TOP ENGINEER

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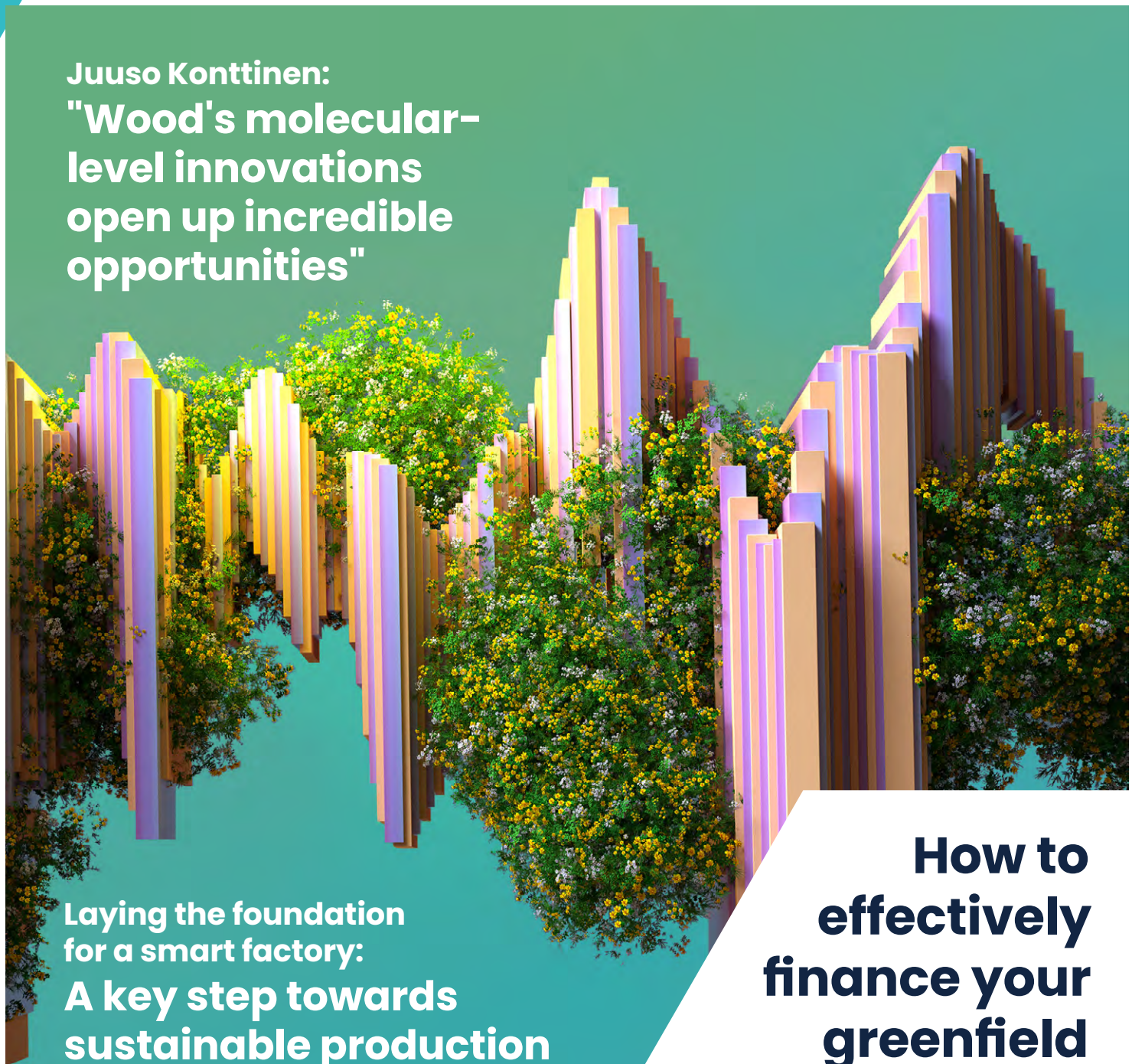

Juuso Konttinen: "Wood's molecular-level innovations open up incredible opportunities"

Laying the foundation for a smart factory: A key step towards sustainable production

How can we ensure global access to medicines?

How to effectively finance your greenfield infrastructure project

2/2024

Top Engineer 2/2024
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Steering towards a sustainable future

As a young marine scout, I learned a valuable lesson: the compass needle always points north, offering a clear sense of orientation no matter where you are. The needle doesn't act on its own; it responds to magnetic forces in its environment, constantly adjusting to maintain accuracy.

Today's industries are facing similar pressures, as environmental changes and shifting market forces reshape traditional value chains. New opportunities are emerging in areas once considered no-man's-lands. For example, as highlighted in this issue of Top Engineer, modern biorefineries have evolved far beyond wood pulp production. They now focus on higher-value components, blurring the lines between traditional industry sectors while simultaneously improving resource efficiency.

Given this situation, spearhead competencies will be key to understanding the new dimensions of traditional industries, enhancing the utilization of renewable resources and reducing dependence on non-renewables. The pharmaceutical industry has long been a frontrunner in this area, and new renewable material applications in areas such as wound healing, medicine, and packaging are continually developing. In every industry, our common goal must be to enhance resource consciousness – conserving natural resources, optimizing their use, and prioritizing recycling whenever possible.

As we navigate these shifting landscapes, I find myself once again guided by a compass – this time, a symbolic one that informs our corporate strategy. To be well prepared, Elomatic has already established the new Industry business unit. In times of uncertainty, we want to ensure our full range of competencies are aligned with the demands of emerging markets and innovations on the horizon. Creativity, engineering excellence, and innovation will be essential as we face challenges where standard solutions no longer suffice. That is our compass north, and by carefully adhering to our strategy and purpose, we can manage any disturbances or external forces affecting our performance.

At the heart of Elomatic's strategy is our commitment to our core values: we succeed together, we are trustworthy, and we have a passion to improve. These principles will guide us as we work towards a more sustainable future.

Tom Lind
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How to effectively finance your greenfield infrastructure project

Text: Robin Norrbäck, Timo Kurki
Images: Elomatic, GettyImages

Lenders typically regard established technologies, like those utilized in wind farms, as more reliable compared to cutting-edge innovations in the circular economy. However, well-structured offtake agreements can mitigate the risks associated with these novel technologies. In all cases, a realistic bank model is essential for optimizing debt terms.

Financing an infrastructure project typically requires both debt and equity, with the ratio between the two depending on several factors. To optimize returns, it is generally advisable to maximize debt while ensuring that the financing terms remain attractive. Equity and debt financing have different characteristics, as do projects, which can vary significantly by industry, technology, and ownership structure.

Over the past two decades, our team has facilitated various large-scale financing arrangements for greenfield projects and M&A transactions, arranging billions of euros in debt financing. Below, we share key insights from successful debt transactions, with a focus on large-scale financing.

Mitigating risk with well-structured agreements

The key to securing competitive and lucrative debt terms lies in proper risk allocation. For greenfield infrastructure investments, this can be achieved through well-structured agreements established at the outset of the debt procurement process. Typically, offtake agreements serve this purpose. These agreements are used to hedge the price and/or quantity of an input or output of the project in question.

> **The key to securing competitive and lucrative debt terms lies in proper risk allocation.**

For example, a waste incinerator requires waste as a fuel input while selling heat and electricity as outputs. Both the price and quantity of waste, heat, and electricity can be hedged in advance through offtake agreements with various counterparties. While achieving this can be challenging, successfully doing so will appeal to lenders and result in more favorable financing terms. The point is that such agreements enhance the predictability of cash flows, reducing volatility and facilitating lenders' credit assessments.

Considering the sponsor's perspective

In project-financed (i.e., non-recourse) transactions, the amount of debt – leverage or gearing – depends on forecasted cash flows. Therefore, it is essential to consider if the available offtake terms are feasible from an equity investor's perspective. First and foremost, it is crucial to remember that every case is unique, and finding the optimal funding structure always requires a careful balancing act.

From a lender's perspective, established technologies, such as those used in wind farms, are generally viewed as more reliable than entirely new innovations within the circular economy. Nonetheless, regardless of the technology employed, having well-structured offtake agreements can mitigate project risks, assuming the counterparties possess strong creditworthiness.

Importance of staying realistic

All business plans and financial models rely on assumptions, which are typically drawn from either third-party market forecasts or historical data such as past sales, costs, and industry benchmarks. Due to the inherent uncertainty of the future, risk-averse financiers, such as banks, often focus on how projects will perform under pessimistic scenarios. This is especially true for novel technologies.

However, financiers also prioritize conservative assumptions for established technologies with proven track records to mitigate risk and ensure financial viability in potentially unfavorable conditions. For instance, when assessing the profitability of a wind farm investment and sizing the appropriate amount of debt financing, banks commonly require careful revenue projections that include low-wind scenarios to inform their financial calculations.

Nevertheless, conservatism is not to be mixed with the worst-case scenarios. Conservative or pessimistic assumptions can represent probable outcomes, while worst-case scenarios are typically unlikely to occur.

Value of comprehensive market understanding

To remain realistic regarding the success of the project and secure funding from external sources, it is crucial to have a thorough understanding of customer demand and market conditions in the foreseeable future. This includes comprehension of the prevailing market conditions and the level of competition, whether the product is being sold in markets that are emerging or already saturated. Additionally, macroeconomic factors such as tightening regulations and the financial market environment must be considered.

Unrealistic assumptions and expectations can not only deter banks

from providing debt financing but may also damage the project developer's reputation by suggesting incompetence. A truthful and pragmatic approach helps clarify the assumptions used in the business and financial model, showing whether the project can sell its products, generate profit, and repay or refinance the debt as forecasted.

> **Unrealistic assumptions and expectations can not only deter banks from providing debt financing but may also damage the project developer's reputation by suggesting incompetence.**

Unlocking success: cautions and opportunities

While offtake agreements can be beneficial, there have been instances where they have led to significant challenges, highlighting the necessity of thoroughly understanding the associated processes. Furthermore, if Operations and Maintenance (O&M) agreements or other outsourcing arrangements are required, it is vital to ensure that these are either finalized or nearing completion when securing debt financing.

Ultimately, a realistic bank model not only facilitates the optimization of debt terms but also enhances the risk-return profile for equity investors. Therefore, careful assessment of all critical factors is vital for ensuring bankability of the project with best possible terms.

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Robin has over six years of experience in investment banking and strategy work within the Nordic energy sector. He is currently an Associate Director at Elron, a member of Elomatic. Robin's focus areas include M&A, financing, and project development of renewable energy projects.

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Timo Kurki
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Timo has over four years of experience in the energy sector and currently works as an Analyst at Elron, a member of Elomatic. He has worked in financial consulting and investment banking within the energy market, focusing primarily on valuations and financing related to renewable energy projects, district heating, and electricity transmission.

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Key points to consider

When assisting our clients with their greenfield investments, we typically follow this high-level procedure:

1. **Ownership structure:**
Who are the sponsors and what features/advantages they may bring to the project? Is there a need to broaden the ownership base? Would it be beneficial for the sponsors to provide credit enhancement for the project in some capacity?

2. **Structuring project agreements:**
Beyond funding, how can we pre-optimize financial terms? This may involve establishing offtake agreements and outsourcing arrangements.

3. **Project modeling:**
Is the project modeled based on well-considered assumptions? The project structure should be presented together along the projected cash flows to multiple lenders.

4. **Assistance through negotiations:**
We provide support throughout the negotiation process until the financing is closed.

It is important to consider steps 1 and 2 before progressing to step 3. A clear understanding of how contracts operate under various conditions and how these outcomes can impact funding is crucial.

Juuso Konttinen:

”Wood's molecular-level innovations open up incredible opportunities”

Juuso Konttinen, who joined Elomatic's board just over 1.5 years ago, leads the biomaterials growth business unit at Stora Enso. His team is currently immersed in the exciting fields of sustainable battery materials, bio-based chemicals, and renewable fiber products.

Images: Elomatic

How do you see the sustainability challenges of the forest industry compared to other sectors?

In the forest industry, a major topic is the sustainable use of forests and how to manage this in practice. However, compliance with environmental regulations, industry standards, and the adoption of voluntary management practices have long been standard practice for us, providing valuable insights to other industries. We have extensive expertise, technologies, monitoring systems, certifications, and standardized processes that could benefit other sectors as well.

What opportunities do you see in forest sector innovations, such as biomaterials?

The forest sector is undergoing a big transformation. So far, the focus has been on the energy value of wood, its structural properties, such as using timber in construction, and wood fiber-based products like packaging boards. While these applications remain relevant, a new dimension is emerging at the molecular level. This involves utilizing wood's molecular components for various purposes, such as battery materials or bio-based chemicals.

New possibilities are arising for the use of lignin, which is one of the three main components of wood, alongside cellulose and hemicellulose. Currently, it is primarily used for energy production in pulp production, even though it is a renewable resource with potential for various material applications.

Can you elaborate on what can be made from lignin?

One example already in use is lignin-based adhesives. Moreover, a wide range of new possibilities is emerging. At Stora Enso, we are actively developing lignin-based hard carbon for battery anodes to replace fossil and mined graphite. We have been working on this for years and have a pilot plant running in Kotka that allows us to test and refine the process with customers. In the near future, we plan to build a larger demonstration plant to further validate the concept for commercialization.

How do you view the potential of wood-based battery materials?

Electrification is inevitable and a prerequisite for achieving our climate goals, thus the demand for batteries is growing rapidly. Batteries require carbon-based anodes, which presents a significant opportunity to provide sustainable solutions using renewable raw materials. After all, electrification must be viewed as a holistic sustainable option – not only by focusing on emissions-free vehicles but also by considering the entire lifecycle of the battery.

There are two parallel approaches in bio-based battery materials. Bio-graphite serves as a direct substitute for the fossil- or mineral-based graphite currently used in anodes. Another option is hard carbon derived from lignin, which has a slightly different structure than graphite but can still be used in batteries, offering distinct functional benefits.

The forest industry produces carbon dioxide, which contributes to climate change, during its processes. What steps are you taking to capture it?

We are actively researching carbon capture from our processes and the potential for converting it into new products. We already have a pilot project to capture carbon underway in Skutskär, Sweden. A key distinction compared to carbon capture in fossil-based industries is that our CO_2 emissions are mostly biogenic: when we capture CO_2 from pulp production and convert it into new products, those products are bio-based, providing a significant advantage.

What do you see as the biggest obstacles to advancing sustainability?

First, developing new technologies is anything but fast and straightforward. It requires significant long-term effort and investment to find and implement technologies that can produce what

customers want while considering sustainability. Additionally, commercializing new products takes time, especially when these products have new or different properties. If the new products are direct, one-to-one replacements for current fossil-based alternatives, customer adoption tends to be quicker and smoother.

Are customers willing to pay for sustainable products?

Some products are more expensive initially compared to their less sustainable counterparts, making it essential to find the right customers who recognize their value within their own businesses and are willing to pay the appropriate price. Overall, there has been a noticeable shift in customer expectations.

Customers vary widely: some are early adopters eager to introduce sustainable products into the market and expand their portfolios, believing it is the right thing to do. Others are more reactive, influenced by the value chain as end customers demand products that meet specific sustainability criteria. Additionally, there are regulated sectors where certain standards must be met, as well as business areas where sustainability is not a primary decision factor and is often undervalued. Fortunately, even in these latter areas, an increasing number of customers are beginning to take the initiative.

Can you name a sector with many frontrunners?

Packaging is one such sector. There has been a noticeable shift from plastic packaging to fiber-based packaging or renewable plastic solutions. Packaging labels have even been introduced to highlight the packages' lower carbon footprint or that they are made entirely from renewable materials. Since packaging is so close to the end consumer, there is clear pressure throughout the value chain to adopt sustainable practices.

How do you see public measures affecting the sustainability efforts in the forest industry?

Regulation can be beneficial on a case-by-case basis, given the increasing complexity of today's environmental legislation. Large companies need dedicated teams to monitor regulations and advocate for appropriate legislation, which requires significant effort. On the other hand, some mechanisms play a significant role, especially in the early stages of innovation. For instance, the EU Innovation Fund supports flagship projects in sustainability, which is crucial for managing potential challenges and competing with established players.

An extreme example is biofuels, where distribution mandates have created the entire business. However, the more complex the mechanisms, the harder it is to pinpoint the exact benefits. Over time, businesses should be able to sustain themselves in a market economy to ensure long-term viability.

What expectations did you have for Elomatic's board work?

My expectations were very positive. We had meaningful discussions with the management about the values Elomatic represents and the areas of business it focuses on. The company's values aligned well with my own, and I saw a balance of new learning opportunities and areas where my background could make a contribution. The maritime sector was new to me, but it has been exciting to learn about it while also already applying my expertise to some matters.

How can engineering and consulting companies best support addressing sustainability challenges in the forest industry?

In process industries, the solutions typically stem from technological innovations – different technologies, how the overall concept is built, and how everything is designed to ensure that financial, technical, and environmental factors are aligned. This is why I believe engineering and consulting companies have a great deal to offer when it comes to techno-economic, environmentally focused design work.

What excites you the most about the future opportunities in the forest industry?

I am particularly enthusiastic about the broad spectrum of possibilities now emerging. We are transitioning from traditional product development, which focuses on the physical or fiber structures of wood, to a new approach that aims to maximize the value of the entire tree. This includes exploring the potential of wood's molecular components and expanding beyond conventional uses. As sustainability becomes increasingly important, new products and industries are emerging where wood can play a central role. I am excited to see how these innovations will unfold.

Juuso Konttinen

Age: 48

Lives in: Sipoo, Finland

Education: M.Sc. (Tech), M.Sc. (Econ), M.Sc. (Pol.Sc.), executive education in Harvard, IMD, Kellogg, Aalto

Employment history: Various business and leadership positions at the leading Nordic forest industry companies in Finland, the USA and Germany, multiple Board and Advisory Board positions including Chair and Vice-Chair roles in different companies and associations

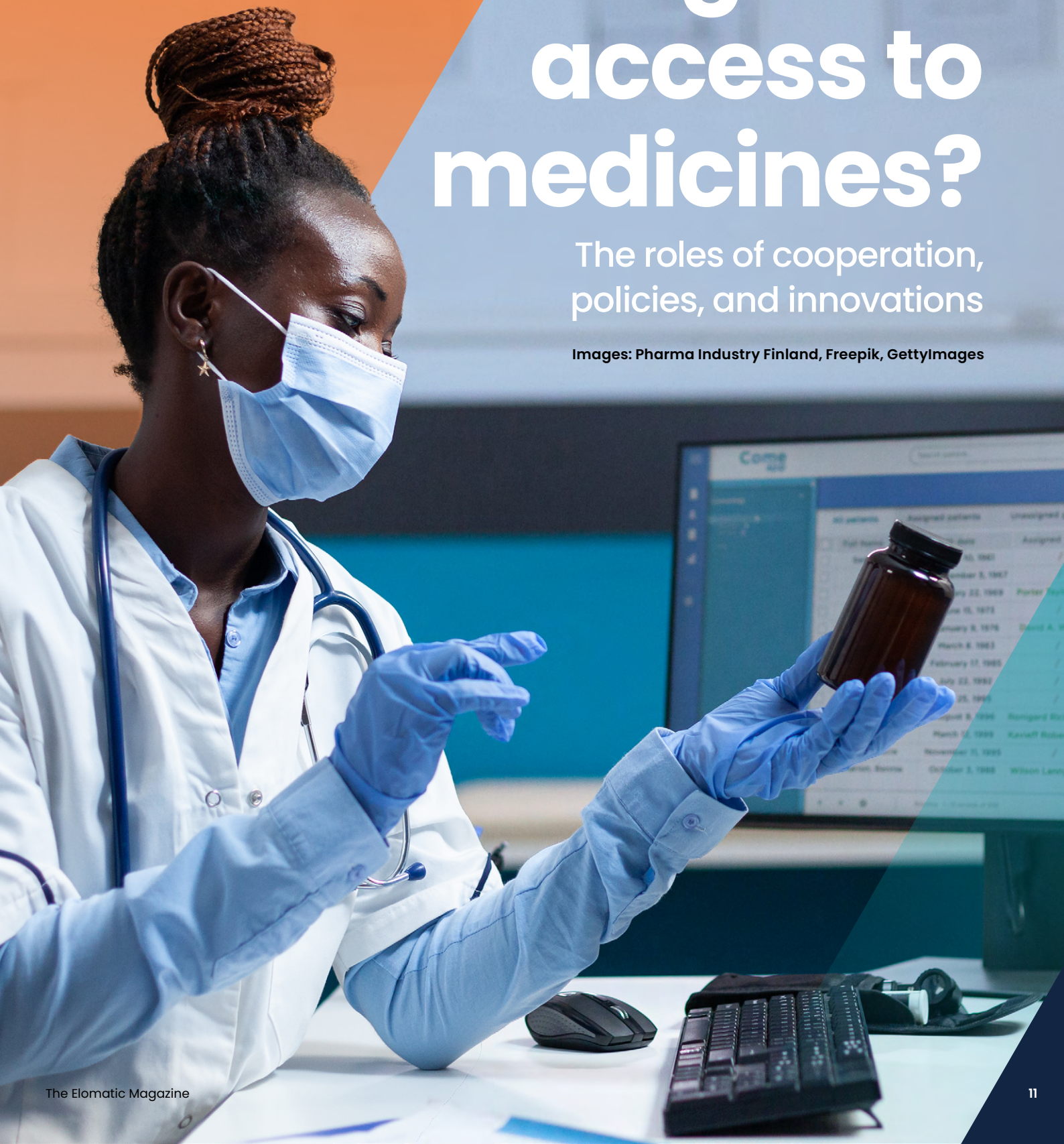
Hobbies: Country house and lake activities, sports (own and kids), reading and music

Expert interview

How can we ensure global access to medicines?

The roles of cooperation, policies, and innovations

Images: Pharma Industry Finland, Freepik, GettyImages



The global availability of medicines and vaccines has become a critical issue, especially highlighted by the COVID-19 pandemic. Despite ongoing efforts, significant barriers to equitable access remain, underscoring the urgent need for global cooperation. However, new EU-level policies and emerging technological innovations present promising pathways toward more sustainable solutions.

Tiina Aitlahti,
Director of Pharmaceutical Care and Services at Pharma Industry Finland

While the challenges of medicine availability are evident across Western countries, they are further exacerbated by global disparities in healthcare infrastructure and resources. This situation raises crucial questions about how the responsibility for improving access to medicines in vulnerable regions should be shared among various stakeholders. What innovative solutions are emerging to tackle this issue?

To gain deeper insights into these topics, we interviewed **Tiina Aitlahti**, Director of Pharmaceutical Care and Services at Pharma Industry Finland.

What are the key challenges currently affecting the availability of medicines?

The availability of medicines is influenced by complex and multifaceted challenges, including raw material shortages and unpredictable fluctuations in demand. The COVID-19 pandemic significantly exposed new risk points in production and supply chains. Additionally, stringent pharmaceutical quality standards can impede rapid process adaptations, as every component, including packaging, must undergo regulatory approval and meet consistent quality benchmarks.

Among the key challenges are the persistent price pressures on established medicines. This has led to the consolidation of production on a global level. In such a concentrated system, if one part fails, it can easily have widespread effects on the availability of a specific raw material or medicine.

What approaches are being implemented to tackle these challenges?

During the pandemic, many countries recognized the importance of stockpiling medicines as a precaution. Efforts are also being made to review supply chains to ensure sufficient alternatives at every critical point, reducing dependency on any single supplier. On the regulatory side, initiatives are underway to increase flexibility in approvals.

The pandemic further highlighted the critical need for global cooperation to facilitate efficient information flow, particularly through effective disease surveillance systems that share data and insights on viral frequencies.

In the EU, pharmaceutical legislation is undergoing significant reform, with a strong focus on ensuring medicine availability. This includes establishing new regulatory requirements for pharmaceutical companies and responsibilities for authorities, to guarantee the continuous supply of medicines. Globally, there is a growing need to build a resilient regulatory system, involving multiple stakeholders, to foster sustainable practices capable of withstanding future crises.

Did the pandemic significantly impact industry practices?

Yes, COVID-19 was the first time that the pharmaceutical industry demonstrated unprecedented speed in developing new vaccines and treatments for an unknown disease, as well as scaling these solutions globally. An extraordinary number of partnerships among different companies were formed to ensure the successful production and distribution of medicines worldwide. The pandemic underscored the critical importance of scalability, revealing bottlenecks in various areas, such as glass vials and syringes.

Relatively little funding is allocated for the development of new antibiotics. What measures are being taken to address this issue?

Antibiotic resistance is an escalating global concern, largely associated with how and for what purposes antibiotics are used in different countries. In Finland, the issue is less pronounced because we have consistently adhered to responsible usage; for instance, we do not administer antibiotics to livestock to promote growth.

A major issue in Europe is the lack of incentives for developing new antibiotics, as market mechanisms don't work when these medicines must be reserved for rare, last-resort cases. This creates a commercial challenge, as companies must invest heavily in products that will be used minimally. The EU's pharmaceutical reform aims to address this by creating effective incentives for antibiotic development.

How can a pharmaceutical company align business goals with ethical responsibilities related to medicine availability?

Pharmaceutical companies operate in a global environment, with their primary goal being to ensure the continuous availability of medicines to patients worldwide. However, market demand and technological advancements significantly influence the direction of medicine development. Over the past two decades, there has been a notable rise in biological medicines, and advancements in gene technology are enabling more precise targeting of treatments.

To address the needs of poorer nations, global cooperation among companies, governments, and non-profit organizations is essential. For example, malaria primarily affects impoverished regions, but pharmaceutical companies have partnered with the World Health Organization (WHO) to create viable conditions for developing treatments for those in need.

What role do reimbursement systems play in ensuring the availability of medicines?

The role of reimbursement systems is intriguing, particularly regarding what is valued when selecting medicines for the health reimbursement system or hospital formularies. The key question is whether continuous availability is prioritized or if the focus is solely on price. Over the past 10–15 years, the importance of price has grown, especially for older products. This focus can weaken availability since production becomes viable only in large quantities. With only a few players in the market, risks increase: what happens if one player encounters issues?

> **With only a few players in the market, risks increase: what happens if one player encounters issues?**

> **Artificial intelligence can significantly enhance medicine availability by refining global demand forecasting, tracking the movement of goods, and pinpointing areas facing shortages.**

Isn't low-price still a critical factor in ensuring the global availability of medicines?

While a low price is essential, it is important to consider whether it should be the sole criterion in public procurement in countries like Finland. Globally, we hope that systems are developed with each country's ability to pay in mind. This may require solidarity among countries, where wealthier nations accept that poorer nations can be offered medicines at lower prices. However, care must be taken to avoid situations where cheaper medicines are diverted to other markets.

How can the availability of medicines be affected by legislation?

A significant amount of regulation aims to ensure the quality, efficacy, and safety of medicines, but EU regulations also emphasize the continuous availability of medicines in the region. I also believe that as the EU develops regulatory measures to ensure the reliability of supply chains, this benefits global supply chains as well, since they often rely on the same production and distribution networks.

Can new technologies, such as artificial intelligence, improve the availability of medicines?

Artificial intelligence can significantly enhance medicine availability by refining global demand forecasting, tracking the movement of goods, and pinpointing areas facing shortages. Overall, digitalization plays a big role in addressing these availability challenges. For instance, utilizing electronic product information allows for the sharing of product information to patients through QR codes, which reduces the need for country-specific packaging requirements, such as Finnish and Swedish language package leaflets. This facilitates the distribution of medicines to regions with the greatest need.

What additional innovations are currently being developed to enhance access to medicines?

Sustainability is a central theme in the pharmaceutical industry today. The goal is to use scarce resources more efficiently, which often also improves the availability of medicines. However, as mentioned, achieving global access to medicines necessitates a collaborative approach. Different stakeholders must work together at a global level to address these challenges.

Laying the foundation for a smart factory:

A key step towards sustainable production

Text: Mika Kuhmonen, Lita Nordén
Images: Elomatic, GettyImages

A smart factory is designed to be inherently productive and resource-efficient, playing a crucial role in the sustainable manufacturing of end products. The basis of intelligence is formed by all the equipment and technologies it contains, skilled users, and the digital solutions that connect the two.

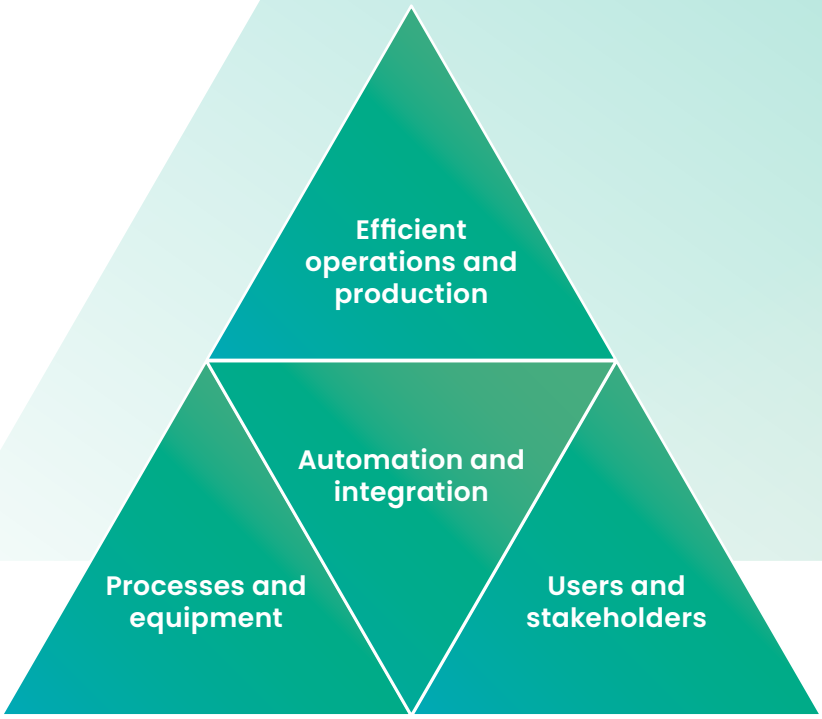


Figure 1. Key components to consider during the design phase

A smart factory extends beyond digitalization; it is rooted in physical equipment, with digital solutions enhancing human-machine interaction and operations. Its success relies on high-quality design that considers lifecycle requirements from the outset. Merely improving data usage in a poorly designed or mis-sized factory cannot lead to true efficiency.

One of the key functions of smart systems is to enhance resource efficiency, which is vital for the profitable operation of production facilities. Moreover, resource efficiency contributes to broader goals of promoting sustainable development.

Engineering as the cornerstone

In the design phase of a smart factory, it is important to consider the entire system (see Figure 1), focusing on material and energy balances, production simulations and optimizations and the impact of various technological choices on waste and efficiency. Success requires conducting techno-economic studies and coordinated multidisciplinary planning, with clear goals for resource efficiency and automation levels established early in the process.

Beyond cost savings, the objectives may include enhancing production quality, increasing flexibility, and improving overall performance. It is also important to recognize that a factory is never truly complete.

Establishing factory fundamentals

To operate effectively, a smart factory must be built on a solid foundation of well-designed components. Intelligence alone does not guarantee a competitive advantage, especially if fundamental issues persist within the operating environment. Effective production control is essential for resource efficiency; when deviations in raw materials or production conditions arise, the smart factory's production control system can gradually correct these anomalies.

Key digital solutions that enhance efficiency include:

- **Predictive maintenance platforms** minimize downtime and maximize equipment availability.
- **Automation and robotics** improve both production efficiency and product quality.
- **Machine vision and AI analytics** enable faster and more accurate detection of visual defects in quality control.
- **System integration** facilitates efficient resource allocation, allowing the factory to adapt swiftly to fluctuations in demand, production disruptions, and raw material shortages.

"Intelligence alone does not guarantee a competitive advantage, especially if fundamental issues persist within the operating environment.

Measuring instruments and sensors gather real-time data for automation and IT systems, which is then analyzed by data analytics to provide actionable insights for informed decision-making. While some operations run automatically within defined parameters, others rely on user input, making accurate, real-time data vital for maintaining efficiency.

Decisions in the implementation phase

Final decisions are made in the implementation phase, where careful planning ensures successful outcomes. This preparation establishes the foundation for acquiring the right technology and support services, with detailed strategies for construction, installation, and commissioning.

In procurement, it is vital to clearly outline resource efficiency targets and the integration of smart technologies. During the bidding process, proposals are evaluated for alignment with these requirements, and the supplier's capability to deliver effective technology cost-effectively plays a significant role.

As the implementation phase concludes, production operations should be fine-tuned incrementally to achieve peak efficiency. Ultimately, the factory's success hinges on seamless collaboration between its physical and digital environments.

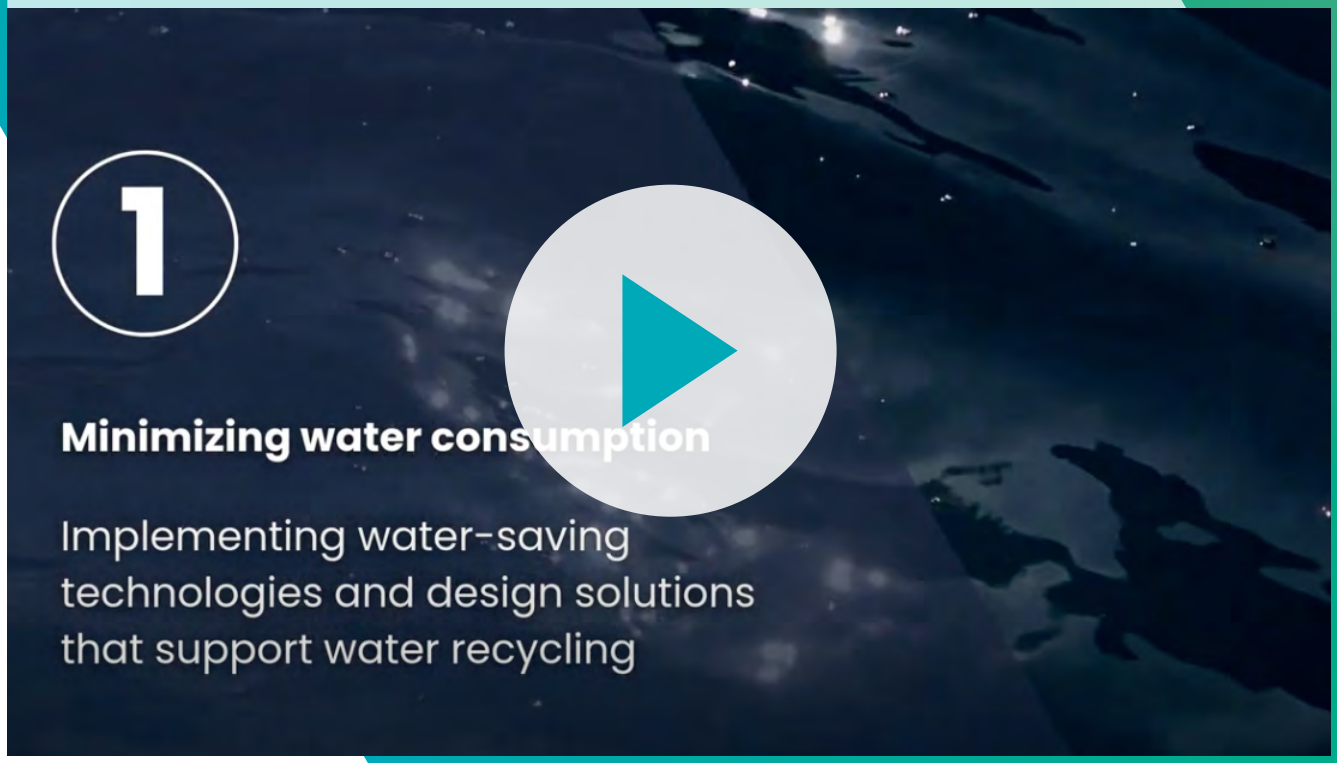
Efficient operations are based on Lean principles

Efficient operations realize the potential of the design phase. Even in a smart factory, Lean production principles serve as the foundation for material flows and operational activities. The resource efficiency mindset behind Lean provides a framework for developing both the factory and its operational methods. Once the factory's fundamentals are in place, efficient data utilization helps maintain resource efficiency in a changing business environment.

To fully harness the benefits of technology, a deep understanding of processes and their potential is key. During the design phase, various process modeling and scenario simulations lay the foundation for implementing Lean principles. Simulation helps identify the most efficient, resource-saving solutions while avoiding costly and time-consuming real-world trials.

> **To fully harness the benefits of technology, a deep understanding of processes and their potential is key.**

Watch video: The key factors for enhancing a factory's resource efficiency (duration: 39 seconds)



Collaboration leads to the best results

Developing a resource-efficient smart factory requires expertise in sustainability, Lean principles, production technology, and digital solutions. It is essential for experts in these areas to understand each other's fields and collaborate during the design phase, as their integration and collective experience significantly contribute to the project's success.

With the help of artificial intelligence, the factory learns from experiences, continuously improves processes, and recommends the best production solutions to its users. Nevertheless, the design phase is crucial for maximizing the benefits of a smart factory, as this period profoundly influences its lifecycle impact. Although the initial investment in a smart factory may be higher than that for basic solutions, the long-term benefits – reduced operational costs, improved efficiency, as well as enhanced sustainability – justify the investment.

Mika Kuhmonen
D.Sc. (Tech)

Mika has extensive global and local experience in production development and factory investments. Currently, Mika works as a Leading Advisor in the Industry Business Area, focusing on the concept and feasibility phases of investments.

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Lita Nordén
M.Sc. in Chemical Engineering

Lita has a distinguished career in the process industry, with extensive experience in production processes, investment projects, and business and people management. Throughout her career, she has integrated safety, circular economy, and sustainable development into her work. Currently, Lita leads Operational Excellence, focusing on refining internal procedures and driving continuous improvemen.

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A stepwise approach to project advancement

When starting a new project, a step-by-step advancement plan is essential for guiding the development process. The key question to consider is whether to construct a production facility that immediately meets the criteria of a smart factory or to pursue this goal through planned incremental steps.

Planning phase

During this phase, the lifecycle costs of the factory should be assessed from both environmental and owner perspectives. Key considerations include:

- The replicability and scalability of the production facility in response to increasing production demands
- The selection of materials and components that comply with the regulations of various countries
- The choice of building and production technologies that meet desired production and resource efficiency standards
- Selecting technologies that minimize maintenance requirements and ensure a long lifecycle
- Designing automation and instrumentation for optimal data collection and equipment control
- Simulating and optimizing process flexibility and quality production capacity across various scenarios
- Enhancing the efficiency of production-related commodities and building services
- Improving internal logistics and material flow
- Ensuring the safety of the environment and employees
- Implementing data security and privacy practices to protect sensitive information
- Adopting sustainable construction practices.

Technology selection for smart production facilities

The capabilities of a smart production facility depend on selecting technologies that align with project objectives:

- **Instrumentation:** Integrating measurement devices and sensors with the automation system
- **Electrification:** Incorporating an electrical system into the automation framework to secure power supply for critical functions
- **Building Automation:** Integrating building automation with the overall automation system to optimize operations
- **Automation:** Choosing a centralized automation system that enables monitoring and control of all processes from a single location, with capabilities for system integration, real-time data analysis, and analytics
- **IT Infrastructure:** Establishing a segmented infrastructure that includes virtualized servers, access control, cybersecurity measures, and network traffic monitoring.

Advanced level solutions

At the advanced level, value-added solutions that enhance efficiency and operational effectiveness include:

- Integrating and automating equipment and production lines
- Maximizing the use of robotics solutions
- Creating a comprehensive data collection environment across the factory (data lake, big data)
- Employing process- or operation-specific analytics and optimization tools (AI) to boost factory performance
- Utilizing blockchain technology for decentralized, immutable accounting that enhances supply chain transparency and reliability
- Implementing a digital twin perspective for enhanced simulations
- Developing virtual training environments
- Utilizing XR solutions to facilitate operations and maintenance.

/// CASE

Reducing MS Crown Seaways' fuel consumption with Elogrid:

AN INSTALLATION STORY

Images: Elomatic, DFDS

DFDS A/S installed Elogrid™ on the MS Crown Seaways to enhance the ship's energy efficiency and reduce carbon emissions. The installation was successfully completed during the vessel's annual drydocking at the Fayard repair yard in January 2024.

Elogrid is an advanced system designed for ship tunnel thrusters that reduces water resistance and fuel consumption while improving maneuverability. Additionally, it minimizes noise and vibrations, thereby enhancing the overall passenger experience.

One of Elogrid's satisfied customers is DFDS A/S. They installed the solution on the MS Crown Seaways. This upgrade aligns with their broader initiative to enhance the environmental performance of its fleet, with anticipated fuel savings of approximately 1% contributing to the company's green transition goals.

Fuel savings predicted by analysis

In August 2023, Elomatic and DFDS A/S signed a contract for the fabrication of Elogrid for the MS Crown Seaways, with delivery scheduled for December of the same year. The contract encompassed a range of services, including Computational Fluid Dynamics (CFD) simulations to ensure the Elogrids were fit for purpose, Finite Element Method (FEM) vibration analysis, the design of fabrication documents, and the complete fabrication and painting of the Elogrids.

Our CFD analysis predicted fuel savings of over 1% across all speed ranges, with potential savings of up to 2.5% at lower speeds (10–15 knots). Additionally, our calculations confirmed that the power of the bow thruster would remain unchanged after the installation of the grids.

Ensuring final quality and adherence to schedule

After the CFD analysis was completed and approved by the customer, Elomatic selected its trusted supplier, HL-Metal Ltd from Parainen, Finland, to manufacture the grids. Several development meetings were held with the fabrication team to optimize production time and ensure the final quality of the products.

Once the installation drawings were finalized, they were sent to DFDS for forwarding to the repair yard, where the cost and timeline for the installation work were estimated. The delivery was successfully completed as planned. Transportation to Fayard AS in Denmark took place during the Christmas period in 2023, ensuring that the grids arrived at the repair yard right on schedule.

> **Our CFD analysis predicted fuel savings of over 1% across all speed ranges, with potential savings of up to 2.5% at lower speeds.**

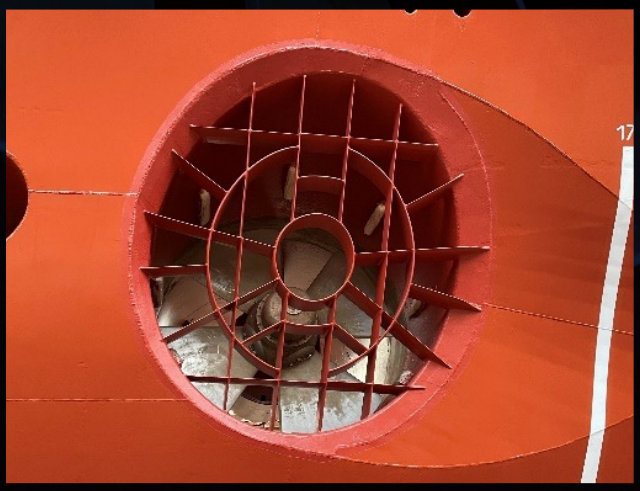
Elogrid installations at repair yard

Installation start

Elogrid at starboard side aft tunnel

Elogrid at starboard side forward tunnel

Elogrid at port side forward tunnel



Elogrid at port side aft tunnel

> **The vessel now experiences reduced vibrations, enhanced maneuverability, and a much quieter arrival and turn in the harbor.**

The importance of supervision in installation

The installation began on January 8th, with Elomatic's supervision team on-site to ensure that the installation crew performed as agreed. Some issues arose because the design model did not perfectly align with the actual vessel's form. This is a common occurrence, underscoring the importance of having the supervision team present to make quick decisions when the grids do not fit precisely into their designated positions. In this instance, the design and installation teams reached a compromise to shape the blades for a better fit with the aft tunnel scallop plates.

The nature of supervisory work can vary in difficulty depending on how the shipyard has contracted the work and how well the installation team understands and adheres to the installation instructions and drawings. This time, the supervising team had the unique experience of living onboard the vessel during the dry dock, while the ship was neither floating nor rolling.

Learning through installation

The installation team was new to this type of work and was learning the necessary methods throughout the process. Initially, lifting the grid proved more challenging than expected due to inconsistent availability of cranes, telescopic handlers, and forklifts. Consequently, the team had to install lifting eyes in the ship's shell plating, which was crucial for raising the grid high enough for a proper fit, as the initial attachments had been placed too low.

Once the team identified the correct working methods, the installation process became significantly smoother, although a slight delay occurred due to the overhaul of one thruster and the wait for its equipment reassembly. Despite this setback, the remaining tasks were completed on schedule.

Result was satisfactory for all parties

The shipowner is pleased with the new Elogrids, even though clear measurements for fuel savings are not yet available. He sent the Elomatic team photos of the vessel after the installation and painting work (see the images), and everything closely resembled the assembly drawings.

Both the chief and the captain have also expressed their satisfaction; the vessel now experiences reduced vibrations, enhanced maneuverability, and a much quieter arrival and turn in the harbor.

Following the installation, ownership of the vessel changed hands, with Gotlandsbolaget purchasing it along with its crew and route from DFDS. However, the itinerary between Copenhagen and Oslo will remain unchanged, and the ship will continue to sail under the Danish flag.

Jari Yli-Tolppa
B.Sc.
(Naval Architect)

Jari Yli-Tolppa is an accomplished naval architect with over 30 years of experience in ship design and production management. He has worked in various design offices across Europe and held managerial positions at the Turku and Rauma shipyards. Currently, Jari is the product manager for Elogrids and design manager within the Marine BU team for Shipowner services.

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Levels of sustainability

Sustainability has become a frequent topic in corporate discussions. However, there are clearly different levels of sustainability, ranging from 'weak' to 'strong', based on the actions taken by organizations. But what actions and mindsets define these different levels? And most importantly, what must we do to reach the strongest level?

Text: Jaakko Mattila
Images: Elomatic, GettyImages

There is a compelling reason to focus on sustainability at this very moment. We are in the defining decade for the future of our planet and human civilization, as climate change must be limited to 1.5°C by 2030 (IPCC). While the planet is getting hotter, it is hard to find anything as meaningful as contributing to the continuation of life and prosperity on Earth. While the challenge may feel immense, exploring a new direction for our society is both necessary and intriguing.

However, companies – and the people working within them – often have different perspectives on what the sustainability transformation actually requires. As a result, a spectrum has emerged around the term 'sustainability,' encompassing what we might call weak sustainability, actionable sustainability, and strong sustainability. Let's examine these different levels and the actions and frames of thinking that underpin them.

The lowest level of sustainability

At the weakest level of sustainability lies the 'business as usual' approach. Here, sustainability is distorted to become a synonym for Lean practices: resource efficiency and smart growth. The thinking goes, "Let's produce higher quality products more efficiently." This mindset leads companies to look at their current operations, grab a metaphorical green spray can, and label existing activities as 'sustainable', showcasing them as examples of responsible business practices.

It is as if companies have been acting sustainably all along, and the planetary crisis we face today just appeared out of nowhere. Weak sustainability is a mindset that relegates sustainability to a side concern – an inconvenience to be dealt with while the focus remains on driving an ever-growing market and its endless demand. This form of 'sustainability' is, in reality, completely unsustainable.

The next level: What companies should do right now

At the next level of sustainability, companies make a genuine effort. They invest significantly in renewing their infrastructure, processes, and products to be more resource-efficient and circular. They transition to renewable energy and move away from fossil fuels. Biobased materials take priority, with a focus on selecting those that consume fewer natural resources. Companies manage their value chains with due diligence, ensuring that all operations start aligning with planetary boundaries. Across the board, they invest in renewing their business.

> To ensure vitality, radical innovations, such as technology that produces protein from the air, are needed.

At this level, companies focus on what they can control and influence most directly – how to achieve short-term reductions in greenhouse gas emissions and biodiversity loss, both in their operations and across their value chains. This is the sustainability demanded by this decade, as we redesign our businesses to be more sustainable, implementing the technologies at hand.

This is what companies must do, as much and as quickly as possible. It is the direction the EU Green Deal is pushing us toward. It is where startups are innovating, technologies are advancing, and new unicorns are emerging. This is where the focus of our economy and future growth is shifting.

The strongest sustainability transforms our entire system

At the highest level is strong sustainability, which ensures the future I like to imagine: a life where stress is limited, and basic necessities are secured with a reasonable amount of effort, resources, and energy. This allows time to enjoy relationships, leisure, and learning through play. It is a world less focused on ownership and more focused on experiences – less about what you have and more about who you are.

This level of sustainability not only involves the transition to sustainable technologies and infrastructure at the corporate level but also seeks to transform our entire economic system. This is the work political advocacy, activism and visionary thinking aims at – a systemic change that decouples increasing well-being from the relentless pursuit of economic growth.

Why do we need a paradigm shift?

Over the past 200 years, we have lived through one of the most transformative periods in human history. The Industrial Revolution doubled the Earth's population, and capitalism quadrupled it again. We have grown from one billion people to over eight billion. This has been an era of technological advancement and prosperity unlike any other, which has molded our lives and our cultures to their current form. We have experienced economic growth, digitalization and globalization and have transformed the human experience on earth.

Yet, in the face of the planetary crisis, we are reaching the limits of our current paradigm. Technological advancements have accelerated, but they have been fueled by the unsustainable use of resources. Moreover, the scale of human activity has become so vast that our very existence now acts as a planetary force.

Exploring alternative system models

Several thinkers, including Kate Raworth, Jason Hickel, and the Ernst & Young New Economy Unit, have proposed models that challenge the current paradigm and offer visions of possible futures. These alternative systems aim to align human life within planetary boundaries. Achieving this requires not only a green transformation through corporate sustainability efforts but also an economic structure that is free from the necessity of perpetual growth.

Ernst and Young describe an economy based on sufficiency and circularity, along with a redefinition

> **Pursuing an ideal solution does not mean that a perfect solution is always achievable. Instead, it serves as a good guideline and motivator, encouraging creative thinking.**

of value in how we measure progress and well-being – paving the way for a globally just and equitable system. Kate Raworth's model outlines the boundaries our economic system must respect, addressing both basic social needs and ecological limits. Jason Hickel's degrowth model advocates for reducing resource use, redistributing wealth, and pursuing planned economic degrowth.

These frameworks offer vital alternatives to consider when creating a roadmap for sustainability and a strategy for the long term.

How to get started?

I encourage everyone to take action within their own context, right now, by embracing sustainable solutions that are already available. Allow the leap to the unknown as we redefine the systems that define human activities, culture, and life on a global scale. Trust that sustainability is the path to long-lasting development.

We have immense capacity to navigate this transformation. After all, we are living at the pinnacle of human history. Let's embrace it.

Jaakko Mattila
MBA (Information System Sciences)

Jaakko is a sustainability pioneer with a background in information systems. Jaakko took on the responsibility for CSRD reporting at Elomatic last fall after previously working in digital business development. Jaakko's goal is to promote strong sustainability by aligning companies with planetary boundaries.

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The concrete guide to action: What can companies do?

The first step toward improving sustainability is to map out your impacts. Understand what you affect and how, in order to establish a set of metrics to track progress. Generally, transitioning from a linear business model to a circular or regenerative one is the most important strategic improvement any company can make.

Start by evaluating the environmental handprint of your business. This assessment should cover:

- **Enablers of your business:** Upstream footprint, including suppliers and your own operations
- **Negative impacts of your core business:** Downstream footprint, including the entire lifecycle
- **Positive impact of your core business:** Value created

Next, break this down into individual environmental metrics that can be measured:

- Energy, water, and land use
- Amount of pollution generated in soil, water, air, or living organisms – categorized by type of pollutant
- Amount of waste produced – categorized as organic/biobased or non-organic
- Resource use, including the impact of their acquisition (supply chain) on energy, land and water use, biodiversity, and pollution

To help you get started with circular business models that effectively manage environmental metrics, consider the 9 R strategy framework:

- **R0: Refuse**
- **R1: Rethink**
- **R2: Reduce**
- **R3: Reuse**
- **R4: Repair**
- **R5: Refurbish**
- **R6: Remanufacture**
- **R7: Repurpose**
- **R8: Recycle**
- **R9: Recover**

/// INSIGHT ///

How do you think sustainability challenges will drive innovation in your field?

Abhay Ranjan | **CEO at Elomatic India** | Pharma

Sustainability is driving innovation in the pharmaceutical and biotech sectors, focusing on the controlled use of degradable energy, materials, water conservation, and low-emission production. As factories aim to reduce their carbon footprint, there is a strong push for innovations in energy-efficient design. Additionally, the high levels of water consumption in various processes demand significant attention.

Green manufacturing practices, aimed at minimizing the environmental impacts of medicine production, are increasingly supported by automation systems that optimize production, reduce waste, and improve resource efficiency. The biophilic design of the building incorporates nature into factory design, which not only enhances worker well-being but also contributes to sustainability.

Data analytics help track energy and water conservation and enhance sustainability strategies, while digital twins enable companies to simulate processes, optimizing throughput and minimizing waste without real-world trials. Process optimization, extended production batches, and single-use technologies further reduce waste, water consumption, and greenhouse gas emissions. Efforts to use fewer harmful chemicals and implement solutions like recycling and alternative water-saving methods also play a crucial role.

However, the implementation of sustainable practices faces challenges, particularly in developing economies, such as high investment costs, the need for advanced workforce training, and extended ROI timelines. Despite these obstacles, sustainability presents significant opportunities for innovation, competitive advantage, and long-term environmental and economic benefits.

Emilia Siltanen | **Head of UX & Service Design** | Industry

Everything around us is designed, from products and services to transport, food and waste systems, healthcare, and urban environments. 80 % of products' environmental impact is influenced by decisions made during the design phase. Sustainability and circular economy are all about design and therefore, those of us involved in design decisions have a significant impact on preventing waste and pollution from the start.

With the system-level thinking and tools of service design, we can approach even the most complex challenges and reveal their "non-obvious" layers as well. For example, food retailers can maximize benefits not only for the environment but also for their businesses and customers. By utilizing, for example, the by-products from plant-based milk production, companies can take advantage of new business growth opportunities. In the same way, industrial parks can improve their circular economy and their businesses by assessing the use of fly ash or waste heat.

Tackling sustainable challenges requires policies, collaboration, stakeholders with different skillsets, and creativity to success in this innovative and far-reaching journey we are on together.

Ismo Hyvärinen | **Senior Design Manager** | Marine

The global marine industry has a substantial impact on climate change. In response, the International Maritime Organization (IMO) has set ambitious targets: a 20% reduction in greenhouse gas (GHG) emissions by 2030 and 'Net Zero' emissions by 2050. These goals create a pressing need for advanced technical solutions with low or zero emissions, presenting both challenges and opportunities for innovation in the field.

New ship engine technologies are emerging, offering the potential to use low-carbon or carbon-free future fuels. At the same time, electric ships are becoming a viable option, particularly for short-distance routes. Ship engines are transitioning to alternative fuels such as methanol, ammonia, and hydrogen. However, these fuels pose technical challenges, especially in adapting engine room designs to meet new safety standards. Hybrid propulsion systems, which combine energy storage with traditional engine power, are also being explored to meet the IMO's emission reduction targets.

In addition to propulsion technologies, there is a growing focus on sustainable materials in shipbuilding, such as using sustainable steel to reduce the industry's CO_2 footprint. Furthermore, energy efficiency innovations are continually being developed to help ships optimize energy use and further contribute to emission reduction efforts.

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