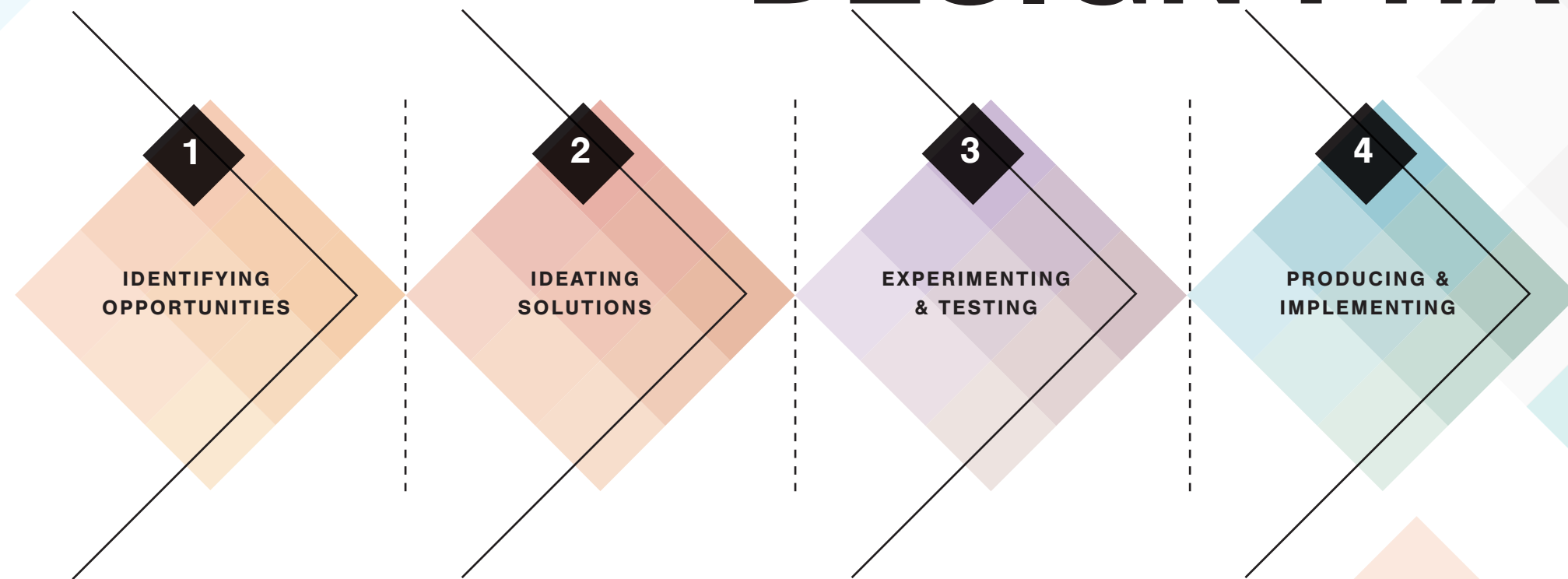


# DESIGN PHASES



See also the **SUSTAINABILITY PILLARS** case deck



Aalto University  
Design Factory

## IDENTIFYING OPPORTUNITIES

# CASES:

- ◆ **Iittala Vintage, Fiskars:**  
**VALUE CREATION VIA 2ND HAND MARKET**
- ◆ **Helsinki Central Library Oodi:**  
**DEMOCRATIC PARTICIPATION**
- ◆ **Kemppi Weld Assist:**  
**USER MENTAL MODELS**
- ◆ **Reinvent the Toilet challenge, Gates Foundation:**  
**UNDERSTAND USE**
- ◆ **Ecosystem of Death:**  
**COLLABORATION ACROSS ORGANIZATIONS**
- ◆ **Valmet's Metal Belt calendar:**  
**KEY PHENOMENON**



## Case: Iittala Vintage, Fiskars

# VALUE CREATION VIA 2ND HAND MARKET

Through Iittala Vintage service, Fiskars buys used Iittala dishes back from consumers. The company then either resells or recycles the used products, depending on their condition. When users bring old products to Iittala stores, they are paid in gift cards. Products are paid for based on their type and condition. The service helps people dispose of Iittala products in an environmentally friendly way. At the same time, it promotes the value of the brand's vintage products, reaching both customers buying new products and customers preferring vintage ones.

### REFLECT:

- What kind of products might be desirable within a second hand context?

### APPLY:

- How could you increase the future value of your product?

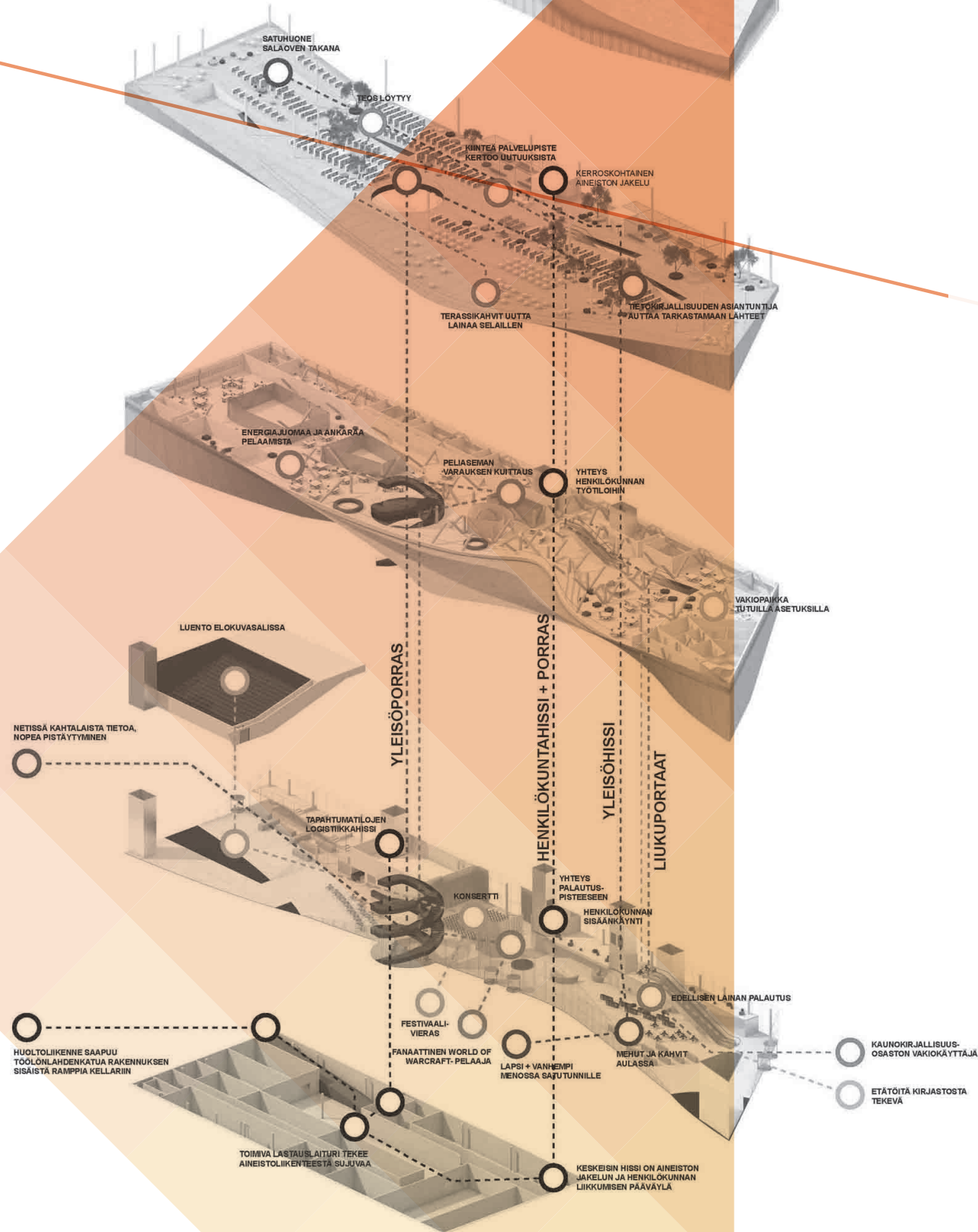
### SEE ALSO:

- ◆ Environmental Sustainability: **PROMOTING RECYCLING**

Read more:

- <https://www.iittala.com/en-gb/about-us/sustainability/vintage-service>

## IDENTIFYING OPPORTUNITIES



# Case: Helsinki Central Library Oodi

# DEMOCRATIC PARTICIPATION

City of Helsinki wants its habitants to have a say in the city's services and decisions. For example, many types of people took part in designing the Oodi library. Designers gathered ideas from teens, families, children, immigrants, and people who do not usually go to libraries. They raised awareness of the project with small pop-up libraries and campaigns. Helping other people take part in design makes projects more democratic.

### REFLECT:

- Can you see the impact of participatory design in Oodi today?
- What might be the challenges of involving underserved communities in design projects?

### APPLY:

- Who should have a say in how your product is designed?
- How could you encourage people to take part in the design of your product?

### SEE ALSO:

◆ Social Sustainability: DEMOCRATIC PARTICIPATION

Read more:

- <https://www.fazergroup.com/well-being/health-nutrition/fazer-groups-principles-for-balanced-diet>

## IDENTIFYING OPPORTUNITIES



# Case: Kempppi Weld Assist USER MENTAL MODELS

Good welding depends on many physical factors, like voltage, wire feed speed, and pulse frequencies. However, welders can't directly see these things. The Weld Assist feature of Kempppi's welding machines ties welding parameter selection into things that can be seen, such as material type, material thickness, and joint type. These considerations are part of a welder's mental model about welding. Weld Assist connects them to the physics of welding.

### REFLECT:

- Since the parameters in Weld Assist are new, how do you think Kempppi should support welders in re-learning how to select the right parameters?
- When might Weld Assist be detrimental?

### APPLY:

- How could you match a product to how users think about a task?

Read more:

- <https://www.kemppi.com/en-US/download-center/file/kemppi-s-weld-assist-helps-find-the-right-parameters-for-tig-welding/>

## IDENTIFYING OPPORTUNITIES

# Case: Reinvent the Toilet challenge, The Gates Foundation UNDERSTAND USE

The Gates Foundation has given billions of dollars to sanitation development for developing countries. However, many cheap and clean toilet concepts exist already, and the sanitation crisis still goes on. Many say that the real problem is making toilets work “on the ground.” The real question might be how to maintain toilets in under-resourced communities. Or, how to make sure that people feel safe going into public toilets at night.

### REFLECT:

- Why do you think Gates Foundation wants to solve the sanitation crisis through new technology development?

### APPLY:

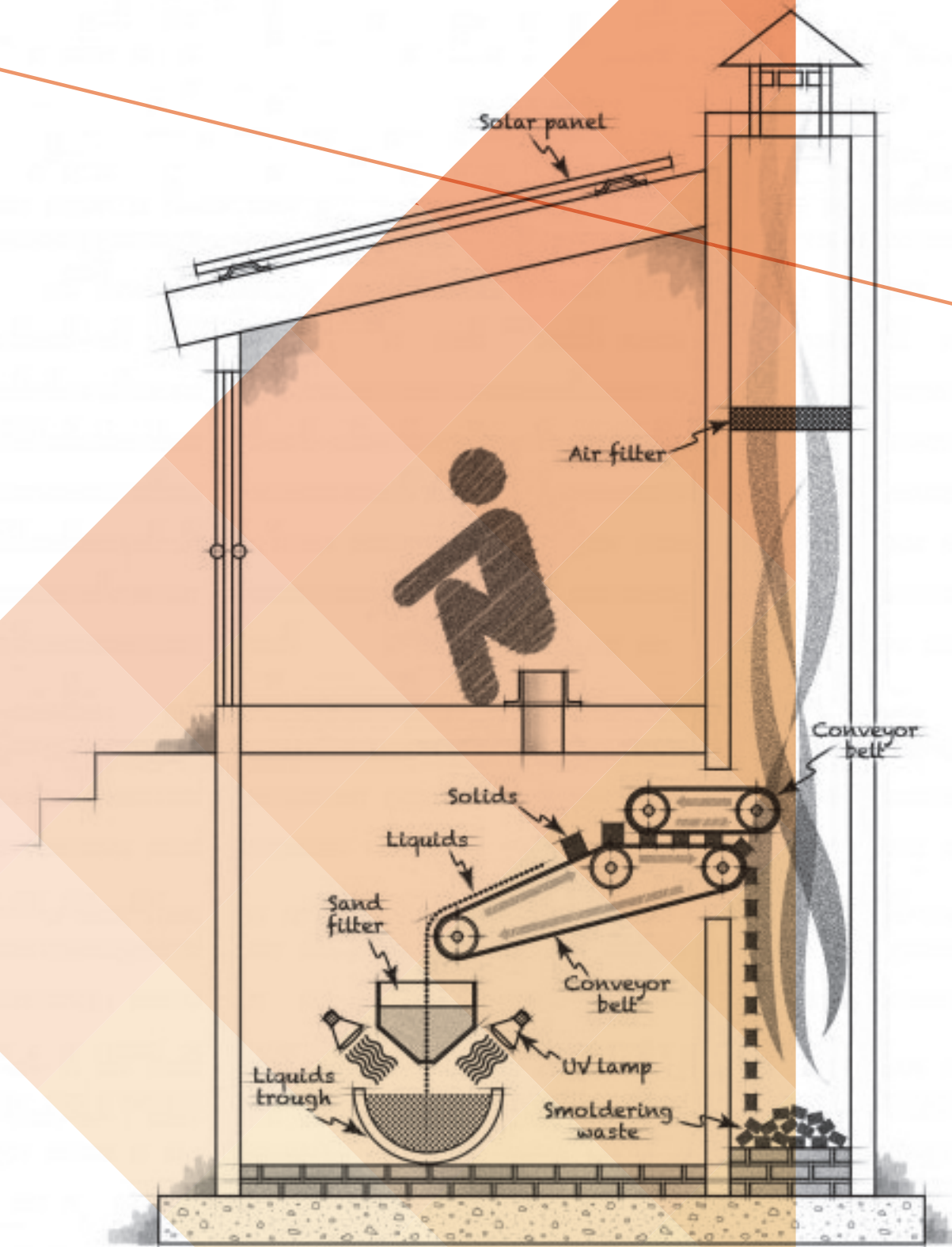
- Is a new product needed for the problem you are trying to solve?
- How could you make sure that your product will change how people behave for the better?

### SEE ALSO:

◆ Environmental Sustainability: UNDERSTAND USE

Read more:

- <https://design-justice.pubpub.org/pub/0v6035ye/release/2?readingCollection=9eadecb0#design-challenges-full-of-crap-notes-on-the-gates-foundations-reinvent-the-toilet-challenge>



# Case: Ecosystem of Death

# COLLABORATION ACROSS ORGANIZATIONS

Finnish Digital and Population Data Services Agency, Finnish Tax Administration, Siili Solutions, and various other organizations are building a service to manage bureaucracy related to death of an individual. The project has many different stakeholders as the current system is split under many institutions. To create a more human-centered service, organizations had to start working together. Early on, the project team created a map of all the needed organizations and invited them to take part in the project.

## REFLECT:

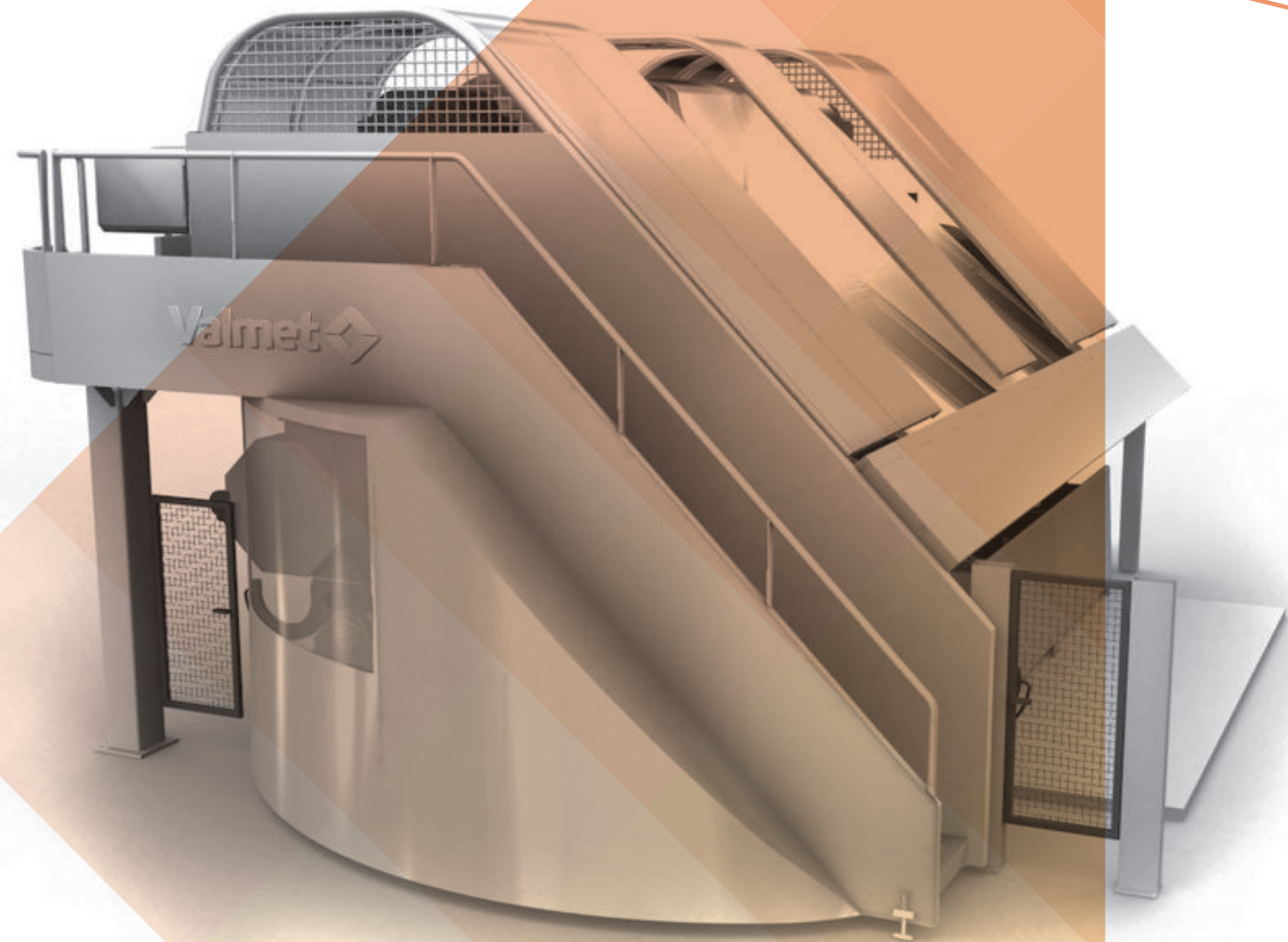
- Can you think of an example where many private companies would need to collaborate to create a better product or service?

## APPLY:

- If you view your solution from the user's point of view, what larger "journey" is it part of?
- Who could you collaborate with to create a more complete user experience?

Read more:

- <https://www.siili.com/ecosystem-of-death>



# Case: Valmet's Metal Belt calender

## KEY PHENOMENON

Valmet's Metal Belt calender project aimed to reduce stiffness loss in paper after calendering. At the start, the inventor studied the physics of the calendering process. They realized that the duration of heat treatment was a key parameter. In existing calenders, heat treatment lasted only a few milliseconds. Some niche solutions enabled longer heat treatment, but only at slow production speeds. Thus, the project turned its focus improving heat conduction without slowing the production speed.

*\*A calender is a device used in paper manufacturing. It uses heated rolls and pressure to smoothen and condense paper. Calendering improves many paper properties, such as printing quality and coatability. Calendering also has some negative effects, such as stiffness loss.*

### REFLECT:

- What could be other valuable “key phenomena” in calendering?

### APPLY:

- What are the key parameters and relationships in your product?

Read more:

- Full case article: [Valmet OptiCalender Metal Belt](#)



# IDEATING SOLUTIONS

# CASES:

- ◆ **Velcro:**  
**BIOMIMICRY**
- ◆ **Valmet's Metal Belt calender:**  
**RELAX CONSTRAINTS**
- ◆ **Valmet's Metal Belt calender:**  
**ANALOGIES**
- ◆ **Timeless aesthetic:**  
**DESIGN FOR REFURBISHING**
- ◆ **Research insight:**  
**OBSERVATION**

# Case: Velcro

## BIOMIMICRY

The hook-and-loop fastening feature in Velcro was invented by Swiss born George de Mestral. He was allegedly inspired by burrs from burdock plants after seeing how strongly they clung to his dog's fur. Burrs are seeds covered in tiny "hooks" that easily catch onto the "loops" in fur and clothing. After much investigation, development, and marketing, de Mestral's Velcro grew into a successful business.

### REFLECT:

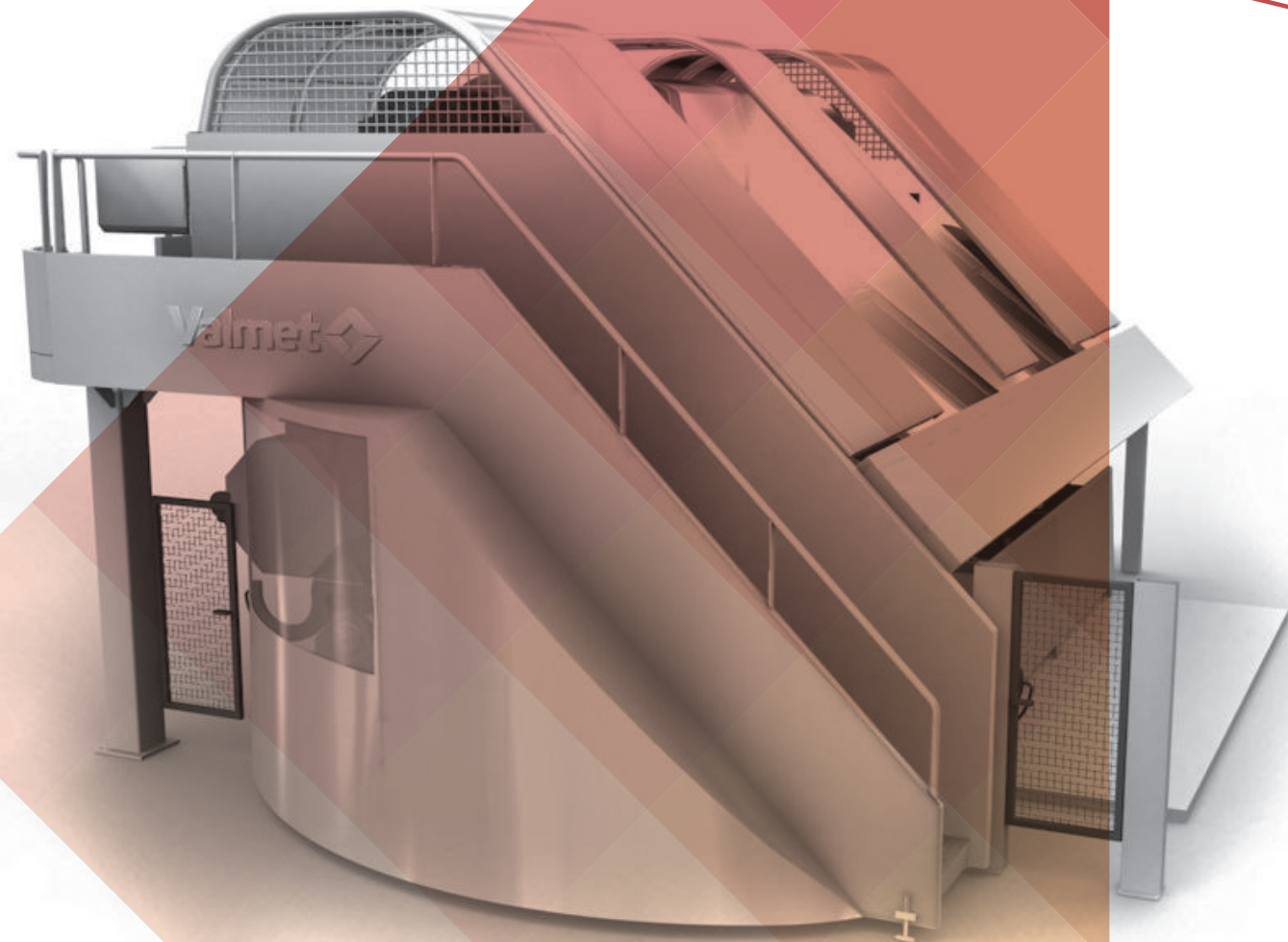
- What other solutions could burdock burrs inspire, besides temporary fastening?

### APPLY:

- Can you think of a situation in nature that relates to your design challenge or research question?
- What part of this natural element or system could you incorporate in the development of your solution?

Read more:

- <https://asknature.org/strategy/hooked-spines-grab-onto-fibers/>



# Case: Valmet's Metal Belt calender

# RELAX CONSTRAINTS

Paper machines have many heated rolls in them. So, when designing Valmet's Metal Belt calender\*, the inventor tried to create a new calender using heated rolls. However, during ideation they were able to relax the constraint of using rolls. Instead, they thought to use a heated sheet that moved with the paper in the machine. This idea became the core innovation in the Metal Belt calender.

*\*A calender is a device used in paper manufacturing. It uses heated rolls and pressure to smoothen and condense paper. Calendering improves many paper properties, such as printing quality and coatability. Calendering also has some negative effects, such as stiffness loss.*

## REFLECT:

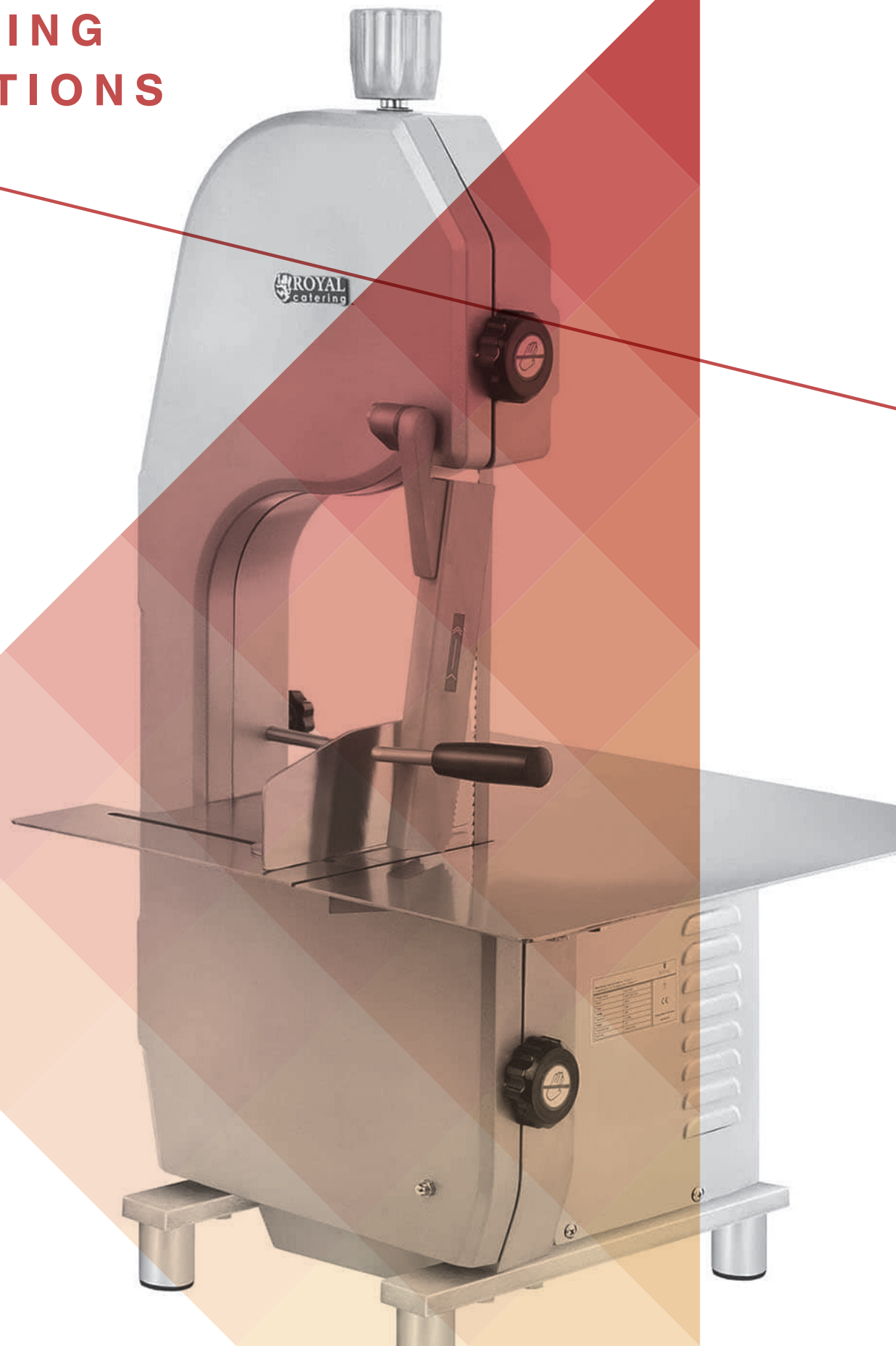
- Why do paper machines and calenders use rolls?
- Why might relaxing constraints be difficult?

## APPLY:

- What constraints could you question in your project?

Read more:

- Full case article: [Valmet OptiCalender Metal Belt](#)
- Research on design fixation: Linsey, J.S., Tseng, I., Fu, K., Cagan, J., Wood, K.L. and Schunn, C., 2010. A study of design fixation, its mitigation and perception in engineering design faculty. *Journal of Mechanical Design*



## Case: Valmet's Metal Belt calender

# ANALOGIES

At the start of the Valmet Metal Belt calender\* project, the inventor saw a device that supported his idea. The device, however, was being used in a very different context. When at a grocery store, the inventor noticed that the fresh meat counter used a band saw to cut meats with a taught metal belt. Seeing the metal belt work in the saw helped the inventor trust that a much larger belt could work in calendering.

*\*A calender is a device used in paper manufacturing. It uses heated rolls and pressure to smoothen and condense paper. Calendering improves many paper properties, such as printing quality and coatability. Calendering also has some negative effects, such as stiffness loss.*

### REFLECT:

- Where else are high-tension metal belts used at high speeds?
- What other aspects of the metal belt calender could one search analogies for? What might these analogies be?

### APPLY:

- Could some existing product's features or functions be similar to those of your product?
- What features from existing products could you copy to your product?

Read more:

- Full case article: [Valmet OptiCalender Metal Belt](#)



## Case: Timeless aesthetic **DESIGN FOR REFURBISHING**

Many people gravitate toward timeless designs when buying refurbished products. For example, minimalist products are thought to be from good brands and may remain desirable even when they are not new. Also, used products that look retro are thought to be high quality. However, people usually do not want to see signs of use (such as scratches) or reduced functionality (such as shorter battery life) when buying used products.

### REFLECT:

- What other styles might be desirable for a longer period of time, in addition to minimalist and retro styles?
- Could there be other aspects that effect how much people like refurbished products?


### APPLY:

- How could your product look and feel timeless?
- Could your product be made easier to refurbish?

### Read more:

- Wallner, T.S., Magnier, L. and Mugge, R., 2020. An exploration of the value of timeless design styles for the consumer acceptance of refurbished products. *Sustainability*, 12(3), p.1213.
- Wallner, T.S., Magnier, L. and Mugge, R., 2022. Do consumers mind contamination by previous users? A choice-based conjoint analysis to explore strategies that improve consumers' choice for refurbished products. *Resources, Conservation and Recycling*, 177, p.105998.

# Case: Research insight **OBSERVATION**



A study on successful innovative entrepreneurs found that they observed new and ordinary situations carefully. For example, the founder of Starbucks claims to have come up with the idea after observing espresso bars in Italy. In small Italian bars, servers greeted people by name. They also served drinks like lattes that americans at that time had not heard of.

## **REFLECT:**

- **Have you ever observed new or ordinary situations and come up with new ideas?**

## **APPLY:**

- **What situations could you observe related to your project?**

Read more:

- <https://onlinelibrary.wiley.com/doi/pdf/10.1002/sej.59>

## EXPERIMENTING & TESTING

# CASES:

- ◆ **Gold&Green:  
DESIRABLE TESTING**
- ◆ **VR Group:  
INCLUSIVE SOLUTIONS**
- ◆ **Valmet's Metal Belt calender:  
SIMPLE PROTOTYPE**
- ◆ **Valmet's Metal Belt calender:  
SUB-SYSTEM ISOLATION**
- ◆ **Valmet's Metal Belt calender:  
SCALE PROTOTYPE**
- ◆ **Valmet's Metal Belt calender:  
CRITICAL PROTOTYPING**
- ◆ **Valmet's Metal Belt calender:  
SEQUENTIAL PROTOTYPING**
- ◆ **Chillaa application for mental health:  
RESPOND TO A REAL NEED**



# Case: Gold&Green

# DESIRABILITY TESTING

Gold&Green made plant-based food. People generally like tasting new foods, and the company used this to their advantage when including people in their testing process. First, they had a volunteer group test new products. The group received free food samples and gives the company feedback. Second, Gold&Green gave a lunch restaurant free food ingredients to make new meals. The restaurant collected feedback on the ingredients from chefs and final meals from clients.

## REFLECT:

- What effects could continuous testing have on development work?
- Why do you think Gold&Green started their feedback collection?

## APPLY:

- What feature of your product do you think people would like to test?
- How could you get continuous feedback?



# Case: VR Group **INCLUSIVE SOLUTIONS**

VR Group (Valtion Rautatiet, the national railway company in Finland) aims to listen to everyone's needs. This means that trains and trams must work for all, including people in wheelchairs, and those with reduced hearing, reduced vision, or cognitive restrictions. With this in mind, the Tampere Tram was tested by people with diverse levels of mobility. Also, most VR trains include accessibility features, such as braille text, high-visibility colors, and low floors.

## **REFLECT:**

- **How do you think accessibility impacts VR's business?**

## **APPLY:**

- **What vulnerable groups of people might use your product?**
- **How could your product be made usable for all?**

## **SEE ALSO:**

- ◆ **Social Sustainability: INCLUSIVE SOLUTIONS**



## Case: Valmet's Metal Belt calender

# SIMPLE PROTOTYPE

As many components in paper machines are huge in size, testing them can be costly and risky. However, when designing Valmet's Metal Belt calender\*, the inventor created many simple prototypes. For one, they tested the physics of heat treatment in their kitchen with a clothes iron and an oven plate. Also, they used cheap leftover parts from a bankrupt company to build the first larger prototypes of the calender.

*\*A calender is a device used in paper manufacturing. It uses heated rolls and pressure to smoothen and condense paper. Calendering improves many paper properties, such as printing quality and coatability. Calendering also has some negative effects, such as stiffness loss.*

### REFLECT:

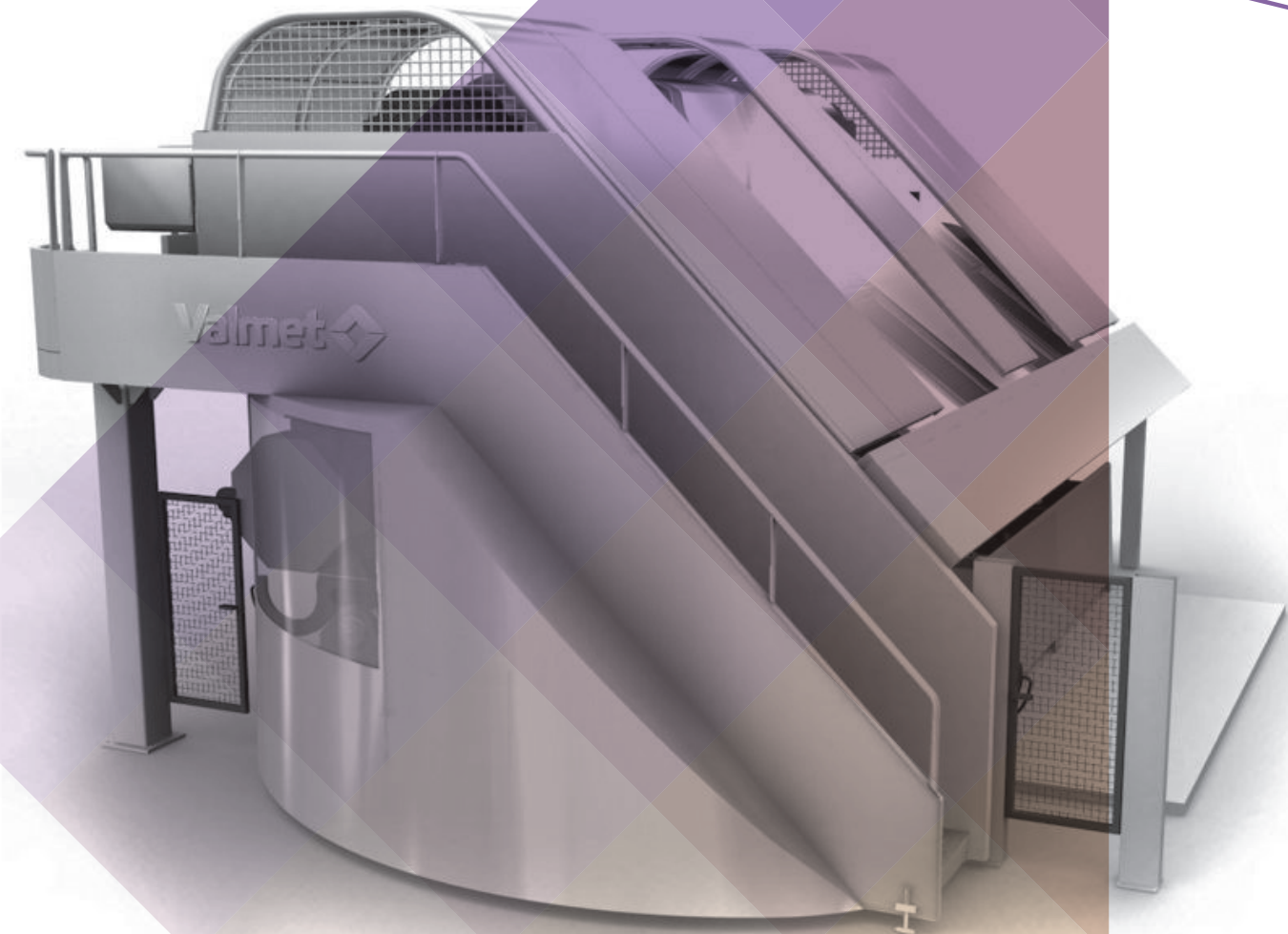
- Why do you think the inventor wanted to test heat treatment with a simple prototype?

### APPLY:

- What is the simplest way you could test a part of your product?

Read more:

- Full case article: [Valmet OptiCalender Metal Belt](#)



## Case: Valmet's Metal Belt calender **SUB-SYSTEM ISOLATION**

Valmet's Metal Belt calender\* project had many sub-system prototypes. One sub-system was the metal belt itself. Here, designers asked questions, like 'what material could reach the required tension' and 'how could the belt be welded together without lowering paper quality.' Testing these things did not require a prototype of the whole machine. Rather, separate prototypes were built to answer separate questions.

*\*A calender is a device used in paper manufacturing. It uses heated rolls and pressure to smoothen and condense paper. Calendering improves many paper properties, such as printing quality and coatability. Calendering also has some negative effects, such as stiffness loss.*

### **REFLECT:**

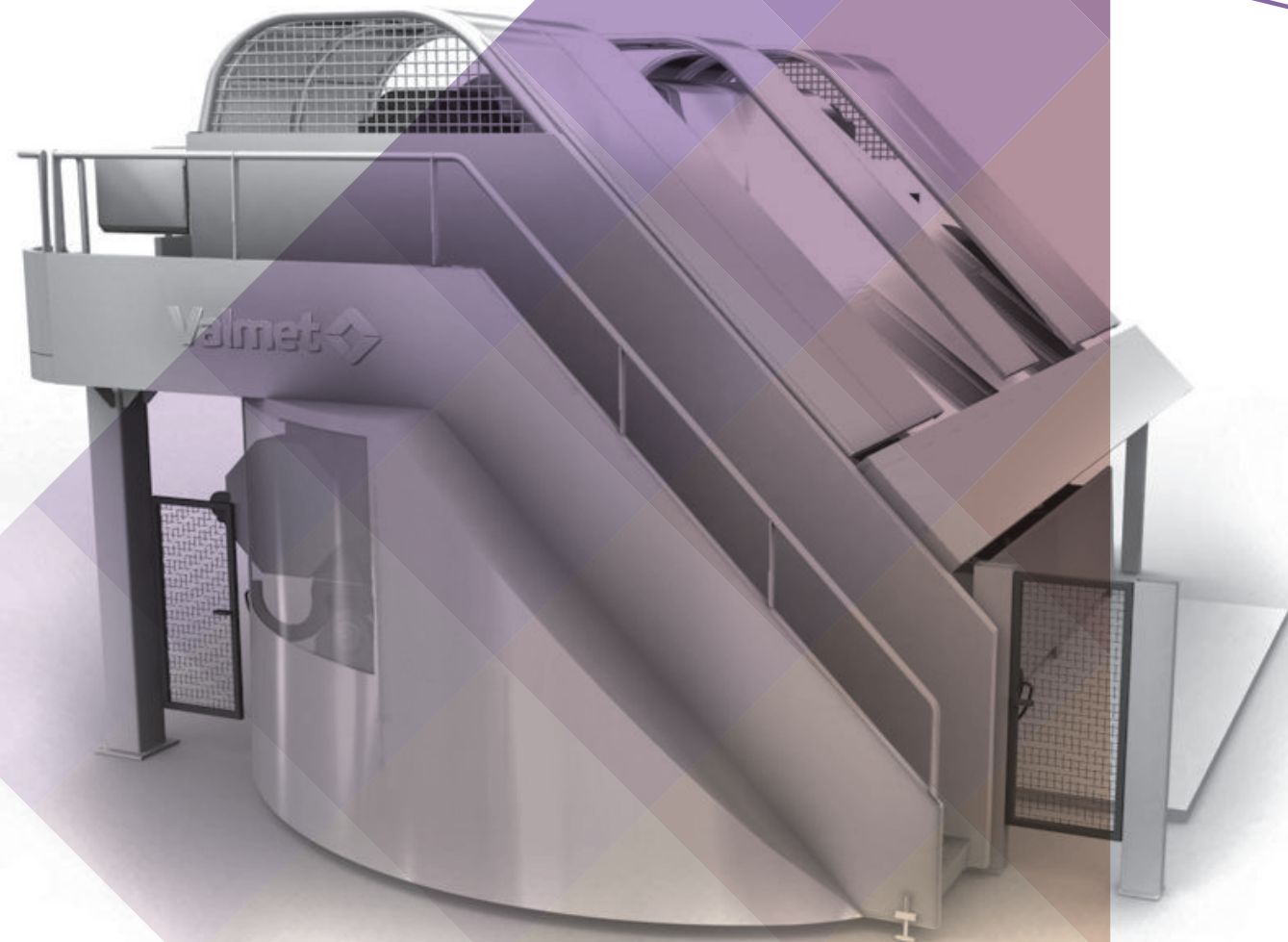
- **What pros and cons could a prototype of the whole machine have?**

### **APPLY:**

- **Could you build separate prototypes to test parts of your product?**

Read more:

- **Full case article: Valmet OptiCalender Metal Belt**



## Case: Valmet's Metal Belt calender

# SCALE PROTOTYPE

Making smaller prototypes can help reduce prototyping cost and effort. For example, while paper machines are typically many meters wide, some aspects stay the same at different widths. Thus, early tests can be done on machines that are only 27 cm wide. When developing the Metal Belt calender\*, Valmet's employees used a narrow metal belt. This helped them use less material when trying different ways to smoothen the metal surface.

*\*A calender is a device used in paper manufacturing. It uses heated rolls and pressure to smoothen and condense paper. Calendering improves many paper properties, such as printing quality and coatability. Calendering also has some negative effects, such as stiffness loss.*

### REFLECT:

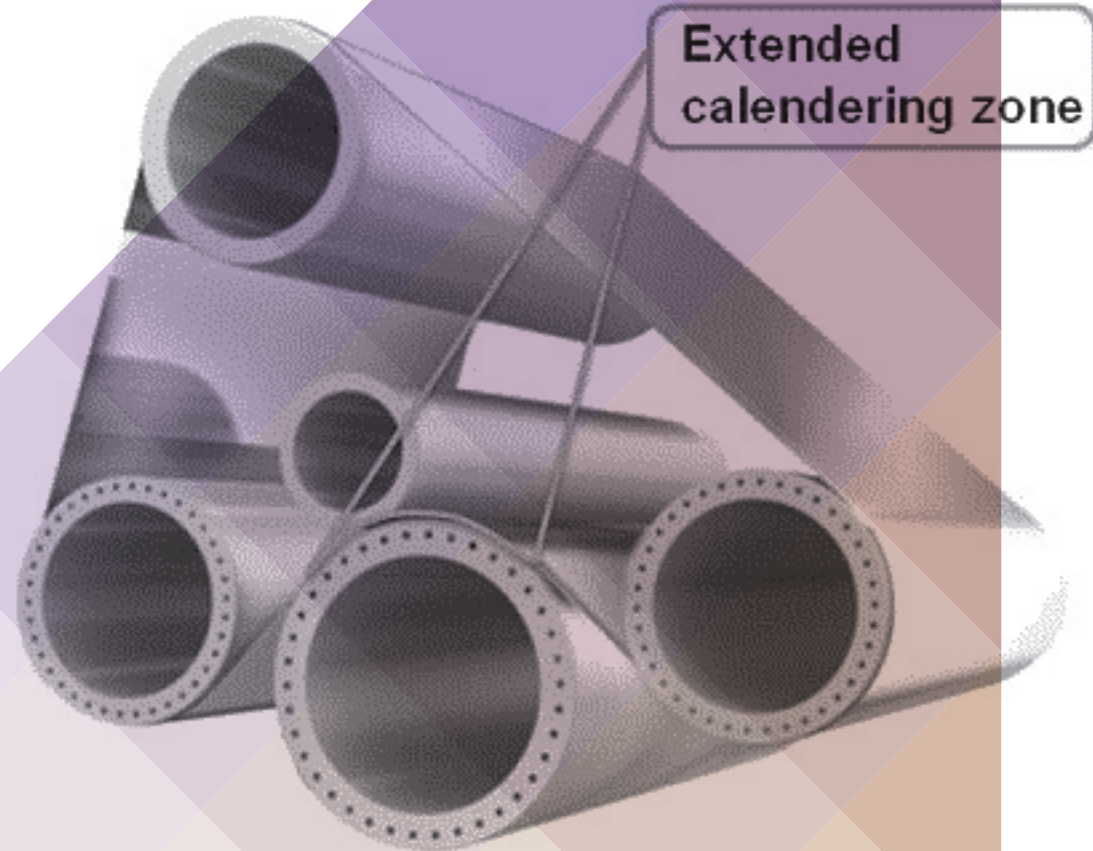
- What do you think does not scale well between a narrow paper machine prototype and a real-width machine?
- Why do you think other aspects of paper machines (e.g., speed, roll diameter, pinching forces) can be difficult to scale?

### APPLY:

- What aspects of your product could you test in a smaller scale?

Read more:

- Full case article: [Valmet OptiCalender Metal Belt](#)



## Case: Valmet's Metal Belt calender

# CRITICAL PROTOTYPING

In the Valmet Metal Belt calender\* project, the design team only prototyped parts that were new in the company. The machine utilized many parts that had been used in other Valmet machines. These did not need testing or prototyping. However, the team prototyped and tested critical parts before building the full machine. For example, the team built a metal belt testing device that ran tests 24/7 on different belt tensions and material types.

*\*A calender is a device used in paper manufacturing. It uses heated rolls and pressure to smoothen and condense paper. Calendaring improves many paper properties, such as printing quality and coatability. Calendaring also has some negative effects, such as stiffness loss.*

### REFLECT:

- What could be the costs and benefits of prototyping non-critical parts of solutions?

### APPLY:

- What are the new aspects of your product?
- What aspects of your product are difficult to predict without testing?

Read more:

- Full case article: [Valmet OptiCalender Metal Belt](#)

# Case: Valmet's Metal Belt calender

# SEQUENTIAL PROTOTYPING

In the Valmet Metal Belt calender\* project, the design team did more than a hundred tests for the machine. Many of these tests were informed by previous tests. For example, when tests found that a belt made of urethane stretched too much, the team began testing if other materials could withstand the required tension.

*\*A calender is a device used in paper manufacturing. It uses heated rolls and pressure to smoothen and condense paper. Calendering improves many paper properties, such as printing quality and coatability. Calendering also has some negative effects, such as stiffness loss.*

## REFLECT:

- Why do you think the metal belt calender team did not give up after failed tests?

## APPLY:

- How could your tests build on what you have already learned?

Read more:

- Full case article: [Valmet OptiCalender Metal Belt](#)

## EXPERIMENTING & TESTING

# Case: Chillaa application for mental health RESPOND TO A REAL NEED

Adventure Club developed an app to help youth manage anxiety. The company tested the app with 300 users. They collected data with scientific surveys, interviews, and app analytics. While the test was not as precise as clinical trials in medicine, it gave the company concrete information. For example, users thought that their anxiety was reduced and would recommend the app to others.

### REFLECT:

- What are the costs and benefits of testing the impact of a solution?
- In what other ways could Adventure Club have tested the app, without missing deadlines or going over budget?

### APPLY:

- How could you measure the impact of your solution?
- Who could assess how well your solution works?

### SEE ALSO:

- ◆ Social Sustainability: RESPOND TO A REAL NEED

Read more:

- Full case article: Valmet OptiCalender Metal Belt

# PRODUCING & IMPLEMENTING

# CASES:

- ◆ **Fiskars ReNew Scissors:**  
**QUALITY CONTROL**
- ◆ **ABB EnergySave calculator:**  
**TRANSPARENCY OF IMPACT**
- ◆ **Nanso:**  
**DESIGN FOR AFFORDABILITY**
- ◆ **Research insight:**  
**LEAN PRODUCTION**
- ◆ **Research insight:**  
**PRE-PRODUCTION PROTOTYPE**



# Case: Fiskars ReNew Scissors

## QUALITY CONTROL

Quality control involves testing ready products for their performance. For example, for Fiskars' scissors, this can mean their resistance, the sound made when cutting, and the stability of the grips. Quality control is usually done on a random sample of products. However, Fiskars claims to test each pair of scissors by hand.

### REFLECT:

- **Why do you think Fiskars would test every pair of scissors by hand?**

### APPLY:

- **What measures could you use to test the performance of your solution?**

Read more:

- [https://www.fiskars.com/en-gb/scissors-shears/products/recycled-scissors?showAll=true#aq=@categories%20=%20\(%22recycled\\_scissors%22\)&numberOfResults=1000](https://www.fiskars.com/en-gb/scissors-shears/products/recycled-scissors?showAll=true#aq=@categories%20=%20(%22recycled_scissors%22)&numberOfResults=1000)

# Case: Finnair Clean Kit LOCAL SOURCING

Finnair sourced most parts of its Covid-19 Clean Kit from Finland. For example, the kit came in a paper envelope made from Finnish paper. Also, the kit was illustrated by a Finnish print designer, and it had hand sanitizer made by a Finnish distillery. Sourcing these items from Finland was new to Finnair. However, doing local sourcing for a small cleaning kit helped the company learn how it could be done in bigger projects.

## REFLECT:

- What factors contribute to a product being defined as ‘local’?

## APPLY:

- Could you source parts of your product locally?

## SEE ALSO:

- ◆ Environmental Sustainability: LOCAL SOURCING

Read more:

- <https://runwaygirlnetwork.com/2020/07/finnair-goes-local-in-designing-and-sourcing-new-clean-kit-and-masks/>
- <https://www.finnair.com/en/bluewings/world-of-finnair/see-finnair-s-updated-in-flight-service-for-safer-flying-2131952>



## PRODUCING & IMPLEMENTING

# Case: ABB EnergySave calculator TRANSPARENCY OF IMPACT

ABB offers an online service for calculating the energy use of drives. Drives manage transmission and can power a range of industrial equipment and machinery. The service also compares the energy use of ABB drive controls to “existing control methods.” Users can define the application and other technical properties for their drive use case. The service outputs information on how much the user could save in, for example, CO<sub>2</sub> and money by using ABB solutions.



### REFLECT:

- When might people use ABB's Energysave calculator?
- What aspects increase and decrease the calculator's trustworthiness?

### APPLY:

- How could you communicate the environmental benefits of your solution?

### SEE ALSO:

- ◆ Environmental Sustainability: TRANSPARENCY OF IMPACT

Read more:

- <https://new.abb.com/drives/software-tools/energysave-calculator>



# **DESIGN FOR AFFORDABILITY**

To design for affordability, one must first consider how much customers are willing to pay for a solution. Finnish clothing company Nanso begins their product development from this starting point. The company's aim to make affordable clothing can be seen in both their material and production choices. Designing for affordability involves simplifying the solution and the supply chain used to deliver it.

**REFLECT:**

- **How could a company like Nanso define how much customers are willing to pay for clothes?**

**APPLY:**

- **What counts as affordable for potential customers in your project?**

**SEE ALSO:**

- ◆ **Economic Sustainability: DESIGN FOR AFFORDABILITY**



## Case: Research insight

# LEAN PRODUCTION

Lean production is a set of methods aiming to reduce production times and wasted effort. It includes, for example, starting the manufacturing process only when a customer orders a product. In one study, researchers investigated the effects of lean production on the manufacturing process of customized copper strips for conductors. Lean principles improved on-time deliveries from 55% to 80%.

### **REFLECT:**

- **What might be the risks of lean production?**

### **APPLY:**

- **Could parts of your solution be delivered following lean principles?**

Read more:

- <https://www.tandfonline.com/doi/pdf/10.1080/09537280903086164>

# Case: Research insight **PRE-PRODUCTION PROTOTYPE**

Pre-production prototypes are products built in small quantities with realistic production methods. They are the final test to find problems before the product goes on sale. For example, most car manufacturers make pre-production prototypes of new models. Pre-production cars are also shown in exhibitions as a marketing tool.

## **REFLECT:**

- **How might pre-production prototyping work outside mass produced products?**

## **APPLY:**

- **Can you try manufacturing your product with realistic production methods?**