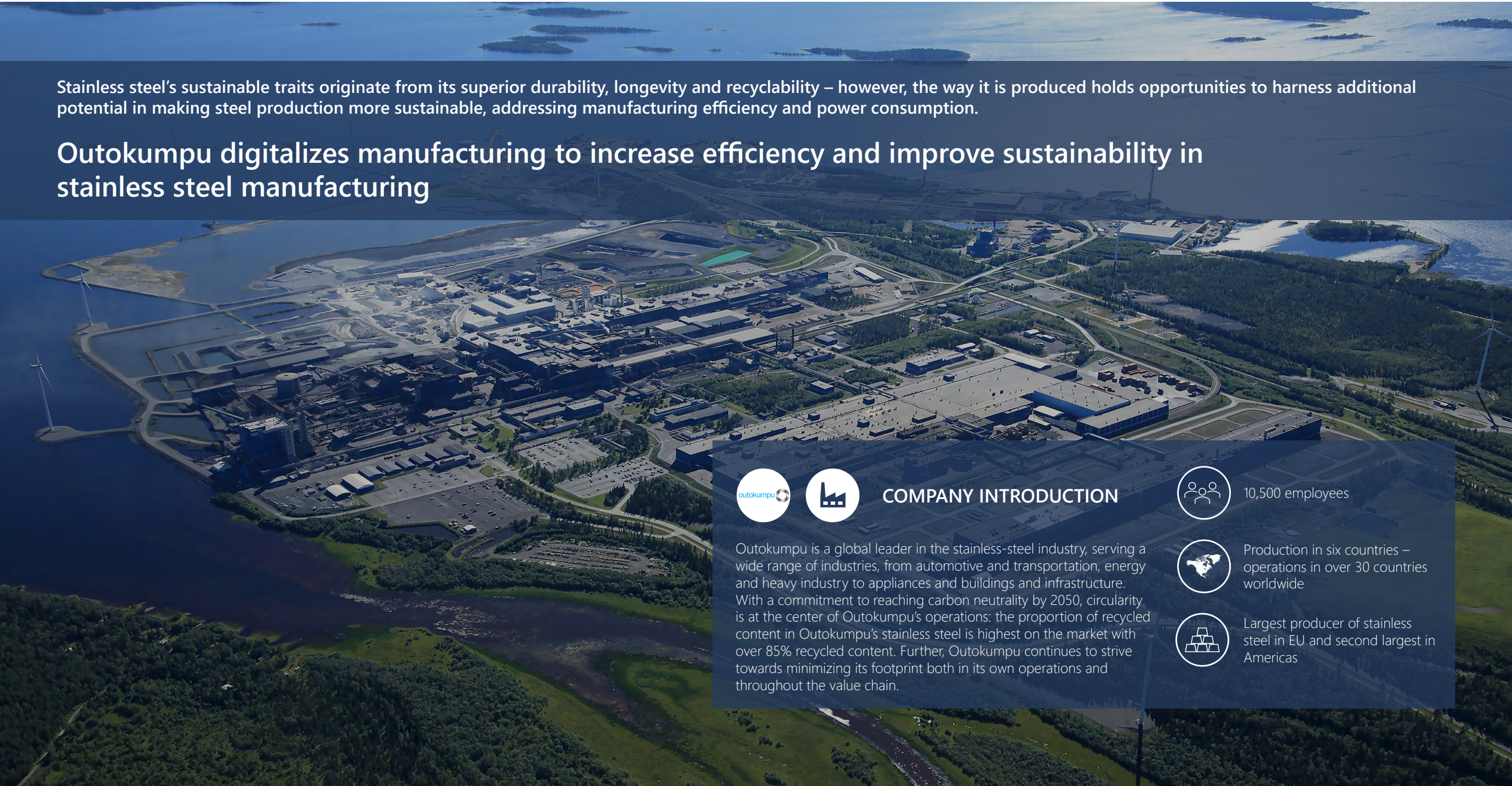
Microsoft

Outokumpu Case Study

A global manufacturer's journey towards carbon neutrality and a sustainable future

Stainless steel's sustainable traits originate from its superior durability, longevity and recyclability – however, the way it is produced holds opportunities to harness additional potential in making steel production more sustainable, addressing manufacturing efficiency and power consumption.

Outokumpu digitalizes manufacturing to increase efficiency and improve sustainability in stainless steel manufacturing



COMPANY INTRODUCTION

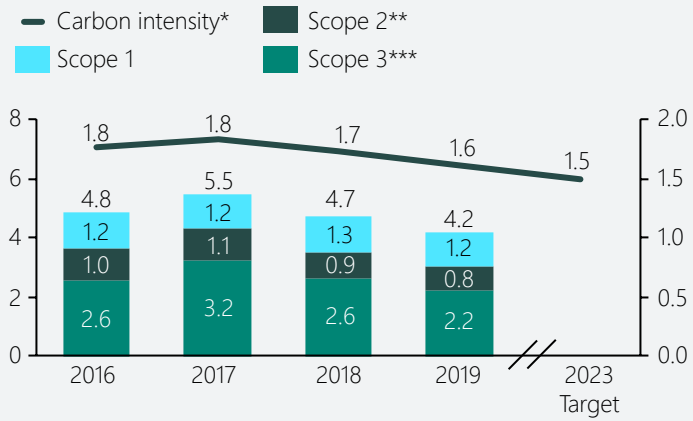
Outokumpu is a global leader in the stainless-steel industry, serving a wide range of industries, from automotive and transportation, energy and heavy industry to appliances and buildings and infrastructure. With a commitment to reaching carbon neutrality by 2050, circularity is at the center of Outokumpu's operations: the proportion of recycled content in Outokumpu's stainless steel is highest on the market with over 85% recycled content. Further, Outokumpu continues to strive towards minimizing its footprint both in its own operations and throughout the value chain.

- 10,500 employees
- Production in six countries – operations in over 30 countries worldwide
- Largest producer of stainless steel in EU and second largest in Americas

Outokumpu is committed to carbon neutrality by 2050 – addressing direct, indirect, and upstream emission drivers, focusing especially on improving circularity in its stainless steel manufacturing

Outokumpu has reduced its footprint and continue to lessen its carbon intensity …

Outokumpu's CO_2 emission profile, 2016-2019 CO_2
(emissions in $mtCO_2e$; carbon intensity in tCO_2e/t steel)



The steel industry is a significant CO_2-emitter, making steel plants strong candidates for decarbonization through a focus on production and electricity emissions (scope 1 and 2 respectively), as well as upstream emissions in terms of mainly use of materials and transportation (scope 3).

* Carbon intensity across all scopes; ** Location based; *** Upstream emissions

… Which is a result of initiatives to improve across its production (direct), electricity / energy consumption (indirect) and upstream emission drivers (use of materials)

Outokumpu's key climate focus areas, selected examples

STEEL MILLS AS RECYCLING FACILITIES

Outokumpu integrates circularity into the core of its productions with high amounts of recycled materials, currently at ~90%. Stainless steel is highly durable, and quality is not compromised over time, which makes it a valuable input as scrap. Further recovery and recycling of residual metals from the production processes, e.g. from dust is also essential. The focus on recycling products also reduces landfill.

Target 90% recycled content in stainless steel

ENERGY EFFICIENCY AND YIELD OPTIMIZATION

With the high energy-intensity of steel production, Outokumpu seeks to save energy through yield optimization by reorganizing production sites, optimizing internal supply chains, and increasing capacity utilization. Further, Outokumpu is sourcing low carbon electricity and applying alternative energy sources, e.g. Tornio site in Finland has fully transitioned to use LNG instead of propane in production.

Target 20% reduction by 2023 vs. '14-'16 baseline

SUSTAINABILITY IN THE SUPPLY CHAIN

Leveraging its integrated supply chain, Outokumpu keeps control of key raw materials – and keeps its products traceable for customers. Further, Outokumpu has in place stringent requirements on its suppliers and screen direct material suppliers on the ESG risks in countries of origin. Materials are transported by rail and ship where possible to reduce CO_2 emissions.

Target reduction of 23% in scope 3 intensity

REDUCE EMISSIONS INTENSITY TO 0.92 TCO_2 PER TONNE CRUDE STEEL BY 2050 - CLMATE NEUTRAL BY 2050

Source: Outokumpu

As a stainless steel producer, Outokumpu is serving the customer demand to decarbonize while setting a new direction for the industry

Selected examples of challenges addressed

Higher standards of living across the globe combined with an urgent need for new technological solutions have increased demand for stainless steel across the globe. Further, as many industries seek to decarbonize, they increasingly set new sustainability requirements for their upstream steel usage. Stainless steel meets these requirements in terms of both serving a demand for recyclability, limiting resource depletion – basing production on scrap steel as primary raw material – as well as serving the need for durability to extend lifetime of the products and infrastructure produced.

Steel manufacturers are faced with increasingly growing economic incentives to decarbonize as a result of tightening regulation. Emission reduction targets set in both national and multinational agreements are being pursued. In addition, there is wide and growing momentum to price carbon in countries around the world.

Further, manufacturers (customers) are increasingly demanding more sustainable products from OEMs and further up the supply chain, as they address their own indirect emissions and react to consumer trends.

Steel production is highly energy intensive. For the recycled steel to melt in an electric arc furnace, it is heated to over 1,400°C. Energy and electricity use are thus key drivers for emissions – as well as costs. In addition to electricity, fuels are used in the production. Improvements in efficiency and use of alternative fuels and energy sources are to be considered for full decarbonization.

High quality standards are also a key concern, as any wasted end products and obstruction to the production line results both in lower yield and wasted energy and electricity use.

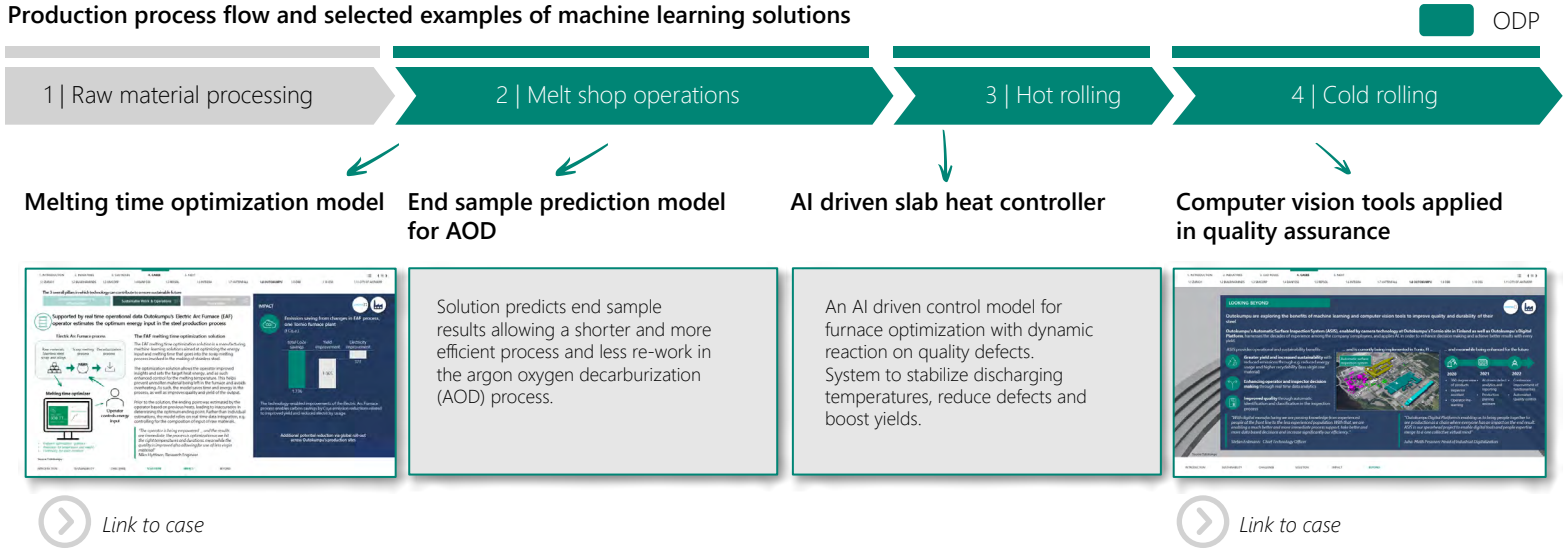
Source: Outokumpu

Outokumpu is integrating sustainability in its digital manufacturing – starting with the transformation at its Tornio site in Finland

DIGITAL MANUFACTURING

Outokumpu Digital Platform (ODP) is Outokumpu's tool to collect and analyze data in every step of their production line, from mining and smelting, to melting, hot and cold rolling and finishing, aiming to optimize manufacturing processes. **The Tornio plant was the nesting ground for the platform. Now the solutions, often machine learning solutions based on Azure cloud and AI services, are implemented and have increased output by 10-15 percent, while predictive technology has in some cases helped reduce quality defects by up to 40 percent**. With the ODP, Outokumpu takes digital manufacturing to the next level with added sustainability benefits. The reductions in electricity, energy and processing time all contributes to a lower carbon footprint. Hence, at low costs, the energy intensity of the stainless-steel production process is reduced step by step, which will be highlighted with a few examples below.

Production process flow and selected examples of machine learning solutions



Source: Outokumpu

IMPACT

Up to 40 percent

Reduced quality defects, limiting re-work and waste and improving yield for certain applications

10–15 percent

Increased output from digital manufacturing

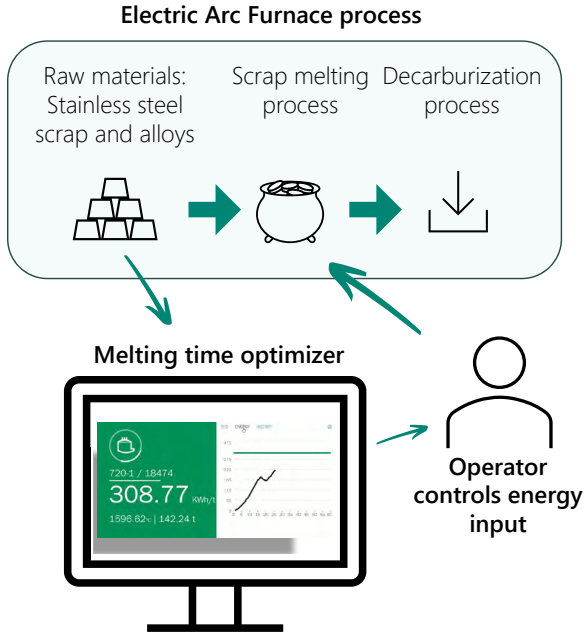
"We have taken the major steps towards reaching end-to-end digital coverage of our manufacturing – we can leverage data mining and turn in depth understanding of our processes into real CO_2 reduction and yield increase"

Juha-Matti Pesonen, Head of Industrial Digitalization

"Our end sample prediction model allows not only a more efficient process but also less rework and thus a higher yield"

Pekka Vainio, Project Manager

Supported by real time operational data Outokumpu's Electric Arc Furnace (EAF) operator estimates the optimum energy input in the steel production process



- Endpoint optimization guidance
- Prediction for temperature and weight
- Controlling for input materials

The EAF melting time optimization solution

The EAF melting time optimization solution is a manufacturing machine-learning solution aimed at optimizing the energy input and melting time that goes into the scrap melting process involved in the making of stainless steel.

The optimization solution allows the operator improved insights and sets the target heat energy, and as such enhanced control for the melting temperature. This helps prevent unmolten material being left in the furnace and avoids overheating. As such, the model saves time and energy in the process, as well as improves quality and yield of the output.

Prior to the solution, the ending point was estimated by the operator based on previous heats, leading to inaccuracies in determining the optimum ending point. Rather than individual estimations, the model relies on real time data integration, e.g. controlling for the composition of input of raw materials.

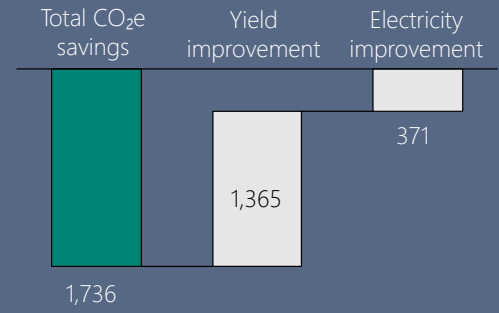
> "The operator is being empowered ... and the results are immediate, the process is optimization as we hit the right temperatures and durations, meanwhile the quality is improved also allowing for use of less virgin material"
>
> **Niko Hyttinen, Research Engineer**

Source: Outokumpu

IMPACT

Emission saving from changes in EAF process, one Tornio furnace plant

(t CO_2e)



The technology-enabled improvements of the Electric Arc Furnace process enables carbon savings by CO_2 emission reductions related to improved yield and reduced electricity usage.

Additional potential reduction via global roll-out across Outokumpu's production sites

LOOKING BEYOND

Outokumpu is exploring the benefits of machine learning and computer vision tools to improve quality and durability of their steel

Outokumpu's Automatic Surface Inspection System (ASIS), enabled by camera technology at Outokumpu's Tornio site in Finland as well as Outokumpu's Digital Platform, harnesses decades of experience among the company's employees, and applies AI, in order to enhance decision making and achieve better results with every yield.

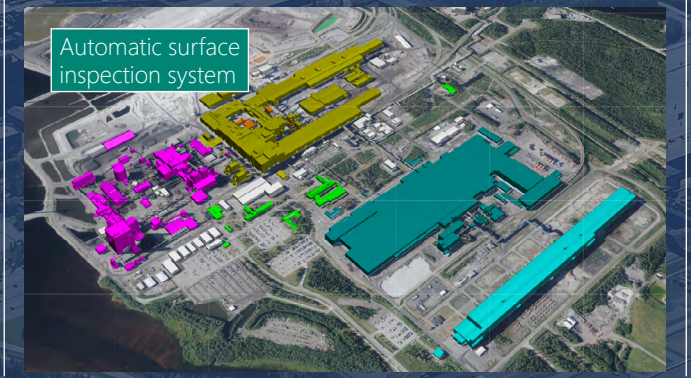
ASIS provides operational and sustainability benefits ...

Greater yield and increased sustainability with reduced emissions through e.g. reduced energy usage and higher recyclability (less virgin raw material)

Enhancing operator and inspector decision making through real time data analytics

Improved quality through automatic identification and classification in the inspection process

... and is currently being implemented in Tonio, FI ...



... and meanwhile being enhanced for the future

2020

- 360 degree view of products
- Inspector assistant
- Operator Pre-warning

2021

- AI-driven defect analytics and reporting
- Production planning assistant

2022

- Continuous improvement of functionalities
- Automated Quality control

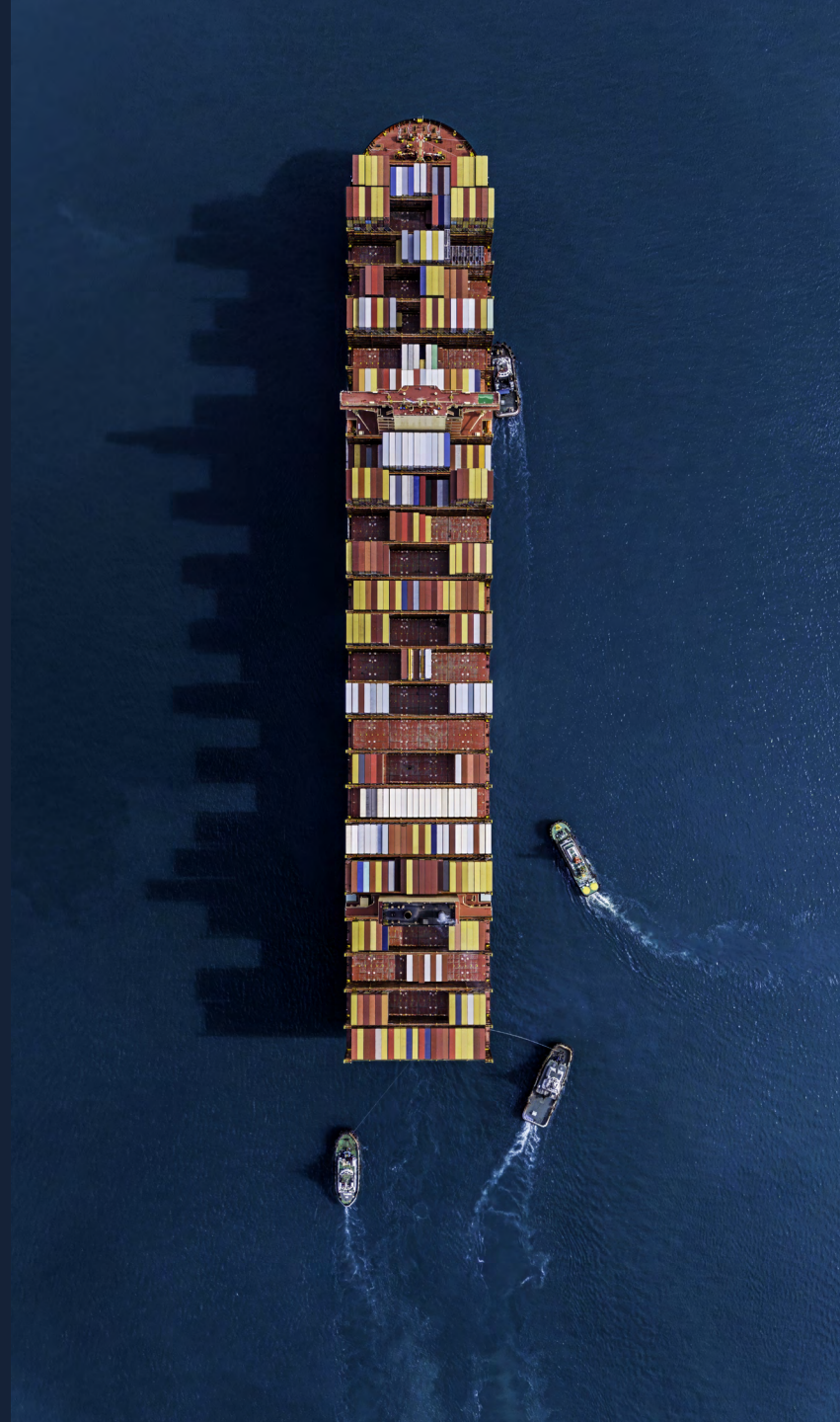
"With digital manufacturing we are passing knowledge from experienced people at the front line to the less experienced population. With that, we are enabling a much better and more immediate process support, take better and more data based decisions and increase significantly our efficiency."

Stefan Erdmann, Chief Technology Officer

"Outokumpu Digital Platform is enabling us to bring people together to see production as a chain where everyone has an impact on the end result. ASIS is our spearhead project to enable digital tools and people expertise to merge into a one collective virtual mind"

Juha-Matti Pesonen, Head of Industrial Digitalization

Microsoft



Learn how Microsoft can help with your sustainability journey

Exerpt from study by EY