AI Assisted Engineering : From Hype to real benefits

2025-04-10

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Etteplan A growth company

TECHNOLOGY SERVICE COMPANY

ENGINEERING | SOFTWARE AND EMBEDDED SOLUTIONS | ASSET & TECHNICAL PRODUCT INFORMATION SOLUTIONS

OUR CUSTOMERS ARE GLOBAL MACHINE AND EQUIPMENT MANUFACTURERS

2024 REVENUE 361M€ EMPLOYEES 4000

**Founded 1983 | Nasdaq Helsinki Ltd**

⬡ etteplan

Tero Hämeenaho

About Me:

My expertise encompasses business & competencies development, engineering services, client relationship management, and ecosystem leadership.

I've been at the forefront of innovative projects, setting up operations, expanding service offerings, and actively participating in R&D initiatives.
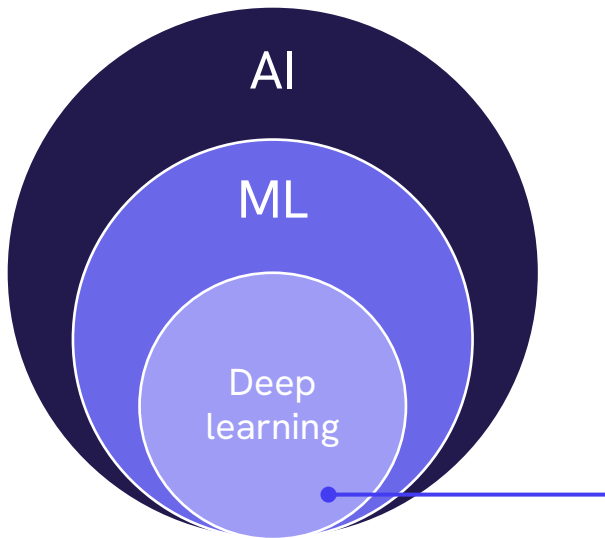
Current role: Program Director in AI & Head of Additive Manufacturing

Other roles: Member of the Management board at Finnish Additive Manufacturing Ecosystem | Member of the board 3D Formtech Oy
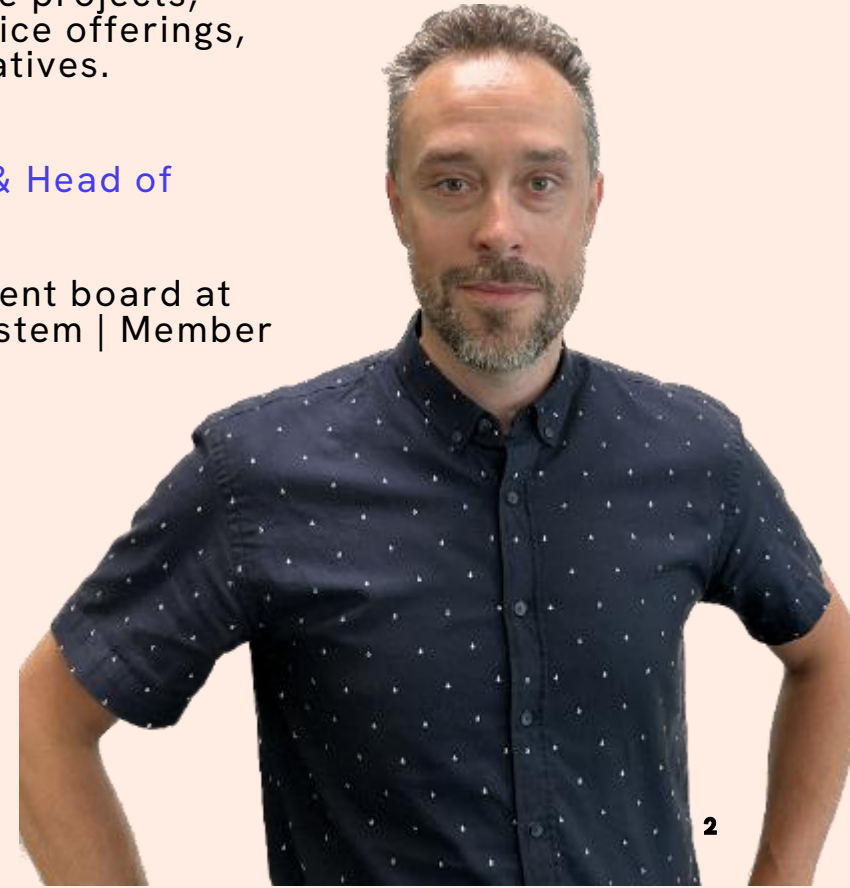
What is Artificial Intelligence at Etteplan

AI = Programs with the ability to learn and reason like humans

AI

ML

Deep learning

Machine learning

Supervised learning

Unsupervised learning

Reinforcement learning

Deep learning

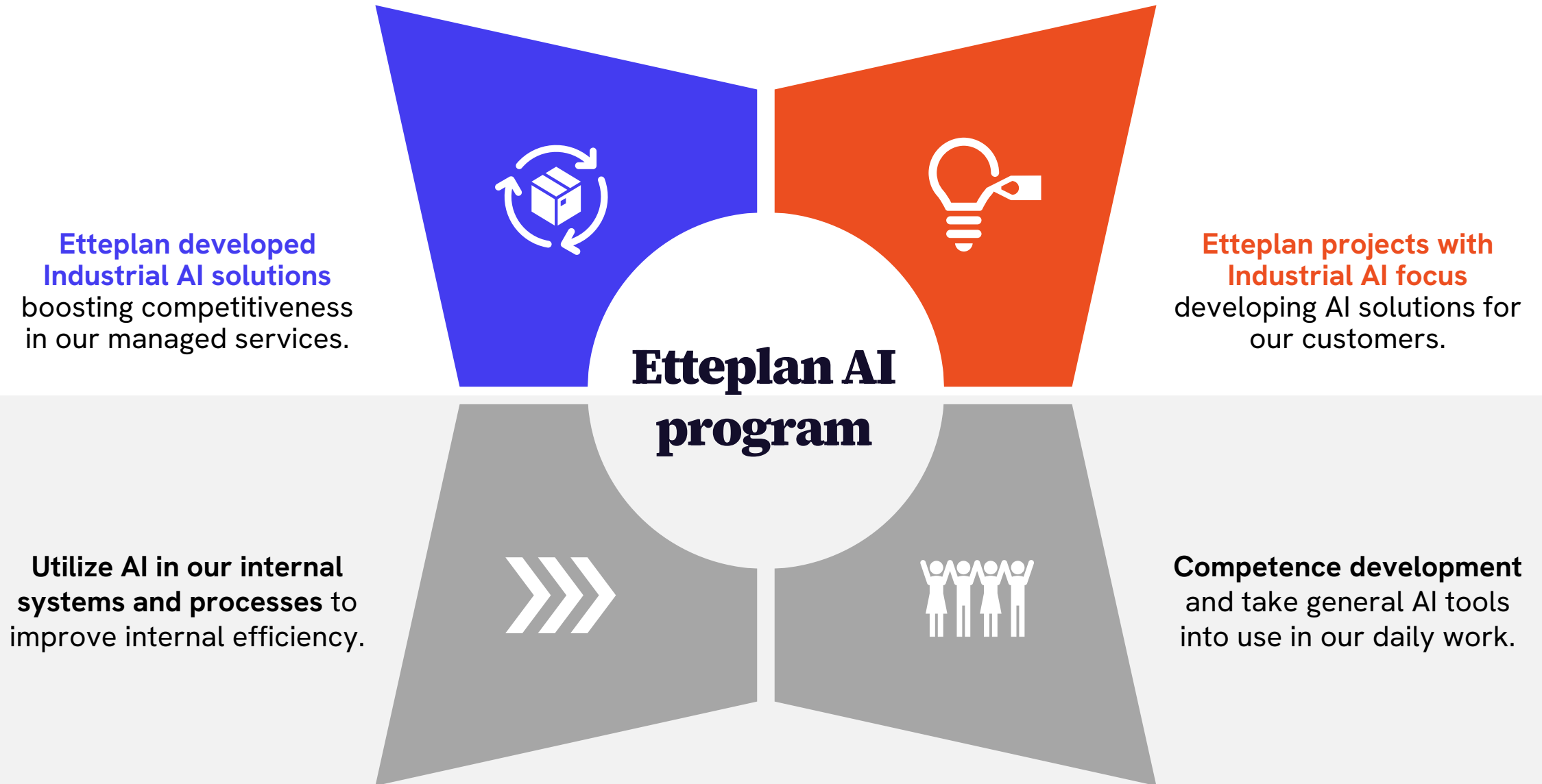**Machine learning**

Generative AI

AI SOLUTIONS CONSULTING
Leverage Etteplan's expertise in service design, data engineering, and software development, combined with our data science team to deliver industrial AI solutions.

ETTEPLAN VISION AI/ML TEAM
Specializing in object detection and image classification, our team excels at identifying defects, locating objects for robotic systems, and more.
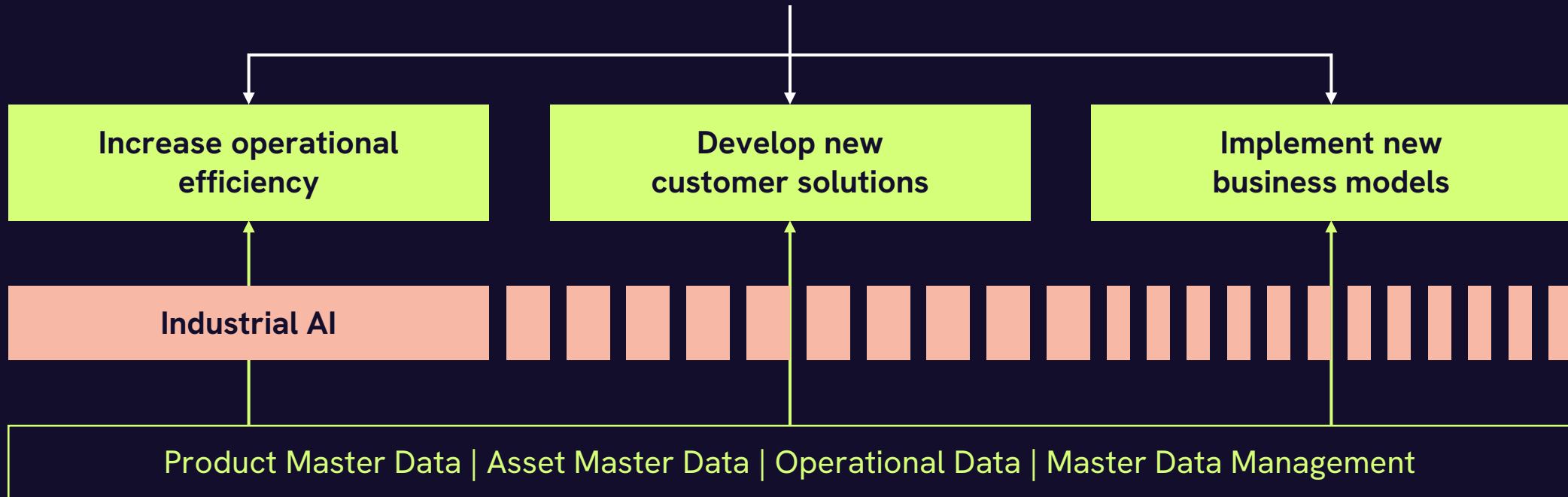
FUTURE INTEGRATION OF GENERATIVE AI
Soon, generative AI will seamlessly integrate into everyday applications and systems, enhancing functionality and user experience.
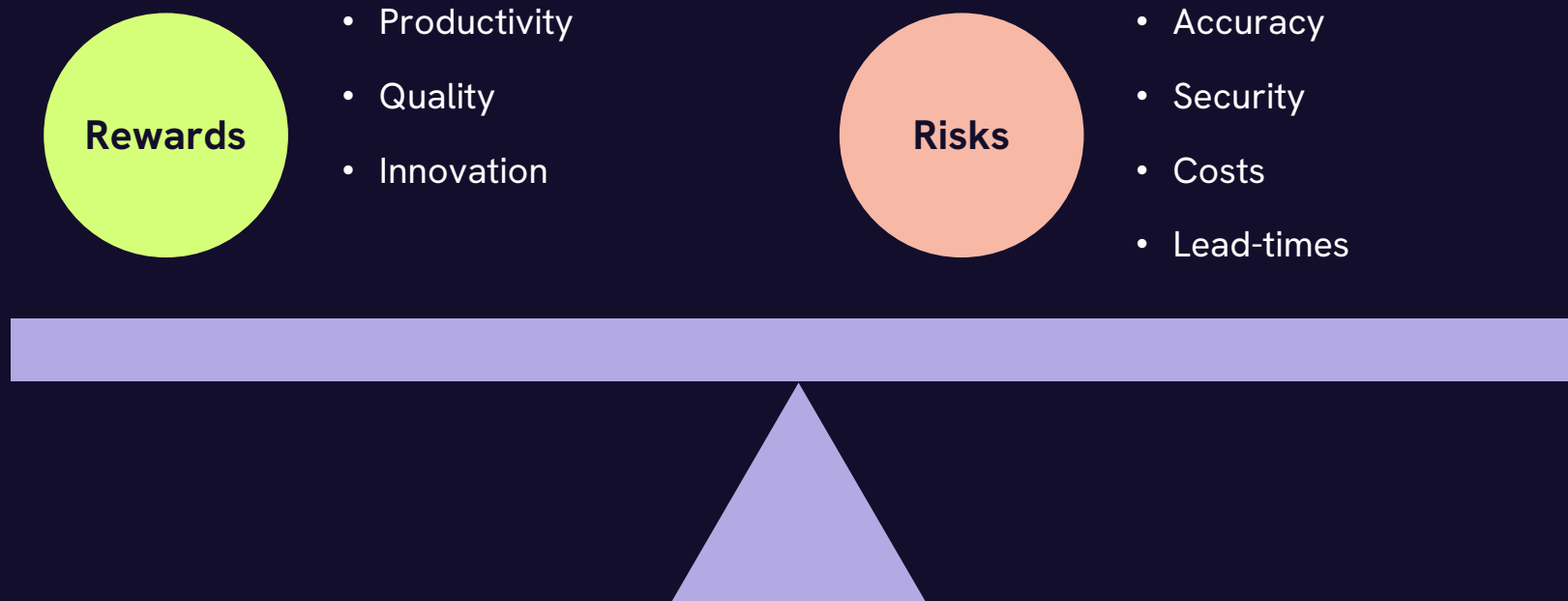
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Etteplan AI program

Etteplan developed Industrial AI solutions boosting competitiveness in our managed services.

Etteplan projects with Industrial AI focus developing AI solutions for our customers.

Utilize AI in our internal systems and processes to improve internal efficiency.

Competence development and take general AI tools into use in our daily work.

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Data &
Digital maturity

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According to market surveys and our customer insights, capabilities to increase digital maturity is critical for our customers

Increase operational efficiency

Develop new customer solutions

Implement new business models

Industrial AI

Product Master Data | Asset Master Data | Operational Data | Master Data Management

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Accuracy and security is critical for our customers, and it is critical for us

Rewards
- Productivity
- Quality
- Innovation

Risks
- Accuracy
- Security
- Costs
- Lead-times

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AI IN Product Development

AI Use cases in Product Design and Development

Market analysis

Customer review analytics

Product discovery

Improved cross-domain knowledge

Brainstorming and idea generation

Simulation-driven design

Task automation

Documentation workflow optimization

Sustainability selections

Process optimization

Quality control

Resource allocation

Energy management

Root cause analysis

Real-time monitoring and alerts

Anomaly detection

Demand forecasting

Employee training and development

Adaptive control systems

Supply chain optimization

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What our customers are saying

Front office

Products and services

Customer Service Key Account management	Not focus area yet
Productivity with AI powered tools	Service and Sales Operations

Back office

Core capabilities

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Generative models' current usefulness

Prediction/Forecasting

Planning

Decision Intelligence

Autonomous Systems

Segmentation/Classification

Recommendation Systems

Perception

Intelligent Automation

Anomaly Detection/Monitoring

Conversational User Interfaces

Content Generation

Knowledge Discovery

LOW   MEDIUM   HIGH

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Source: Gartner (March 2024)

Added value comes from design!!!

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Design approach

Simulation based design

Optimize: topology, shape, size

Take advantage of geometric freedom
- Lattice structures
- Internal channels
- Internal cavities
- Part consolidation

- Optimize print orientation
- Self-supporting shapes

Hexagons:
- Systematic concept design
- Minimize use of material
- Benefit more from AM
- Function driven
- Minimize post-processing
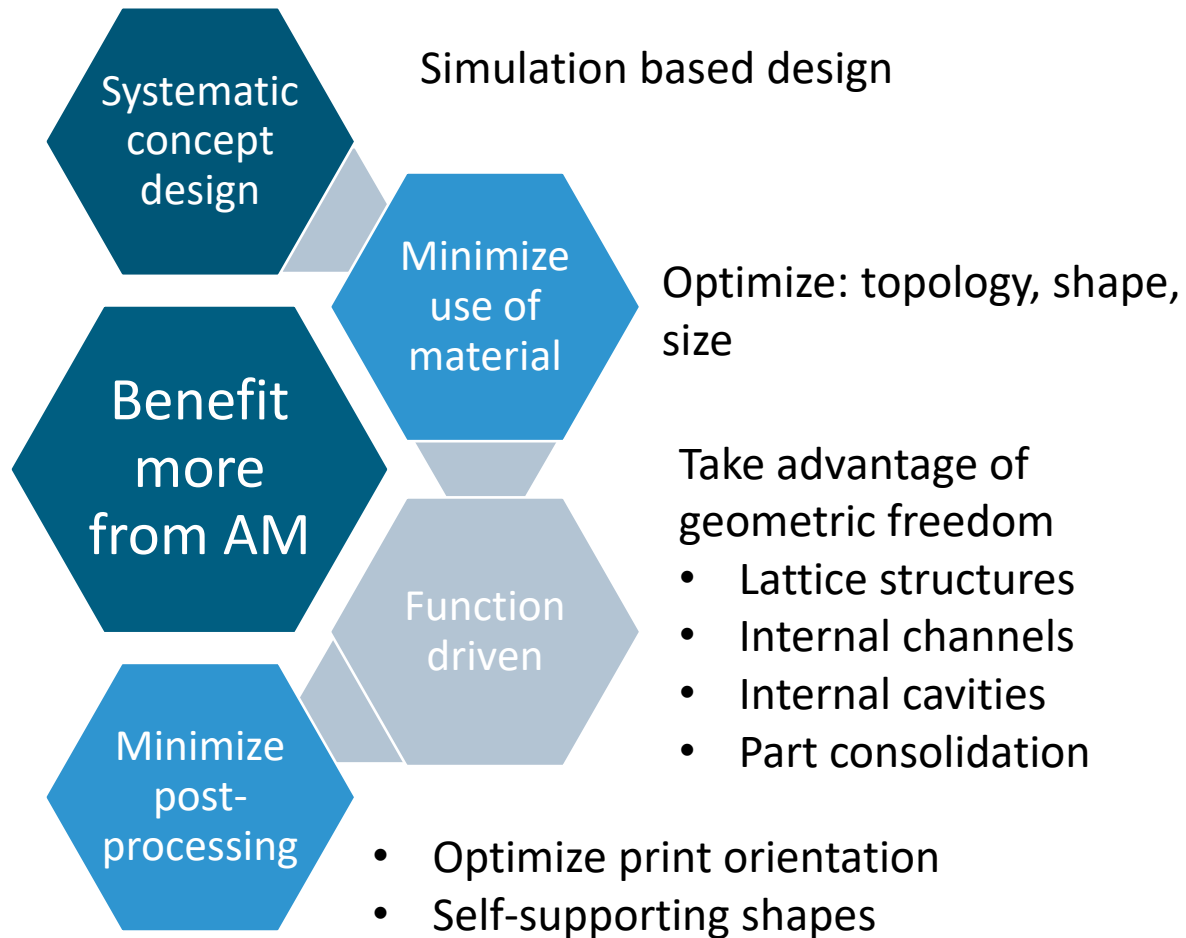
Properties of a successful AM product

- New functionality
- Lightweight, compact
- Short build time
- Single consolidated part
- No assembly needed or design for assembly
- Minimal/easy machining & finishing

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Our design approach

Simulation driven concepting

Simulation driven design

Load case & design space definition — Topology optimization — Preliminary design analysis — Design concept generation

Finalizing design — Design analysis — AM process simulation — Optimized design geometry

- Load cases

- Design space

- Concept creations

- Manufacturing constrains for selected method

- Detail level design

- Design validation

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Manufacturing methods

TRADITIONAL MANUFACTURED

Initial design/idea

Performance improvement work
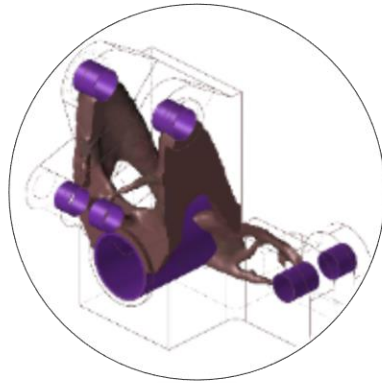
Geometry tailored for mass production method
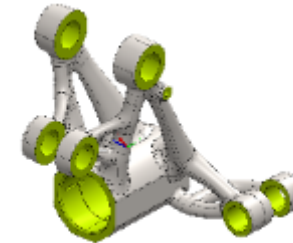
HYBRID CASTING
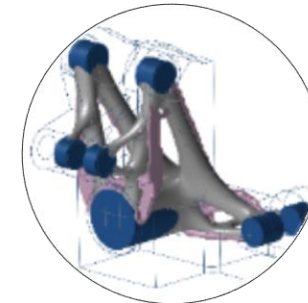
METAL ADDITIVE MANUFACTURING

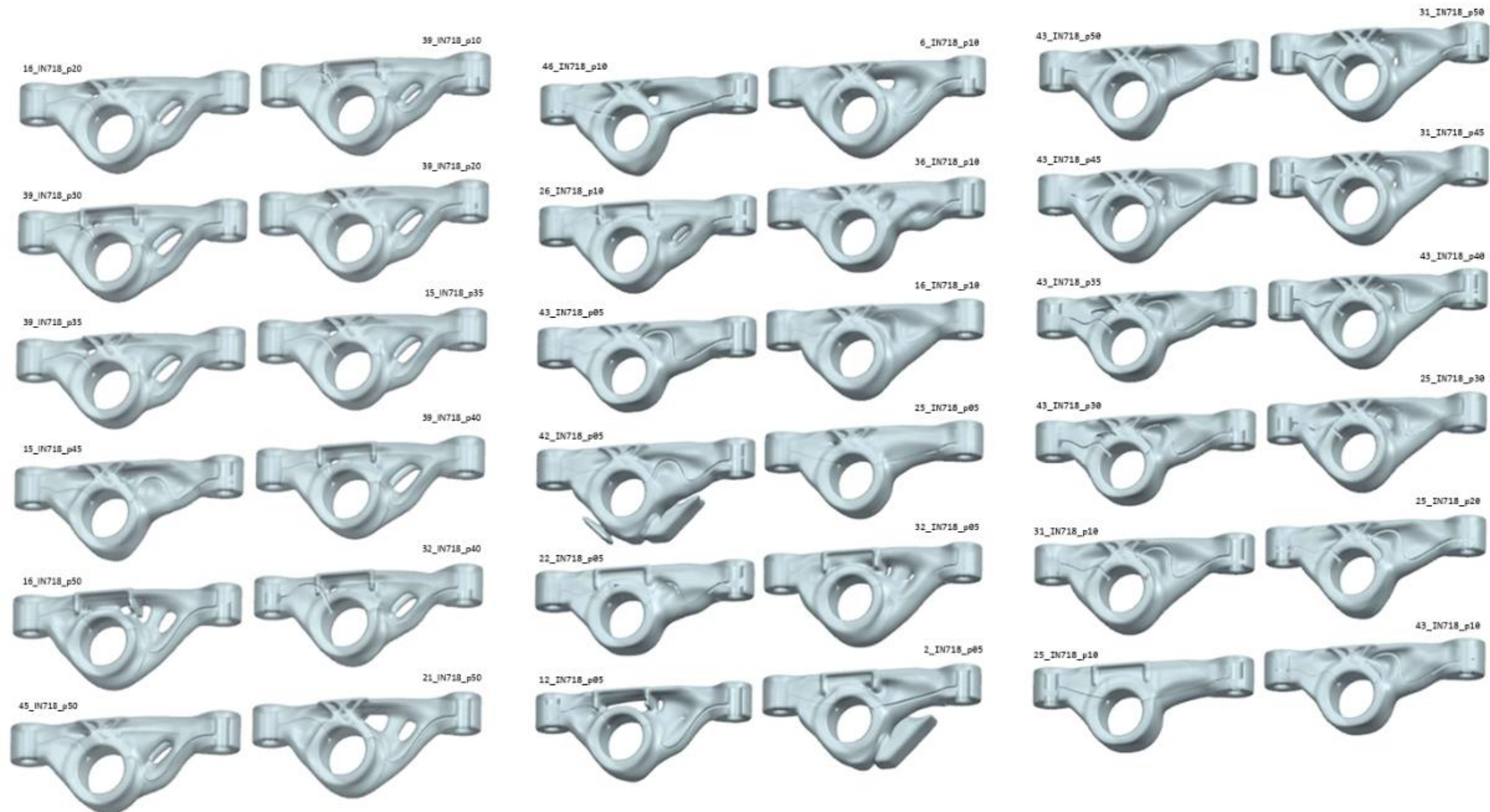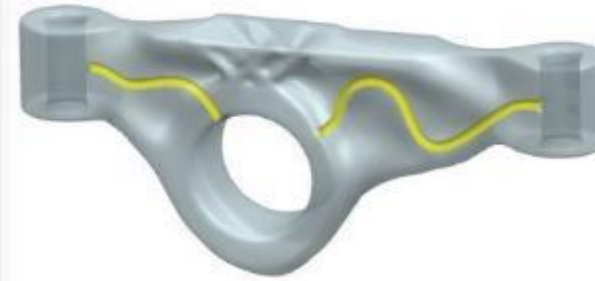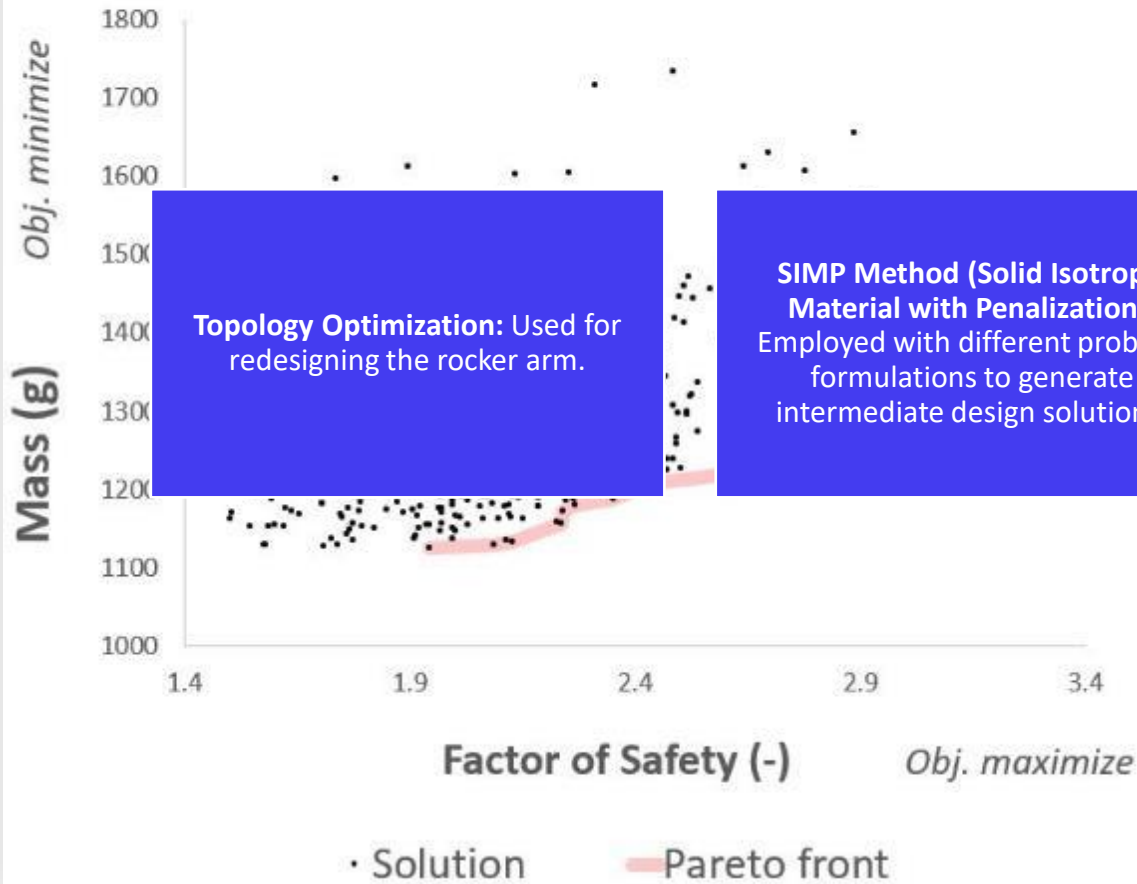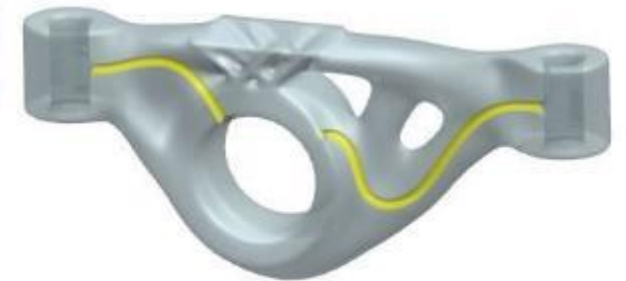Geometry tailored for flexible manufacturing method

MODEL CASTING

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1

16_IN718_p20 39_IN718_p10

39_IN718_p30 39_IN718_p20

39_IN718_p35 15_IN718_p35

15_IN718_p45 39_IN718_p40

16_IN718_p50 32_IN718_p40

45_IN718_p50 21_IN718_p50

46_IN718_p10 6_IN718_p10

26_IN718_p10 36_IN718_p10

43_IN718_p05 16_IN718_p10

42_IN718_p05 25_IN718_p05

22_IN718_p05 32_IN718_p05

12_IN718_p05 2_IN718_p05

43_IN718_p50 31_IN718_p50

43_IN718_p45 31_IN718_p45

43_IN718_p35 43_IN718_p40

43_IN718_p30 25_IN718_p30

31_IN718_p10 25_IN718_p20

25_IN718_p10 43_IN718_p10

Rocker arm optimization
Minimize mass, maximize durability

Topology Optimization: Used for redesigning the rocker arm.

SIMP Method (Solid Isotropic Material with Penalization): Employed with different problem formulations to generate intermediate design solutions.

Multi-objective Optimization (MOO): Utilized to explore various design options considering multiple performance criteria.

TOPSIS (Technique for Order Preference by Similarity to an Ideal Solution): Applied to select a final proposed design from the set of solutions generated by MOO.

AI in Engineering tools

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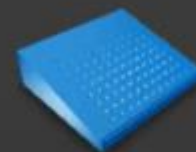
TEXT TO 3D MODEL
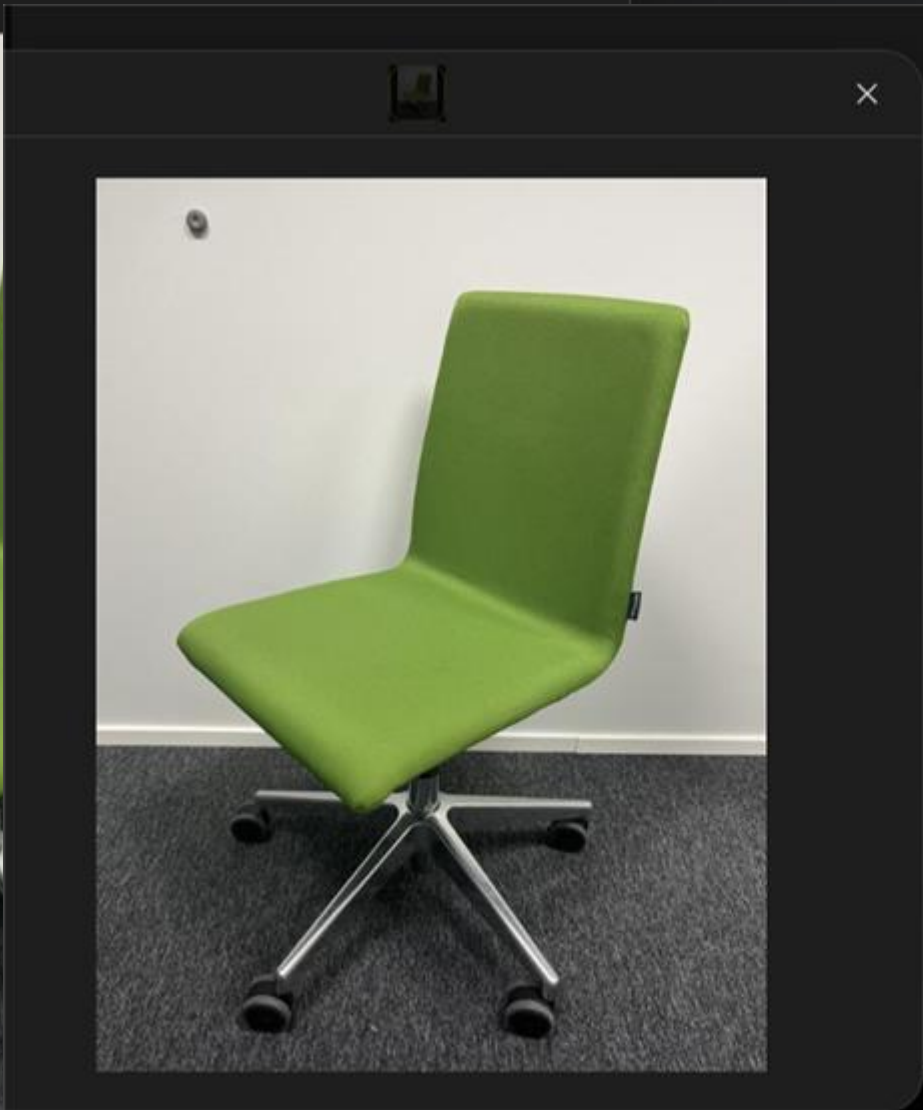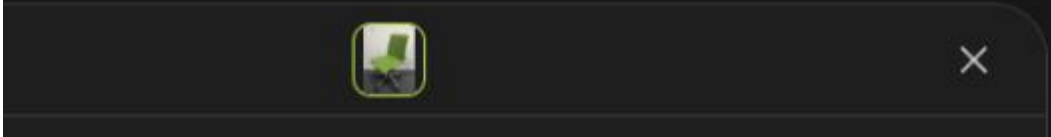
Automated Drawing making

Generative Modeling Demo v20

SOLID SURFACE MESH SHEET METAL TOOLS MANAGE

DESIGN ▾

CREATE ▾   GENERATE ▾   MODIFY ▾   ASSEMBLE ▾   CONSTRUCT ▾   INSPECT ▾   INSERT ▾   SELECT ▾

BROWSER

▲ ⊙ Generative Modeling Demo v... ◉
  ▷ ⚙ Document Settings
  ▷ 📷 Named Views
  ▷ 👁 Origin
  ▲ 👁 Bodies
      👁 Body12
      👁 Body13
      👁 Body11
  ▷ 👁 Construction
  ▷ 👁 Bogie:1
  ▷ 👁 Main Suspension Piston:1
  ▷ 👁 Wheel1
  ▷ 👁 Part4:1
  ▷ 👁 Main Strut Top:1
  ▷ 👁 Upper Panel:1
  ▷ 👁 Lower Panel:1

● GENERATIVE MODELING

▾ Inputs

Faces to Connect   ▶ 3 selected ✕

Bodies to Avoid   ▷ Select

Operation   🗊 New Body   ▾

▾ Alternatives

Generate New Shapes

Alternative 1   ✓

Alternative 2   ✓

Alternative 3   ✓

Alternative 4   0%

Alternative 5   0%

Alternative 6   0%

OK   Cancel

Generative design paradigm shift

Can be weeks /months

| Design requirements and goals | → | Designer creates CAD | → | FEA against requirements | → | Designer creates drawing | → | Machinist evaluates the drawing | → | Fabrication | → | Inspection | → | Qualification |

| Design requirements and goals | → | AI Generates design requirements and fabrication | → | Digital manufacturing "Advanced manufacturing" | → | Inspection | → | Qualification |

Hours / days

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LLM's were trained on public data... How about the engineering tools ?

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3D-model as a single-source-of-truth

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Product definition process is changing
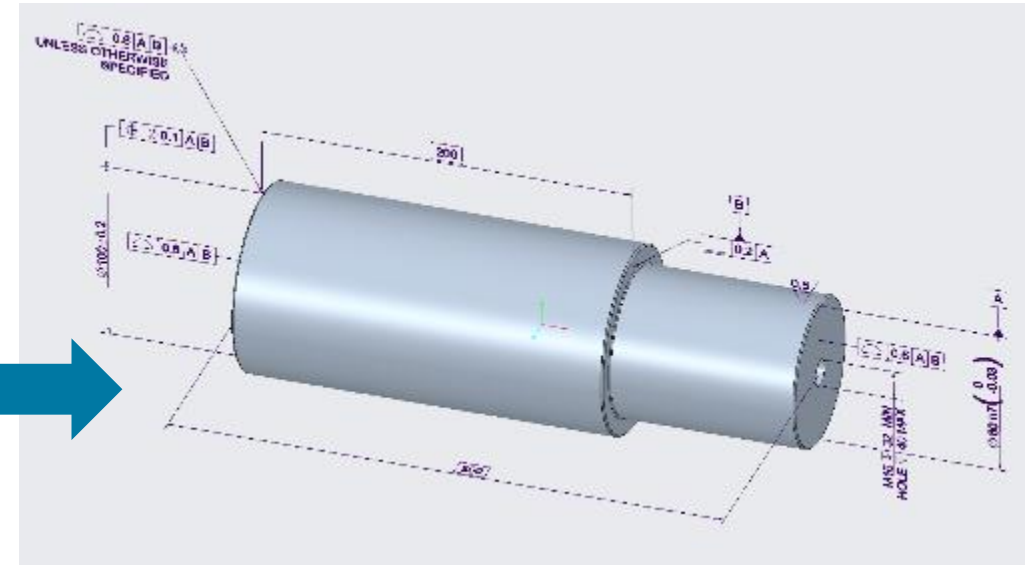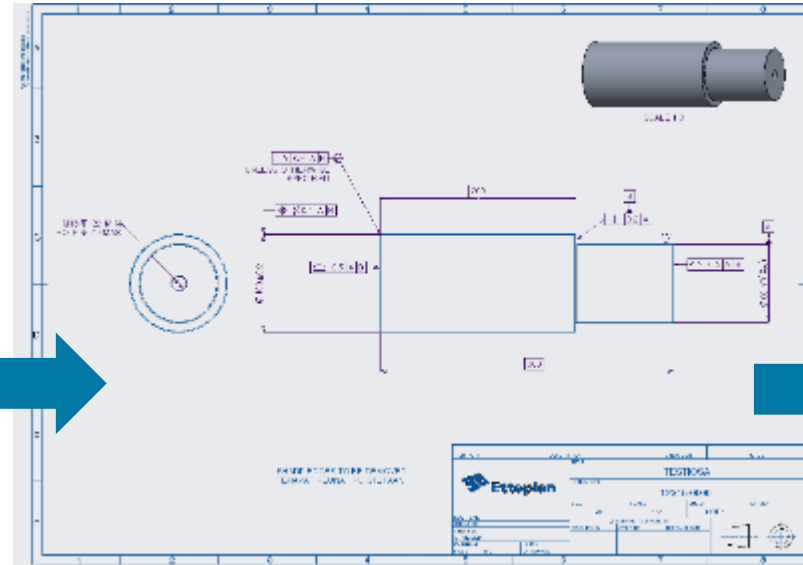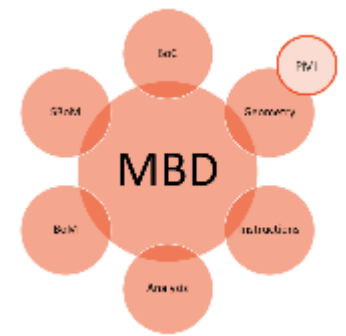
Drawing-Centric Definition

- Up-to the 80s.
- Hand-drafting drawings.
- Design changes were laborious.
- 2D CAD was introduced.

Model-Centric Definition

- Since the 80s
- 2D Drawing as a master with a supplementary 3D model.
- Need to manage both 2D and 3D files.

Model-Based Definition

- Since ~2010
- 3D model as a single-source-of-truth.
- 2D drawings for reference only, when needed.
- MBD as a source of data reuse.

Value for stakeholders

Designers

- 3D annotations are visual.
- 2D drawings not needed.
- Automatic Bill of Characteristics.
- Rapid feedback from other stakeholders.

Manufacturers

- Tolerances easy to understand.
- Materials according to 3D model.
- Automatic CAM&CAI coding.
- Visual communication.
- Increased productivity.

MBD ENABLER FOR FUTURE AI USE ?

Customers

- Increased operational efficiency.
- Improved quality control.
- Faster time-to-market.
- Support for service business.

Picture's source: https://www.ptc.com/en/technologies/cad/model-based-definition

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30
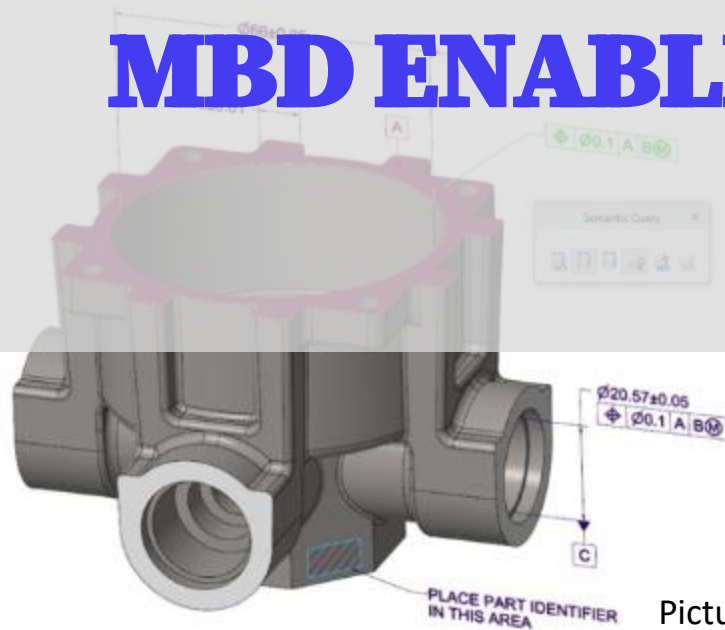
AI in Design & Simulations

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AI & ML in design tools

- All major software providers are now looking into how they can integrate AI and ML technologies into their offerings

- For some of these companies the task has seemingly just started, and others have been in this space for more than a decade

- Example uses:

  - **Tools integrated into CAD to "reduce clicks" and modelling tasks**

  - **Reduce lengthy simulation runs with AI for response prediction**

  - **Generative design**
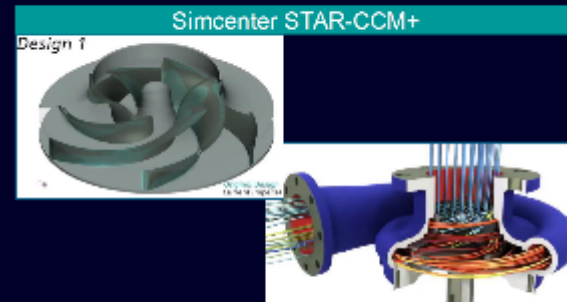
  - **Simulations**

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Example use case:
reduce lengthy simulation runs with AI for response prediction

- Most companies providing simulation tools are now offering physics neutral AI tools to create models that predict simulation outcomes using deep learning or neural networks trained with existing simulations

- These tools tend to be most beneficial in cases where simulation time is long (many hours or more) and many design iterations are required or parameter optimization is necessary

- Example tools:
  - Altair physicsAI
  - Ansys SimAI
  - Hexagon Odyssee
  - Neural Concept
  - Siemens Simcenter HEEDS

HEEDS AI Simulation Predictor
Example – Water Pump Optimization

Water Pump Optimization

- Objective:
  - Maximize Pump Efficiency at a flow rate of 110 kg/s and 1200 RPM

- Constraints:
  - Head (m) ≥ 27
  - Power (kW) ≤ 40

- By Varying:
  - 13x Geometric Variables
  - 1x Number of Blades

Simcenter STAR-CCM+

SHERPA vs SHERPA + HEEDS AI Simulation Predictor

2 Single objective optimizations
- Identical budget: 300 Design Evaluations
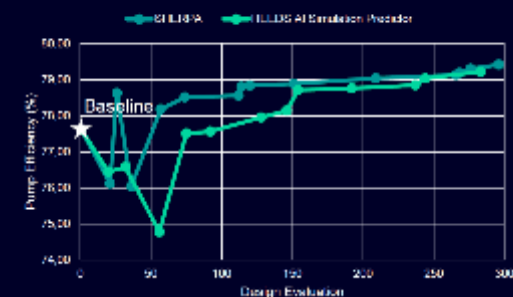- Evaluating: Solutions found, Time savings

HEEDS AI Simulation Predictor
Example – Water Pump Optimization

Benefits: Speed Advantage

- The HEEDS AI Simulation Predictor optimization achieved similar pump efficiencies to SHERPA optimization while meeting the new required head

 | Total Improvement over Baseline |
  | --- |
  | +3% Efficiency |
  | +10% Head (m) |
  | +8% Power (kW) |

- HEEDS AI Simulation Predictor performed 49% of the budget (no CAE simulations)

- 51% of design space exploration budget used real CAE Simulations

Real CAE Simulations *AI Model Predictions Only*

SHERPA — 300 Evaluations — 40 hours
SHERPA + HEEDS AI Simulation Predictor — 151 Evaluations — 20 hours
149 Evaluations — 20 hours of time savings!
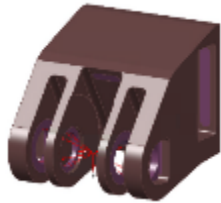
Example use case:
generative design

- Generative design is an AI-based design exploration process

  - **Explores all permutations of a solution**

  - **Generates new alternatives based on previous results**

  - **Tests and learns from each iteration what works and what doesn't**

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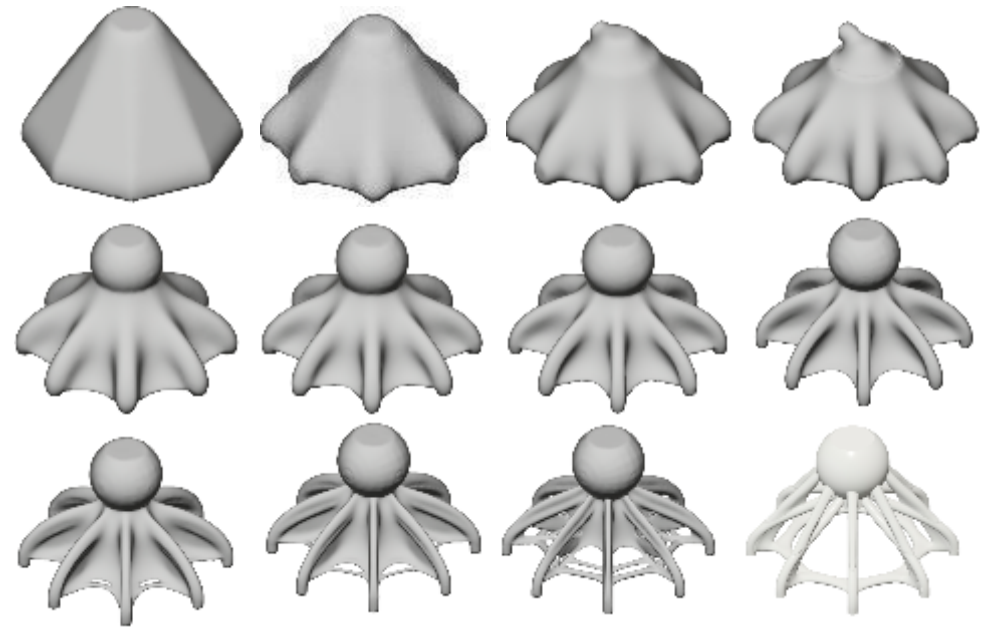
Design in a future ?

Imagine… You will start to discuss with your tool…

Simulation driven design

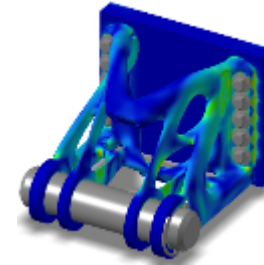Load case & design space definition

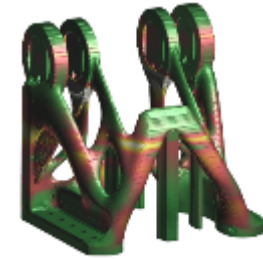Topology optimization

Preliminary FEM analysis

Design concept generation

Finalizing design
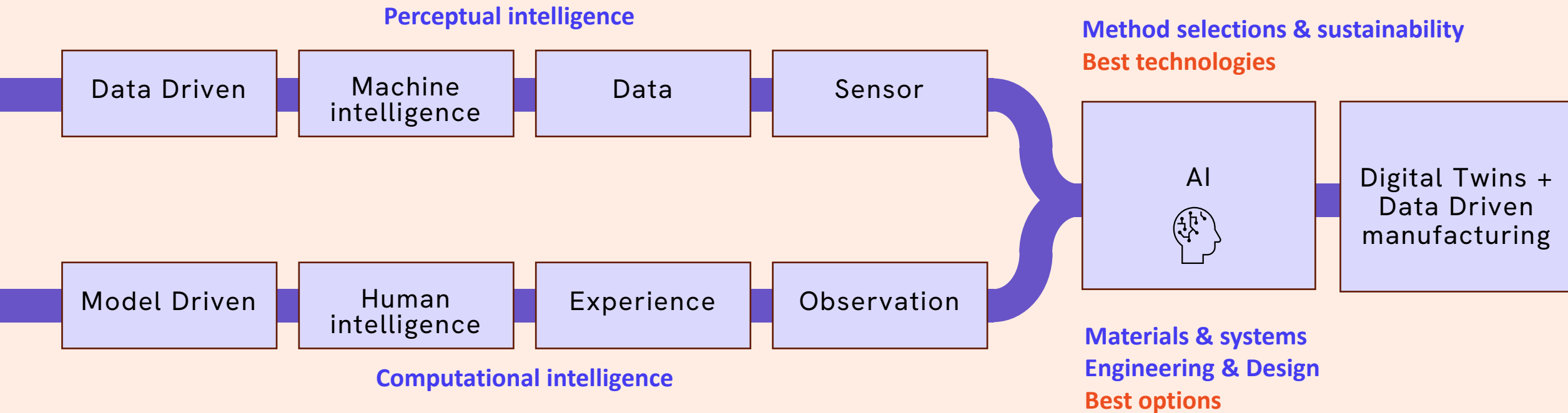
FEM validation

AM process simulation

Optimized design geometry

I would like to build a boom end piece. Please start by collecting all relevant information from the device labeled ETT123548. Once you have gathered the necessary data, we can proceed to the next step. | Great, let's continue. I need you to create various load cases for this project. Specifically, consider the following types of loading: Static loading: The forces that remain constant over time.
Dynamic loading: The forces that vary with time. External loading: This includes forces that may arise from machining processes and potential misuse scenarios. | Excellent, let's move on. Next, I would like you to perform a topology optimization of the case. This analysis should help identify the weakest points in the design, allowing us to make necessary improvements. |Good, let's continue. Please provide me with the 10 best design concepts. When making your selection, consider additive manufacturing (AM) as the primary manufacturing method. Evaluate each concept based on factors such as strength and printability to ensure they are suitable for production.

Model-driven + Data-driven

Perceptual intelligence

Method selections & sustainability
Best technologies

Data Driven	Machine intelligence	Data	Sensor

AI

Digital Twins + Data Driven manufacturing

Model Driven	Human intelligence	Experience	Observation

Computational intelligence

Materials & systems
Engineering & Design
Best options

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Elon Musk says SpaceX has 'the most advanced 3D metal printing technology in the world.'

So does the simplified design of its Raptor 3 engine

RAPTOR 1   RAPTOR 2   RAPTOR 3

DFMA + AM
Design For Manufacture and Assembly +
Additive Manufacturing

SpaceX made 1,000 hardware changes to the
world's largest rocket in just 30 days

Targets in DFMA development

- Lower assembly costs

- Lower cost of quality

- Improved quality

- Better floor space utilization and inventory savings

- Lower product development cost

- Improved throughput and delivery time

- Higher reliability

- Reduced direct and indirect product cost

- Improved time-to-market

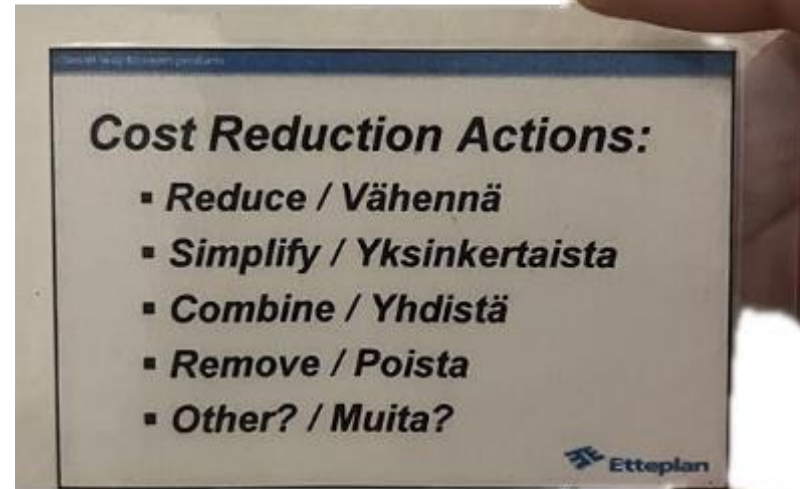- Increased utilization of automation within suppliers

DFMA is a registered trademark of Boothroyd Dewhurst, Inc (2002)

DFMA is used as the basis for concurrent engineering studies to provide guidance to the design team in simplifying the product structure

Nothing new under the ☀️

My DFMA notes from 2010...

Cost Reduction Actions:
- Reduce / Vähennä
- Simplify / Yksinkertaista
- Combine / Yhdistä
- Remove / Poista
- Other? / Muita?

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FASTER

MORE EFFICIENT

OVERALL BETTER

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Key Figures

Growing and developing technology service company

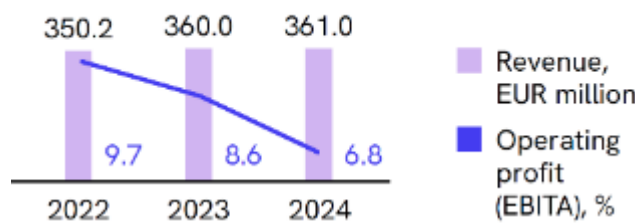Our customers are global machine and equipment manufacturers

We stand out by the high-level of competence and service attitude
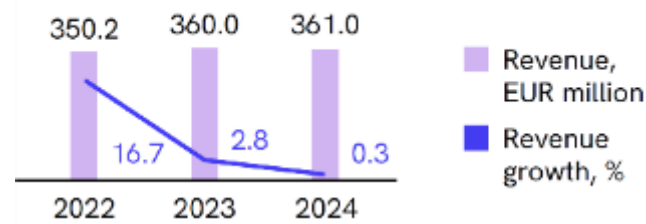
Founded 1983 | Nasdaq Helsinki Ltd

361

REVENUE, EUR MILLION 2024

~4,000

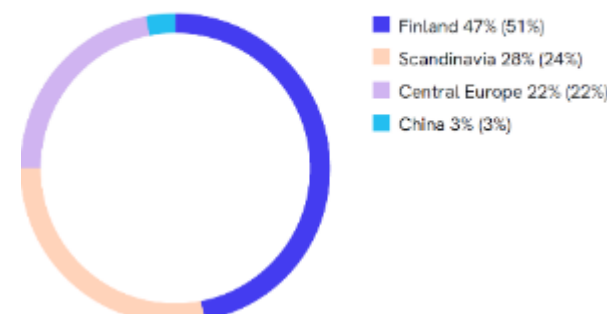**INDUSTRY PROFESSIONALS**

REVENUE AND OPERATING PROFIT (EBITA), %

350.2   360.0   361.0

9.7   8.6   6.8

2022   2023   2024

■ Revenue, EUR million

■ Operating profit (EBITA), %

REVENUE AND REVENUE GROWTH, %

350.2   360.0   361.0

16.7   2.8   0.3

2022   2023   2024

■ Revenue, EUR million

■ Revenue growth, %

REVENUE BY CUSTOMER SEGMENT 2024

■ Energy 16 %
■ Automotive 12 %
■ Industrial Machinery 11 %
■ Forest Industry 10 %
■ Metal and Mining 10 %
■ Aerospace and Defence 6 %
■ ICT and Electronics 6 %

■ Building technology 5 %
■ Chemical 5 %
■ Healthcare and Medical technology 4 %
■ Material handling 4 %
■ Marine and Transportation 3 %
■ Consumer 2 %
■ Other 6 %

REVENUE BY GEOGRAPHICAL AREA 2024 (2023)

■ Finland 47% (51%)
■ Scandinavia 28% (24%)
■ Central Europe 22% (22%)
■ China 3% (3%)

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ETTEPLAN ADDITIVE MANUFACTURING & SIMULATIONS

2025-04

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CORE FACTS

20+ AM DESIGNERS

100+ SIMULATION EXPERTS

50+ AM CASES

AMO TEAM

Product Expert — AM Design expert — AM expert — FEM expert — CFD expert — Material expert

AM SERVICES

NEW PRODUCT DEVELOPMENT

AM ENGINEERING AfAM / DfAM

PRINT PROCESS SIMULATION

TOPOLOGY OPTIMIZATION

FEM

CFD

AM SCREENING

AM TRAINING

AM PURCHASING SUPPORT

AM FACTORY CONSULTANCY

AM ENVIRONMENT, HEALTH & SAFETY

STRENGTHS

- Heavy industry expertise
- Simulation driven design for AM
- AM business case creation
- Strong partner network

And many more...

FOR DEMANDING CUSTOMERS

From tooling and prototypes to critical components

Our customers can benefit from Etteplan's extensive research and development in the field of AM e.g materials, design process, software's.

We industrialize AM for our customers

Contact:
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tero.hameenaho@etteplan.com
+358 40 579 0027

Let's work together