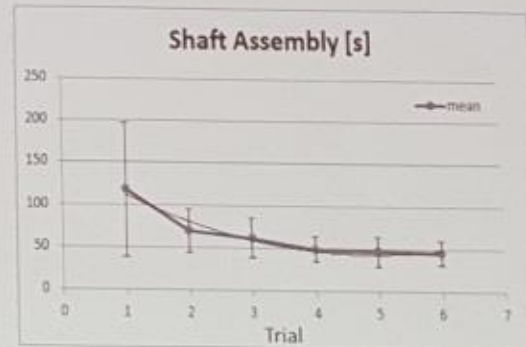
1 trial



# (Dis)assembly results

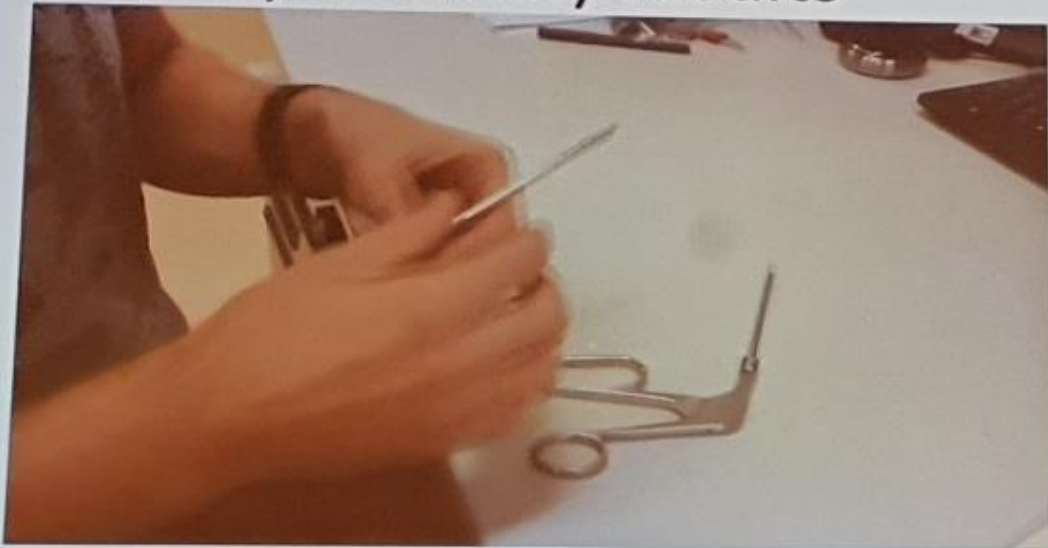


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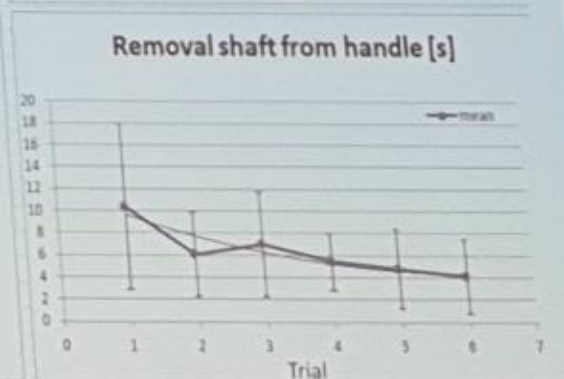
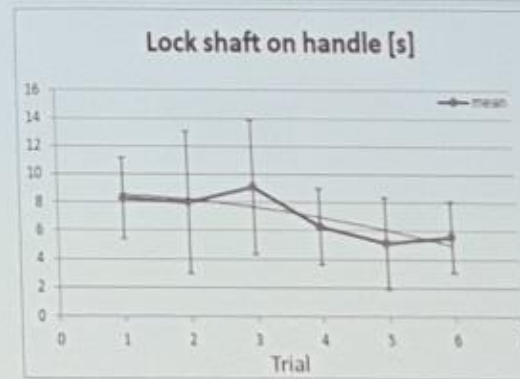
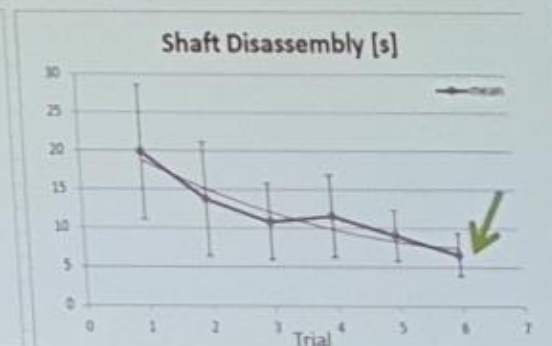
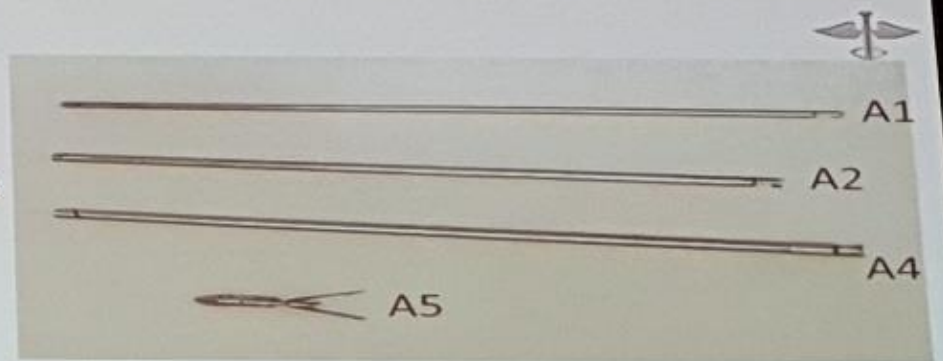


# (Dis)assembly results



- Well trained CSD employee assembles in ~ 1 minute
- DA Vinci instrument (7k euro) 10 times reuse ~ 100 euro processing. Total **60** procedures **43.100 euro**
- SATA instrument (target 5k euro): 60 times reuse cost ~ 600 euro processing & 60 euro fee. Total **60** procedures **5.660 euro**

A



## *Conclusion*

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

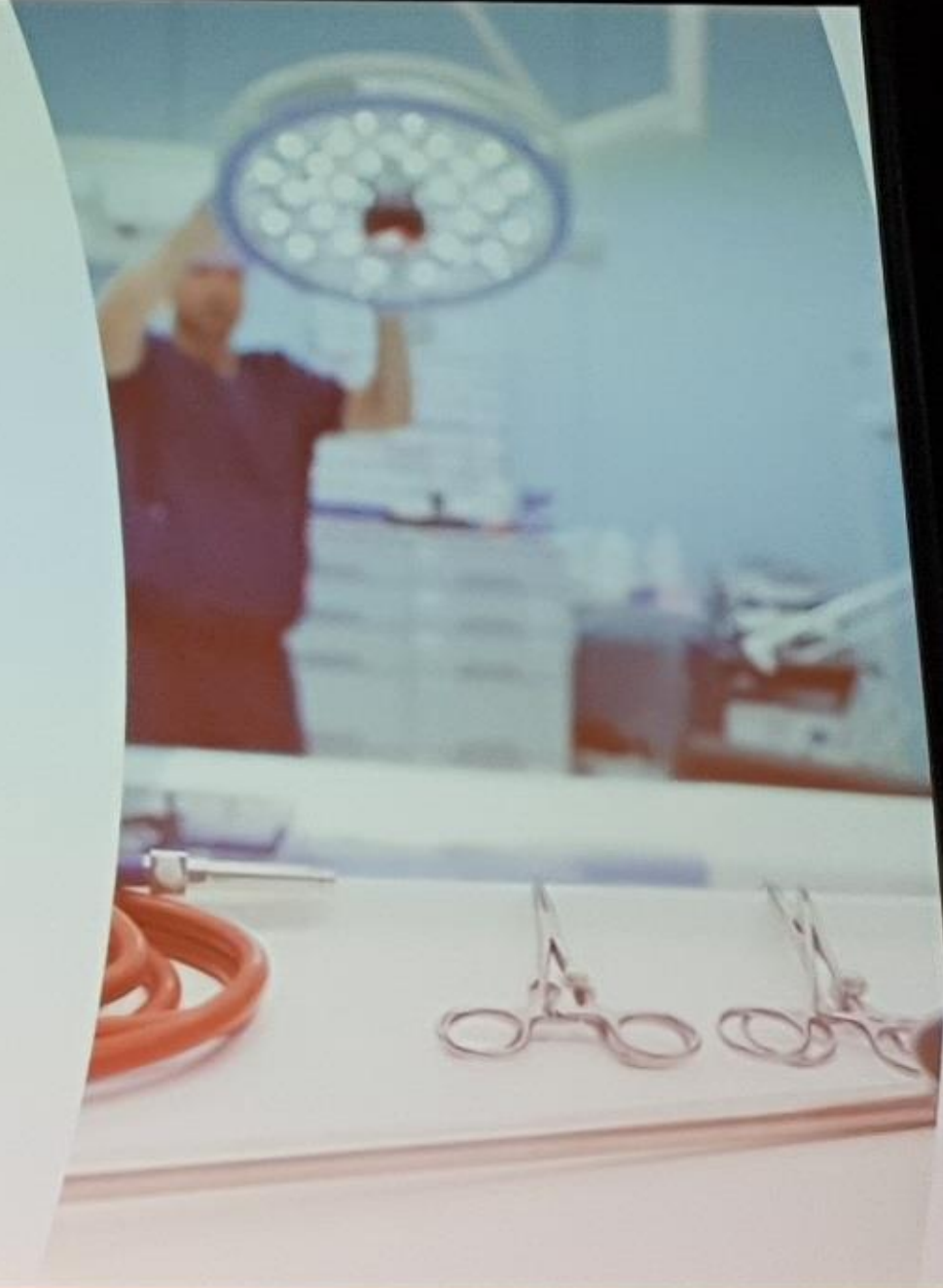
- Collecting and recycling of stainless steel waste is economically feasible.
- Modular advanced endoscopic instruments are feasible in terms of waste and cost reduction.



## *Take home message*

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

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



**How circular economy technology contributes to sustainable instrument management.**

**The circular economy will help protect our natural resources and create sustainability for the next generations.**



**Bart van Straten & Tim Horeman**