top engineer

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The need for partitioning has grown alongside the increase in cruise ship size.
– Ray Essén

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Magnitude matters

Throughout history, humans have been fascinated by breaking boundaries and pushing limits. The Guinness Book of Records is testament to how this fascination with record breaking has continued into the modern era.

The Guinness Book of Records contains a few rather curious records, some held by Finns. The record for the longest barbeque ever, for instance, is held by a team in Lahti, who managed it for a full 36 hours. Another, albeit less peculiar record, is also held by Finns, namely the hosting of the biggest hackathon problem-solving event ever, Junction 2017.

Similarly, the size of man-made structures has long captivated the human mind. Most of us will claim to know at least a few of the biggest and best, for example, that the tallest building in the world is currently the 828-metre Burj Khalifa in Dubai. And who can forget the similar places in history that the Titanic and Tour Eiffel once held? Engineers, in particular, are gripped by such structural wonders, probably as they understand the great feats of design and engineering involved.

The press is also impressed by size. In 2016, when Elomatic announced the signing of a deal to design a Global-class cruise ship for MV Werften, it was the biggest project in our history. When the vessel is completed, it will be the largest cruise ship ever to be built in Germany. The headlines, at the time, strongly featured these record-breaking facts. Magnitude matters.

What is it about large engineering projects that make us sit up and pay particular attention? From an engineering perspective, it is because they allow us to showcase our expertise on a grand scale. In recent years, we have strongly developed our ability to deliver large turnkey projects, often on an EPCM basis. The role of project management, technical expertise, communication and cross-cultural skills are highlighted in such large and complex projects. Project management is critical regardless of project size, but in large projects with many different participants, the demands placed on project management are undeniably far greater.

This edition of the Top Engineer contains several articles where magnitude matters. We have an article that describes how large EPCM projects should be managed and another that tracks the development of modularisation and prefabrication and their role in designing and constructing the biggest cruise ships in the world. In a break from tradition, we are also featuring a particular customer project, namely the installation of a massive Goliath crane at Meyer Turku, the tallest in the Nordic region.

I hope that you will enjoy this edition of the magazine and look forward to your feedback.

Patrik Rautaheimo
Editor-in-Chief
CEO

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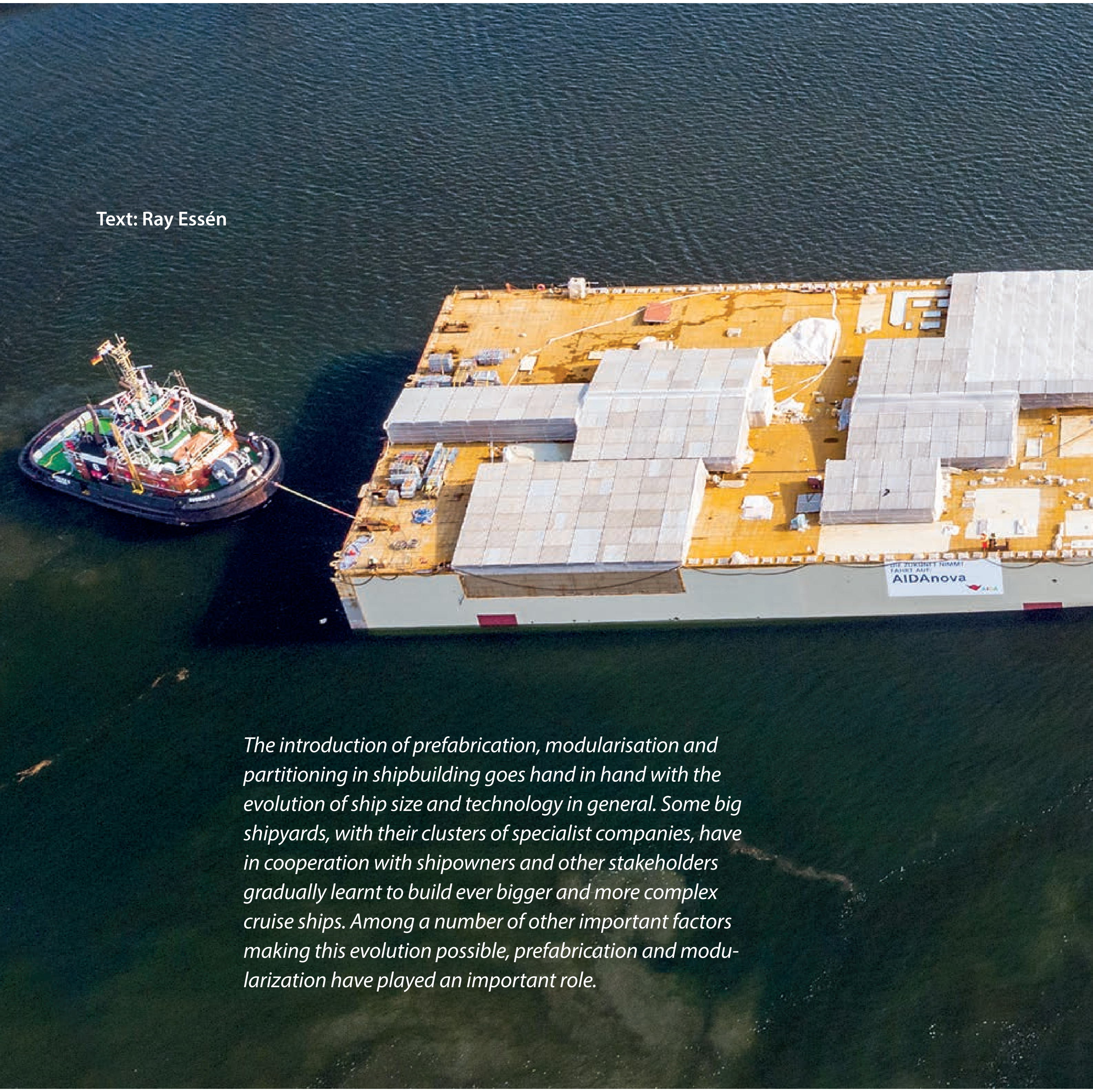
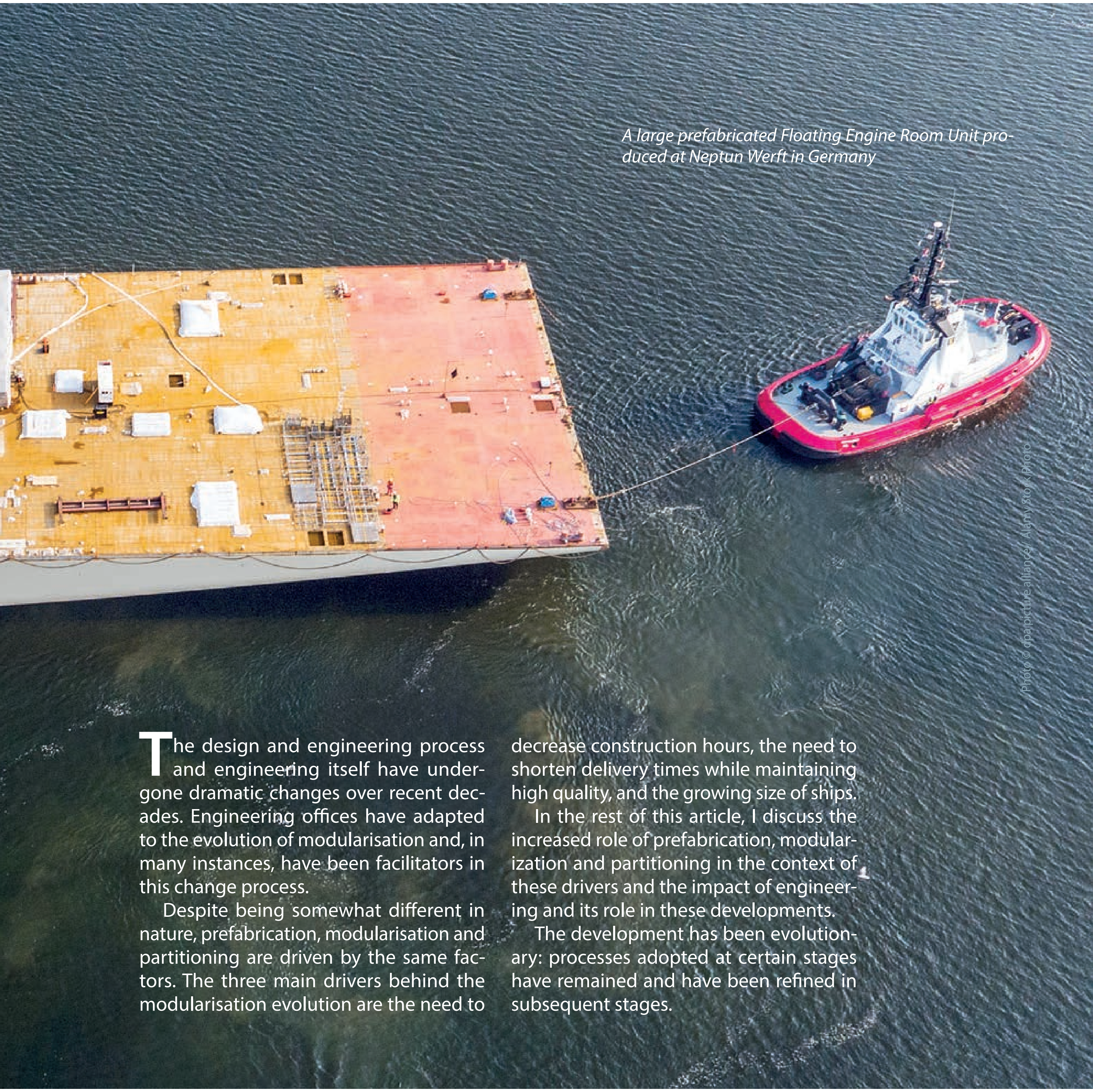
Cover: Ray Essén works as a Senior Advisor in Elomatic's Marine and Offshore Business Unit. Cover photo © 2018 Olli Tuomola / Elomatic.

The evolution of modularisation and partitioning in shipbuilding



Text: Ray Essén

The introduction of prefabrication, modularisation and partitioning in shipbuilding goes hand in hand with the evolution of ship size and technology in general. Some big shipyards, with their clusters of specialist companies, have in cooperation with shipowners and other stakeholders gradually learnt to build ever bigger and more complex cruise ships. Among a number of other important factors making this evolution possible, prefabrication and modularization have played an important role.



A large prefabricated Floating Engine Room Unit produced at Neptun Werft in Germany

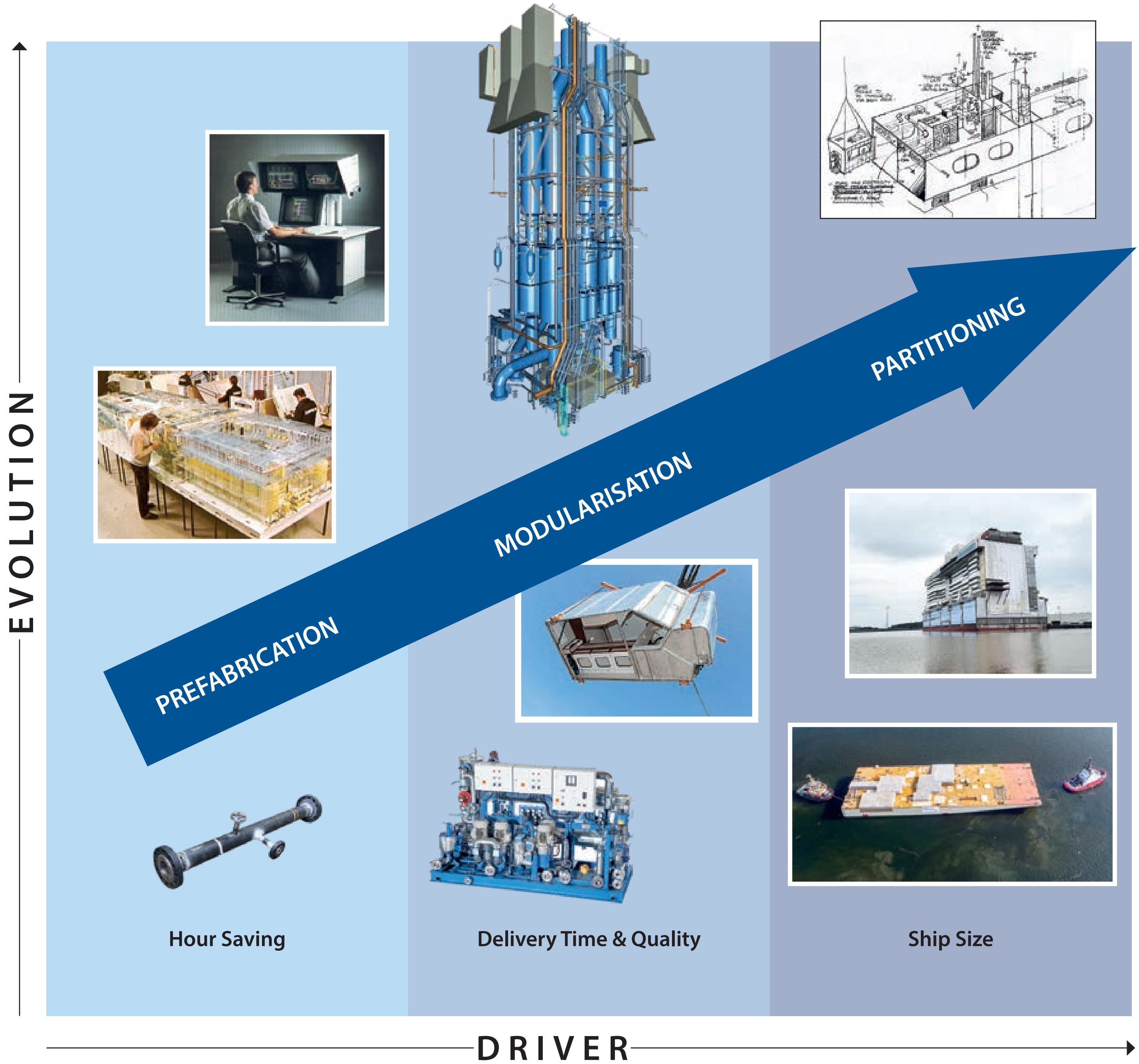
Photo © dpa picture alliance / Alamy Stock Photo

The design and engineering process and engineering itself have undergone dramatic changes over recent decades. Engineering offices have adapted to the evolution of modularisation and, in many instances, have been facilitators in this change process.

Despite being somewhat different in nature, prefabrication, modularisation and partitioning are driven by the same factors. The three main drivers behind the modularisation evolution are the need to decrease construction hours, the need to shorten delivery times while maintaining high quality, and the growing size of ships.

In the rest of this article, I discuss the increased role of prefabrication, modularization and partitioning in the context of these drivers and the impact of engineering and its role in these developments.

The development has been evolutionary: processes adopted at certain stages have remained and have been refined in subsequent stages.



▲ *The evolution of prefabrication, modularisation and partitioning*

STAGE 1: Hour saving – Prefabrication

Perhaps the most significant benefits of prefabrication technology are gained from moving a major part of the work from the ship into workshops, thereby reducing the number of inefficient hours spent on board vessels during construction.

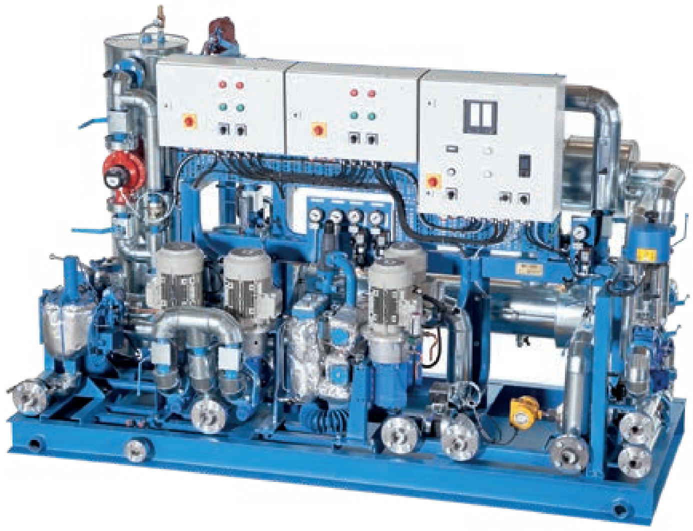
In the early days, prefabrication was limited to various types of equipment and outfitting elements, such as machinery, deck equipment, furniture, hatches and doors. Most of these elements were manufactured in workshops inside the yard.

The use of prefabrication accelerated as the need for efficiency grew. Hull assembly based on building blocks became commonplace while prefabricated pipes and later, pipe packages and system-based modules, were introduced for machinery.

To answer the need for prefabrication in the 70s, Elomatic started to develop CADMATIC software. Based on plastic 3D models and with the help of the software, manufacturing documentation needed for pipe prefabrication was semi-automatically produced in a fraction of the time required for manual drafting.

The benefits of prefabricating are obvious – increased productivity and quality due to better working conditions in the workshop and faster turnaround with more flexibility due to parallel production, shorter installation times and the possibility to subcontract.

▲ *Installation of a drop-in elevator trunk module*



▲ *A feeder booster unit by Auramarine*

► *A prefabricated modular cabin*

STAGE 2: Delivery time and quality – Modularisation

The amount and complexity of prefabricated modules gradually increased as the demand for shorter delivery times and quality grew. Working hours were saved as an increasing share of outfitting was prefabricated and installed at the most favourable stage of the shipbuilding process.

Modularisation became commonplace and a variety of different modules were preassembled before installation on board. Pipes were bunched together to form pipe packages, complex ceiling domes for public spaces were prefabricated as modules, and functional machinery units were developed, assembled and pre-tested. Penetrations were also combined as group penetrations, interior entities such as waiter stations were built in workshops, and window frame panels were standardized and prefabricated.

In refurbishment projects, the use of prefabricated modules has been maximized to enable extremely short turnaround times for on-board work.

In response to increasing demand in the shipbuilding industry, standardised functional modules became commercially available on the market. Specialised suppliers fine-tuned and standardised the processes and standardised the products to fit the growing need.

Auramarine, based in Littoinen in the Southwest of Finland, is one of the pioneer suppliers of functional modules. The company is specialised in fuel supply systems and supplies a comprehensive selection of standardised and tailor-made units.

Today, it would not be possible to build a big cruise ship within the available timeframe and with the required quality without industrially produced prefabricated cabins. Piikkio Works Oy, a subsidiary of Meyer Turku Oy, is a pioneer supplier of modular cabins for cruise ships. It has delivered more than 130,000 cabins and bathroom units during its 30-year history. The production is based on industrial serial production, both at the company's panel production facility in Vilnius, Lithuania, and at the assembly factory in Piikkiö, Finland. This manufacturing process ensures the highest quality standards throughout.

Rather big subparts of ships, such as fully outfitted AC-rooms, are prefabricated and pre-assembled in yard workshops. Others such as funnel casings and drop-in elevator trunks have been delivered by subcontractors.

Modularisation has delivered immense efficiency increases in addition to the savings in calendar time. The shortened delivery times and increased prefabrication have had a considerable impact on the engineering process. To allow time for prefabrication, engineering work has to be finalised earlier and prefabrication requires engineering that is more exact.

STAGE 3: Ship size – Partitioning

The need for partitioning has grown alongside the increase in cruise ship size; it has become obvious that the "elephant must be eaten one bite at a time".

The scale factor has an impact on the design, construction and the management of large projects. Extrapolating from previous experience can be used for a small increase in size. A larger increase in size, however, emphasises the scale factor and requires new solutions. The large number of components, people and organisations involved increase the complexity and amount of questions that need to be answered. The growth of complexity is exponential and no longer linear.

This has led the way to the next stage in the evolution of modularisation, namely partitioning. In order to cope with a gigantic task, we must split it into smaller subtasks. These subtasks involve planning, purchasing, engi-

Prefabrication and modularisation have played an important role in the construction of increasingly large and complex cruise ships.

◄ *Cruise ship assembly at Meyer Werft in Papenburg, Germany*

neering, logistics, and construction as well as commissioning. The target is to split the project into parts that have as small an impact on each other as possible. This allows the tasks to be handled in parallel, with a minimum need for interaction between the parts.

In order to achieve this, the ship itself must be designed to facilitate the project split. Partitioning possibilities must be considered when creating the overall layout of the ship and when designing systems. The forming of the building strategy must progress hand in hand with the overall design of the ship.

The basic design phase is crucial in maximizing the degree of modularisation and enabling project partitioning. The design should take into account the possibility of splitting the project into smaller parts with as little interaction as possible, both from a system and from a structural point of view. The parts should be as autonomous as possible to make partial system testing and commissioning possible.

Meyer group has adopted a strategy to prefabricate massive Floating Engine Room Units (FERU) in a dedicated facility at Meyer´s Neptun Werft in Germany. Pre-outfitted FERUs are assembled for its yards in Papenburg, Germany and Turku, Finland. This is an excellent example of partitioning were one specialized site increases efficiency through series benefits and simultaneously shifts working hours away from assembly yards, thereby facilitating shorter delivery times and distributed manufacturing.

About the author

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Ray Essén graduated in 1981 as a Naval Architect and Marine Engineer from the Helsinki University of Technology (currently Aalto University). He also holds an MBA degree from Henley/Brunel in the UK.

Before joining Elomatic in 2000 as SVP for the Marine Business Unit, he worked at Kvaerner Masa-Yards as a Project Manager with the overall responsibility for the design and construction of the Voyager class cruise ships and a number of other passenger vessels.

Ray currently works as a Senior Advisor in the Marine and Offshore Business Unit at the Elomatic office in Turku.

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EPCM Projects

A blueprint for success

Text: Markku S. Lehtinen

The EPCM model is commonly used in new industrial investments and plant expansion and modernisation projects. In the EPCM model, the consultant takes care of planning the implementation of the investment project, procurement, construction and safety supervision, all on behalf of the customer. The customer, nevertheless, takes care of procuring and external contracts are drawn up between the customer and suppliers. Key success factors in such projects include thorough planning and forecasting, transparent communications and keeping the customer involved throughout the entire project.*

* EPCM = Engineering, Procurement & Construction Management

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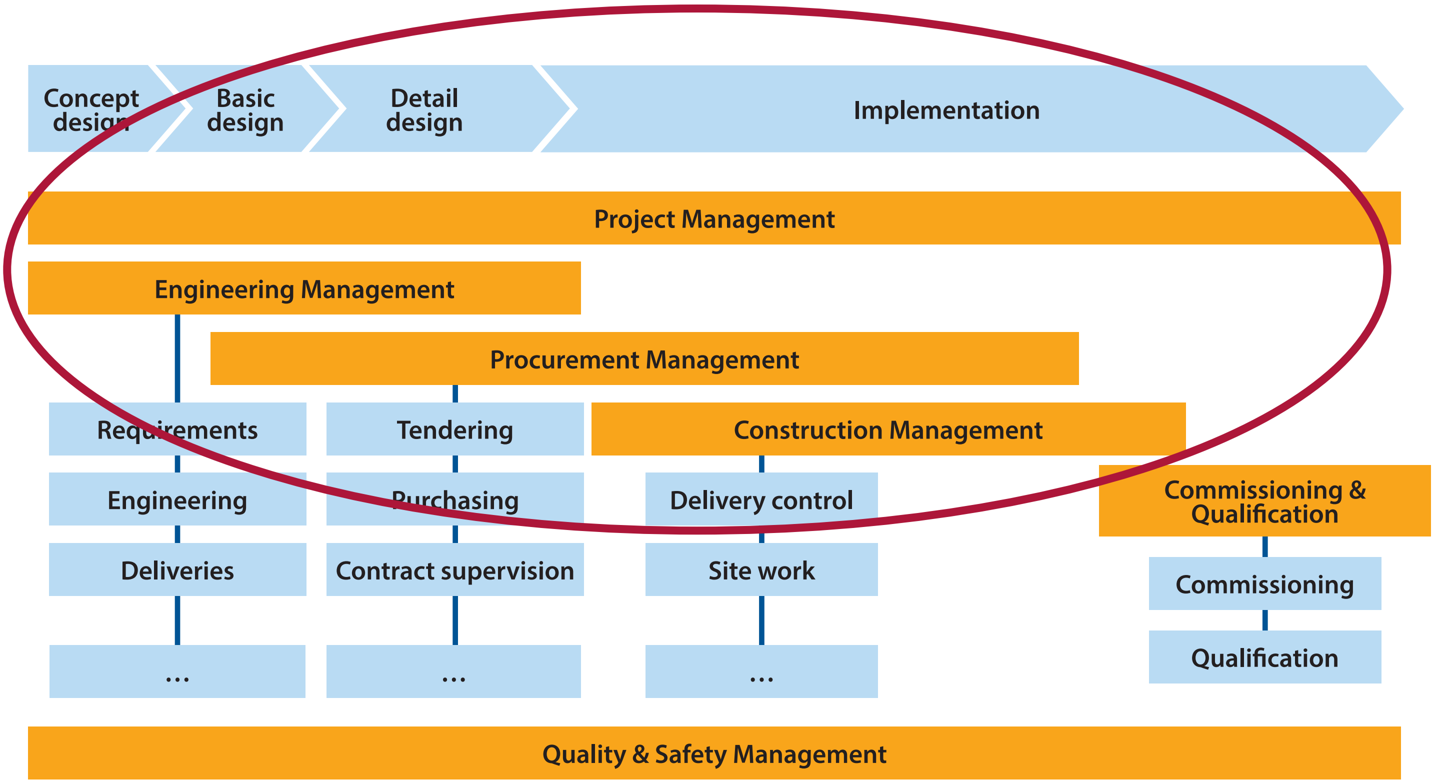

Diagram 1. EPCM concept covers all subareas

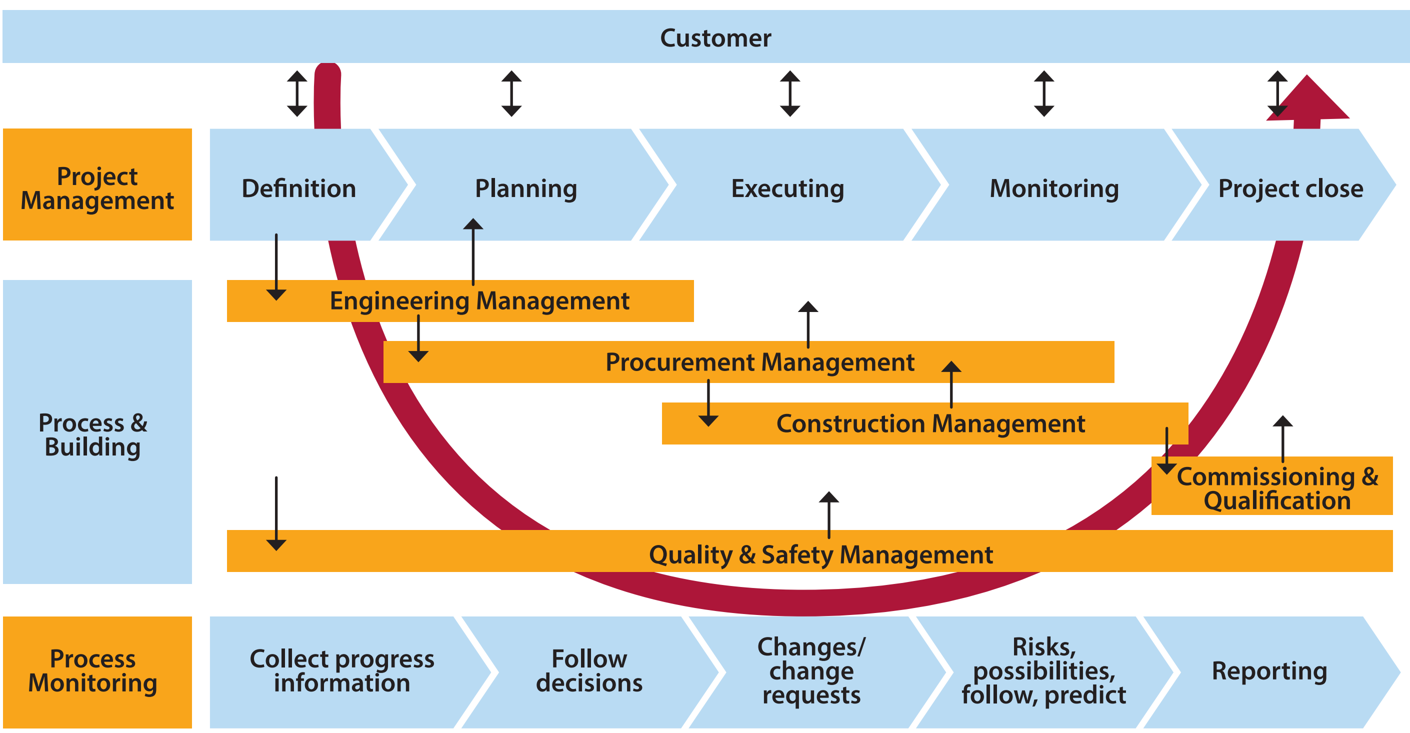

Diagram 2. Project Management guides the successful implementation of the project

It is essential to keep the customer involved throughout the entire EPCM project.

In its purest form, EPCM entails only project management activities; management of the whole investment project, design management, procurement management, construction site management, as well as commissioning and acceptance management. The model does not specify which parties provide the practical design and implementation services. In industrial investments, the process defines implementation and the building takes shape around it.

The crucial role of project management

Project management is the most important activity throughout an EPCM project. It also acts as the interface to the project, the customer and other stakeholders. The core responsibility of project management is the management of risks, timetable, costs, quality, scope, resources and information. This entails planning, supervising and instructing staff to achieve the joint goals created at the outset with the customer.

A key component of successful project management is the ability to forecast and plan for different scenarios throughout the project, as well as risk management in all phases. Good monitoring methods and control procedures related to corrective actions are extremely important. Even if agreement was reached at the start of the project on common procedures and the project atmosphere was good, the management of project interfaces cannot be forgotten. One should keep in mind that project work is a commercial activity for both parties. Further key elements include successful timetable and cost management, communication that is sufficiently comprehensive, transparent and timely, as well as the appointment of professional and experienced persons.

Solutions defined and costs fixed in design phase

Design management is another key task, because solutions chosen during the design phase make up the bulk of the investment cost. Design is usually divided into three phases: conceptual design, basic design and detail design. During conceptual design, the customer's goals are transformed into concrete technical designs. Several alternative solutions are commonly drawn up at this time.

The most important technical solutions are selected at this phase, which defines the costs that arise and the required timetable to a large degree. In basic design, the solutions are specified in more detail prior to the final investment decision. The detail design required for actual implementation often continues in support of construction and installation.

The ability to create designs of the required level for each phase by drawing on sound expertise and experience is a very important factor in the design phase. In the basic and detail design phases, the professional coordination of design work is essential. The design is done systematically with the auditing and locking/freezing of design sub-phases or technical solutions. Change management is of great significance for scheduling and costs.

BIM modelling (Building Information Model) has become a fixture in coordinating the designs of different parties, change management and in ensuring the quality of projects. The later changes are made, the greater is the risk that the budget and timetable will be exceeded. Modifications also always increase the possibility of errors, e.g. when the effects of changes have not been communicated to all parties early enough.

Procurement has a significant effect on cost level

Procurement management should be conducted from the very start of the investment all the way up to the point, where the procured materials have been accepted for the functions they were acquired. Successful procurement has a significant effect on the total cost of the project and on whether savings or additional costs are incurred.

An overall procurement strategy and plan should be drawn up at the start of the project, to which more detail can be added as the project progresses. The procurement plan describes e.g. the procurement process timetable, amount and type, (customer's preferred) suppliers, supplier locations, suppliers' financial status, contractual terms, level of delivery supervision and maintenance services etc.

The procurement and purchasing process is conducted according to the drawn-up specifications. This ensures that one does not have to consider whether everything necessary was done after the fact. Procurements define the project costs and, therefore, sufficient understanding of and expertise in procurement contracting and delivery supervision are of critical importance.

The customer plays an important role in procurement, as it accepts procurements and conducts them in accordance with the consultant's guidelines. In this model, procurement contracts are concluded between the customer and supplier/contractor. The consultant nevertheless guides, supervises and checks the delivery of the procured devices and services. The cooperation between these three parties is a key success factor in the project.

On site – putting plans into practice safely

The site management team is responsible for the practical implementation of the project, thereby realising the planned and fixed costs. In the construction phase, the number of external suppliers increases dramatically, which brings more complexity and adds to the need for coordination.

Both construction work and the installation of process-related devices

Thorough planning and forecasting and transparent communications are critical for EPCM project success.

and systems are conducted simultaneously at the site. Site managers and installation supervisors are responsible for ensuring that these activities are conducted seamlessly with consideration for safety and with an eye on achieving an error-free result.

Preparatory work for construction and installation is already done during the design process. For this reason, a safety coordinator, damp management coordinator, and construction supervisor should be involved in the design process insofar construction is concerned, and an HSE supervisor with regards the process.

Construction site operations require thorough planning, strict control and supervision, as well as clear roles and responsibilities. These factors contribute to creating a good operational culture and coordination of different elements.

Occupational safety is the most important factors to consider at construction sites. In order to ensure safety and achieving the goal of zero accidents, all participants have to commit to common safety instructions and follow them to the letter. The site safety coordinator draws up procedures and instructions to ensure safety.

Commissioning and acceptance of the plant complete the project

Commissioning and acceptance management is concerned with ensuring the termination of the entire project, by inspecting and testing the plant in phases, thereby verifying that the result meets the agreed scope and technical level. Successful commissioning is heavily reliant on the quality of earlier design and procurement and thorough prior commissioning planning. Ensuring safety before operational testing is also of critical importance.

During acceptance, the completed plant is handed over to the customer as agreed for commercial use. The customer can then do the final acceptance of the delivery.

There are no risk-free projects, but…

The management of risks and safety is becoming increasingly important in all operations. Risk management is, therefore, also a factor that needs to be managed carefully in EPCM projects.

Risk management should be conducted as the project progresses from the very start of concept design. The risk register is updated and made more detailed throughout the different project phases. It should be monitored all the way up to acceptance. Risks should be identified and plans and specifications drawn up to mitigate these risks, so that any remaining risks are at an acceptable level. Risk management also provides tools for safety management.

Conclusion

An EPCM project consists of many different parts, each of which needs to be completed successfully to ensure a successful project. This is equally important in both small and large EPCM projects. The EPCM consultant assisting the client ensures that the customer receives the desired result at the budgeted price and within the agreed timetable. The customer trusts in the consultant's ability to manage even large projects. The consultant needs to be worthy of this trust.

If one wants to be successful in EPCM projects, it is crucial to listen to the customer and to come up with common goals. The customer should also be kept involved in decision making throughout the project to ensure that it progresses satisfactorily for both parties from start to finish.

About the author

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Markku S. Lehtinen has 20 years' experience of working in consulting and engineering. His experience covers the energy and process segments, quality issues and a wide range of general management roles. Markku joined Elomatic in 1998. He currently holds the position of Vice President, Consulting & Engineering, Process & Energy.

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MEYER TURKU
KONECRANES
MEYER TURKU

Large investment projects

Case: Meyer Turku

Text: Veli-Matti Niemi

Large and multi-party investment projects require diverse and thorough expertise. The transparent co-operation between the customer, consultant and suppliers is also of critical importance in such projects. Other key success factors include timetable management, cost management and risk management. Reporting and timely communication in all circumstances ensure that the actions taken lead towards achieving jointly agreed goals as planned. Building and earning trust are key components of project management. Meyer Turku's large investment project is a good example of how projects of this nature can be managed.

Elomatic became involved in Meyer Turku shipyard's large investment projects at the end of 2015, when it conducted a study for the yard about possible bottlenecks in their hull production investment. The yard had a full orderbook at the time, including a ship series that required a significant increase in production capacity.

An investment program was drawn up for 2016–2020, based on the results of the preliminary study. A Project Management Office (PMO) did not exist at the time, but a few persons had just been hired for the investment project. Methods and models for project management and the implementation of the investment project were created with Meyer based on Meyer's Hi5 project model. The shipyard already had extensive experience in shipbuilding, which was nevertheless not transferable to implementing an investment programme. This led to large-scale cooperation between Elomatic and the shipyard.

Project documentation

Extensive project documentation was drawn up for the investment programme. The most essential materials included a project plan, procurement plan, cost guidelines, timetable models, documents related to risk and resource management, as well as a range of daily document templates like notes, minutes, and kick-off documents to support the project. The prioritisation of investment targets i.e. the order of implementation was drawn up based on the preliminary study.

Timetable and cost management

Timetable management is a key part of project management at both the project and project portfolio level, for example, linking interdependencies from one project to the next.

Based on the initial cost evaluations and budget offers, a party has to be assigned to oversee implementation, when the customer's goals are clear. Once the final investment decision has been taken, a budget estimate is generated, which is thereafter evaluated on a monthly basis.

Risk management

Different risk management models were sourced and practically evaluated several times. Management tools were developed markedly and serve each project equally. Visibility needed to be increased, which eased and emphasized usability.

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▲ *The Goliath crane is delivered to Meyer Turku.*

Reporting, communication and content management

A reporting model was developed for suppliers, which they used on a monthly basis. After some testing, a reporting model was created for higher-level project reporting that served all projects regardless of the project phase. External communication on the project was handled in cooperation with the shipyard's Communications Manager.

Content management is particularly important as projects are intended to implement a company's strategic decisions. With successful content management, we generate added value and success for the customer.

PMO and ABC models

The Project Management Office (PMO) model developed and managed by Meyer is now officially in use at the shipyard. It is the culmination of wide-ranging cooperation and development of project management procedures. The investment needs were evaluated and the ABC model, familiar to many, is now in use for classification. The current investment programme extends all the way to 2022.

The size and quality of the PMO has grown significantly. The quality adheres to Meyer's Hi5 model used in all Meyer shipyards with corresponding/ relevant updates to fit the purpose of large-scale investment project needs. Over EUR 200,000,000 has been invested so far and indications are that more investments are in the pipeline.

Largest Goliath crane in Europe – 1,200 tonnes

A new Goliath crane supplied by Konecranes was one the more significant of the first wave of investments made at the shipyard. It increased the lifting capacity twofold up to 1,200 tonnes.

Elomatic was responsible for managing the procurement and implementation phase of the project with a team that included several customer experts in the fields of supervision, start-up and inspection. Several other consulting firms from different disciplines took part in design and supervision tasks as well as dozens of subcontractors that completed a wide range of tasks.

The largest part of the project, the construction of the main support, which weighs over 2,000 tonnes, was completed by the shipyard's own production organisation.

The crane was positioned to run in the same crane rails as a similar crane with a 600-tonne capacity that was acquired in 1975. Much effort was put into strengthening the crane trail structures and the construction docks. Many temporary structures were also built to attach erection wires to the ground.

The greatest challenge was accommodating the shipyard's shipbuilding and extremely large steel components

Timetable management and communication proved to be key expertise areas on the project.

such as carriages, legs, supports and lift bogies to the production area. Functionality and capacity testing of the crane was conducted with separately constructed test weights. The test weights included reinforced concrete weights built for the 1975 crane, calibration weights by the new shipyard, as well as the 28-metre-long mid-ship of the Bore II.

Timetable management and communication proved to be key know-how areas in project. The cooperation between the customer, its production department, supplier, sub-contractors and partners was smooth throughout the project. At the time of writing this article, the new Goliath crane had been in operation for over 4 months. A great amount of user feedback has been received and it will soon meet customer specifications for usability and utilisation rates.

According to Tero Lahti, Head of Investments and PMO at Meyer Turku, Elomatic's services for production simulation, process visualisation, BIM model coordination and maintenance supported the special needs of the investment project well.

"The focus for Elomatic has been on project management, design and design supervision, and overseeing demanding procurements. Different Elomatic experts have been involved in almost every Meyer investment project from start to finish. I am very satisfied with the results, also for the very demanding design targets at the shipyard," Mr Lahti describes Elomatic's contribution.

Watch video of Goliath crane delivery and installation. www.youtube.com/watch?v=Jq_MDPzYTWs

About the author

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Veli-Matti Niemi has extensive project management expertise in large projects. His expertise areas cover different tasks from procurement negotiations through to project handover on demanding domestic and international assignments. He has IPMA Class B project management certification and currently works as a Certified Senior Project Manager at Elomatic's Turku office.

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User-centred design

Safe and functional control rooms

Text: Sanni Marttinen

A well-designed working environment as well as systems and tools that support task performance promote efficient working and reduce the possibility of errors occurring. Implementing a user-centred control room is challenging due to the constraints imposed by different systems and their displays, furniture and spaces. One also has to take different users and their needs into account, as well as their physical and cognitive abilities. Control room design challenges can be overcome with diverse design teams, participatory design and the use of new technologies.

Control room workers have to monitor processes and take appropriate actions to ensure their optimal operation. The work often also includes monitoring the process visually or with an audio connection, access control and reporting. This may require multiple user interfaces. The smooth operation of these interfaces is affected by external and internal factors such as lighting, noise and the controller's alertness.

Experienced controllers are valuable employees because they can quickly isolate essential information from the mass of data and control the process assuredly. They have a wealth of tacit knowledge to draw on to develop control room spaces and tools.

Restlessness and outdated workstation furniture are common problems

Noise and restlessness caused by persons passing through control rooms or adjacent operations and facilities can cause disturbances in control rooms. Control room work requires vigilance and concentration. It is often done in shifts, which means that alertness levels can vary greatly.

Disturbances caused by unnecessary noise or movements in the field of vision can not only affect the quality of the work, but also the controller's state of mind and work satisfaction. If controllers are distracted from their primary monitoring tasks, it burdens their memory and ability to process information.

A clear focus on users and their needs enable solutions that have longevity and wider acceptance.

In addition to restlessness, a commonly observed defect in control rooms is workstation furniture. Control room work is done in many different spaces and in two shifts. This means that people with very different physiques make use of the same furniture during the cycle. Tall employees may find that their knees bump into structures under table tops, while for others the tables are too high.

In many control rooms, employees also dine at the same table and there is, for example, no option to work while standing. It has been proven that bad ergonomics at work leads to physical ailments and, if left unresolved, can result in increased sick leave and reduced work performance. Over and above furniture features, the location of furniture also has a significant impact. The placement of workstations and wall displays, for instance, affects observation abilities and communication.

Thorough design with multidisciplinary experts

If one embarks on the modernisation of a control room, it should be done thoroughly. Developing subareas in isolation from others only weakens the overall functionality. The development of a control room affects the entire production plant. Other spaces and persons cannot be completely excluded from the development project. The smooth functioning of a control room is affected by stakeholders, spaces adjacent to the control room, walkways, and the communication channels employed. In addition to controllers, other users of the spaces should also be taken into consideration to enhance the longevity of the modernisation and its acceptance.

A design team made up of experts from many different fields is able to collect initial data with different methods and implement the designs according to appropriate standards. Such a design team could consist of experts in the fields of usability, ergonomics, structural engineering, processes and user interfaces.

Standards for control room ergonomics and user interfaces are concerned with the spaces, workstations, displays, controls and matters related to the design of the environment. Depending on the scope of the design work, the design team integrates the design of different areas – control room, adjacent spaces, access points, workstations, furniture, related technology and user interfaces – into a fully comprehensive design.

If the development work is only related to one subarea, the effects on other areas need to be evaluated. The scope of the project is finalised during the first phase of the development project, i.e. the preliminary study.

Easy comparison of alternative solutions in virtual model

Virtual reality (VR) technology can be used to verify the functionality of a proposed design solution. A VR headset or a VR studio, which can be set up almost in any space imaginable, can be used to "step inside" the control room design and study the designed environment. The user can, for instance, try different locations for equipment and furniture, different lighting levels, and walk along corridors. The control room model can be updated in real time and the effects of changes on functionality can be evaluated on the fly. The testing model can be used in project discussions and the designer can use it to visualise and justify selected solutions to the customer.

Summary

The use of the latest technologies and a wide range of experts enable better control room design. A clear focus on users and their needs enable solutions that have longevity and wider acceptance. User-centred design is essential in ensuring safe and functional control rooms.

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Sanni Marttinen graduated from the Jyväskylä University of Applied Sciences as a welfare technology engineer in 2006. Since her graduation, she worked as a designer at Elomatic's Jyväskylä office. In 2011, she graduated from the University of Jyväskylä with a master's degree in cognitive science. In addition to the design work, Sanni has participated in usability projects and has implemented projects related to organisational development.

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Journey to a car

Introducing the NYK SUPER ECO SHIP 2050

Text: Tomas Aminoff

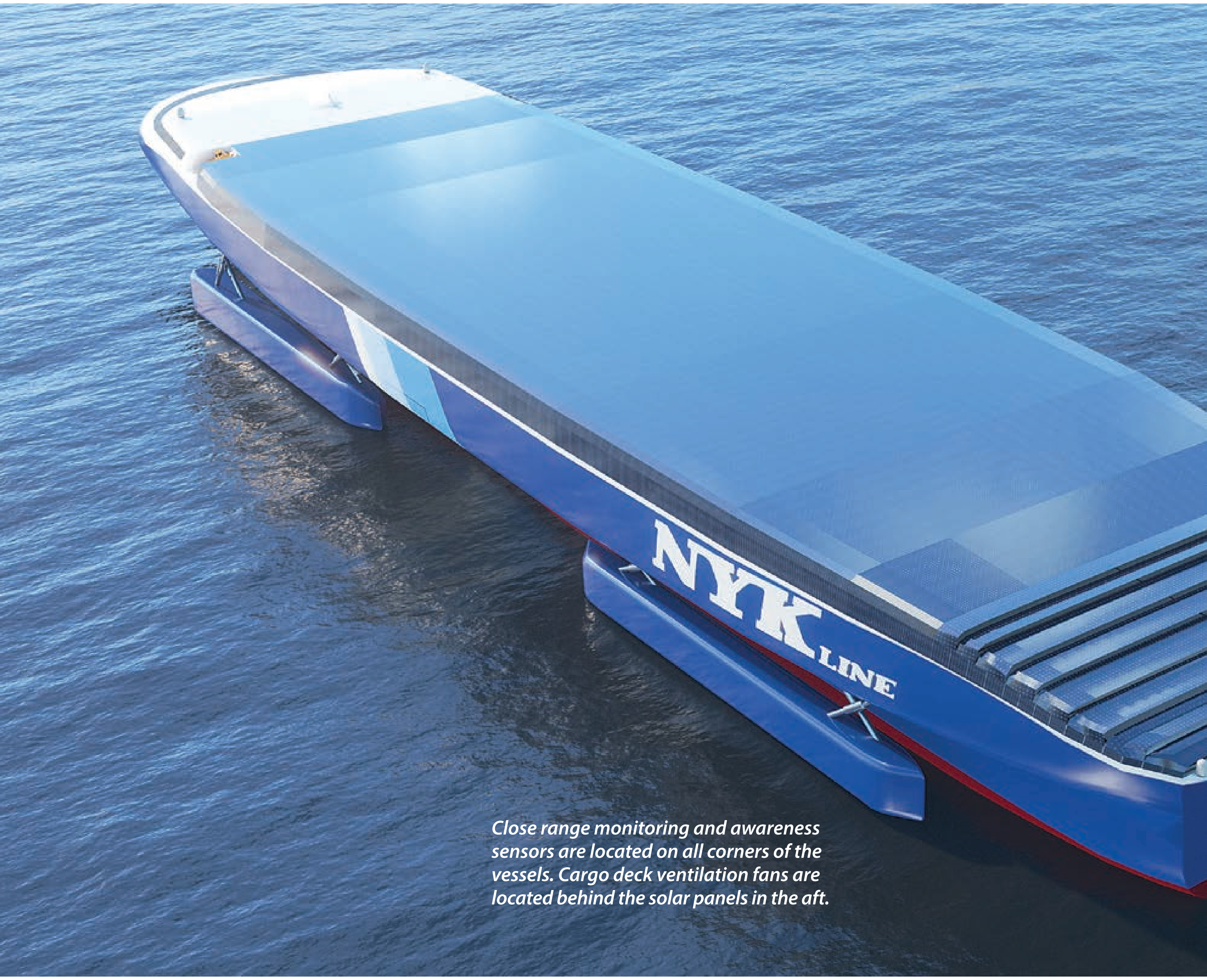
In 2018, the IMO and the shipping community made a strong commitment: By 2050, greenhouse gases from shipping must be reduced by at least 50% from 2008 levels. For an individual vessel, the reduction needs to be far greater. In order to achieve this goal, the journey must start now, by implementing new and existing technologies.

With these words Japanese shipping company NYK, one of the largest and most diverse shipping operators in the world, launched their challenge for CO_2-neutral shipping in 2050. Prior to the above announcement by the IMO, NYK and its technology development arm, the Monohakobi Technology Institute (MTI), had already approached Elomatic for a development roadmap towards more environmentally friendly operation.

rbon-free world

NYK SUPER ECO SHIP 2050 project partners:

NYK GROUP ELOMATIC CONSULTING & ENGINEERING Monohakobi Technology Institute

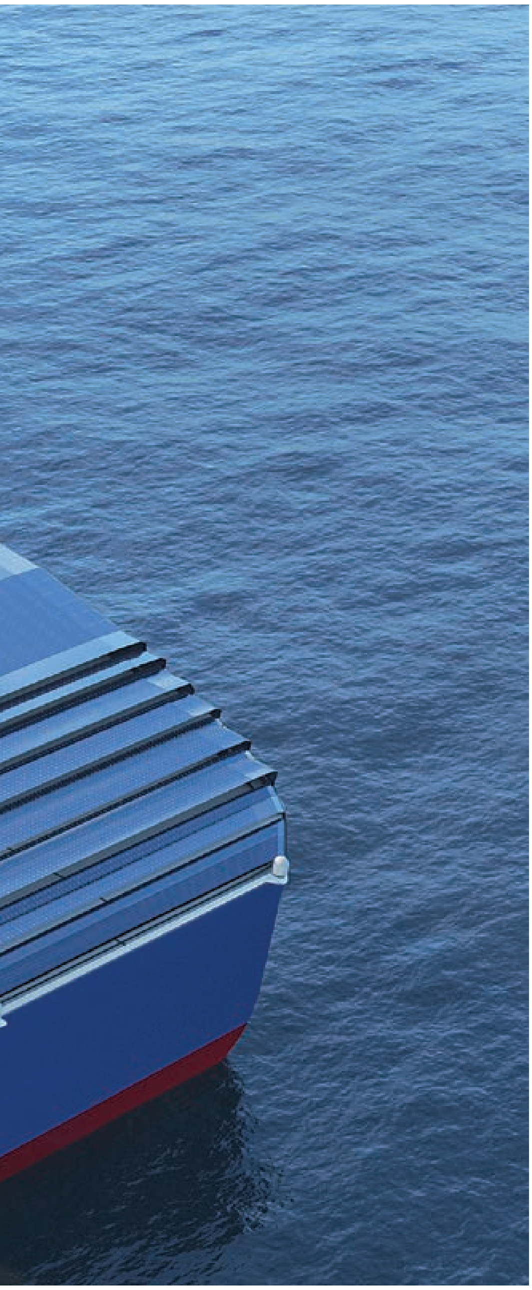


Close range monitoring and awareness sensors are located on all corners of the vessels. Cargo deck ventilation fans are located behind the solar panels in the aft.

Back in 2009, Elomatic conducted a technology study for NYK to reduce energy consumption and emissions. The work culminated in a futuristic container vessel, the NYK SUPER ECO SHIP 2030. This project received much attention and won awards for its environmental friendly design. The on-board energy consumption of the SUPER ECO SHIP 2030 was reduced by 40% from the best-in-class vessel at the time.

Almost 10 years later, the time had come to update the study and raise the bar, while aligning it with and exceeding targets set by the IMO and International Panel for Climate Change (IPCC). While a wide range of vessel types where addressed, the showcase vessel for the updated study was a Pure Car and Truck Carrier (PCTC). The

"Join us on our journey to a carbon-free world."



ship is known as the NYK SUPER ECO SHIP 2050.

By utilising a deep toolbox and touching all fields of ship design and vessel operation, a 70% energy saving compared to today's benchmark was achieved. Significantly, the potential of emission-free operation was reached, depending on the source of primary fuel.

The challenge

In essence, emission-free operation is simple: use fuel with neutral or no CO_2 emissions. The challenge is that such fuels are rare, expensive and, in most cases, difficult to store. They also tend to be inefficient from an energy efficiency perspective, when the entire footprint from primary energy to a bunker fuel on board the vessel is considered. Thus, the path towards the use of alternative fuels is via highly efficient vessels and highly efficient operation of the total fleet and its logistical chain.

To achieve the 70% reduction in bunker fuel on board the NYK SUPER ECO SHIP 2050, many large and small improvements were made. The most critical aspects are highlighted in the rest of this article.

Resistance, resistance, resistance

For a typical merchant vessel, the biggest power demand is required to overcome the resistance of the vessel. Resistance originates from the need to move the vessel through water and air, with the former being the dominating factor.

The hull volume and shape of a vessel is critical in order to reduce resistance. The hull has to provide buoyancy to carry the weight of the ship and its cargo. To minimise the volume of the hull, it is important to minimise the lightweight of the ship. The lightweight of NYK SUPER ECO SHIP 2050 was reduced by 30% in view of developments in topology optimisation, the potential of 3D printing in manufacturing and materials development.

The other purpose of the hull is provide sufficient stability for the vessel, which is especially critical for a PCTC. Computer-controlled stability has been the norm for fighter jets for some time already. In our vision, ships will also have active devices that provide sufficient stability. In the NYK SUPER ECO SHIP 2050, this has been done with gyro stabilisers, but the actual execution can be any other active device.

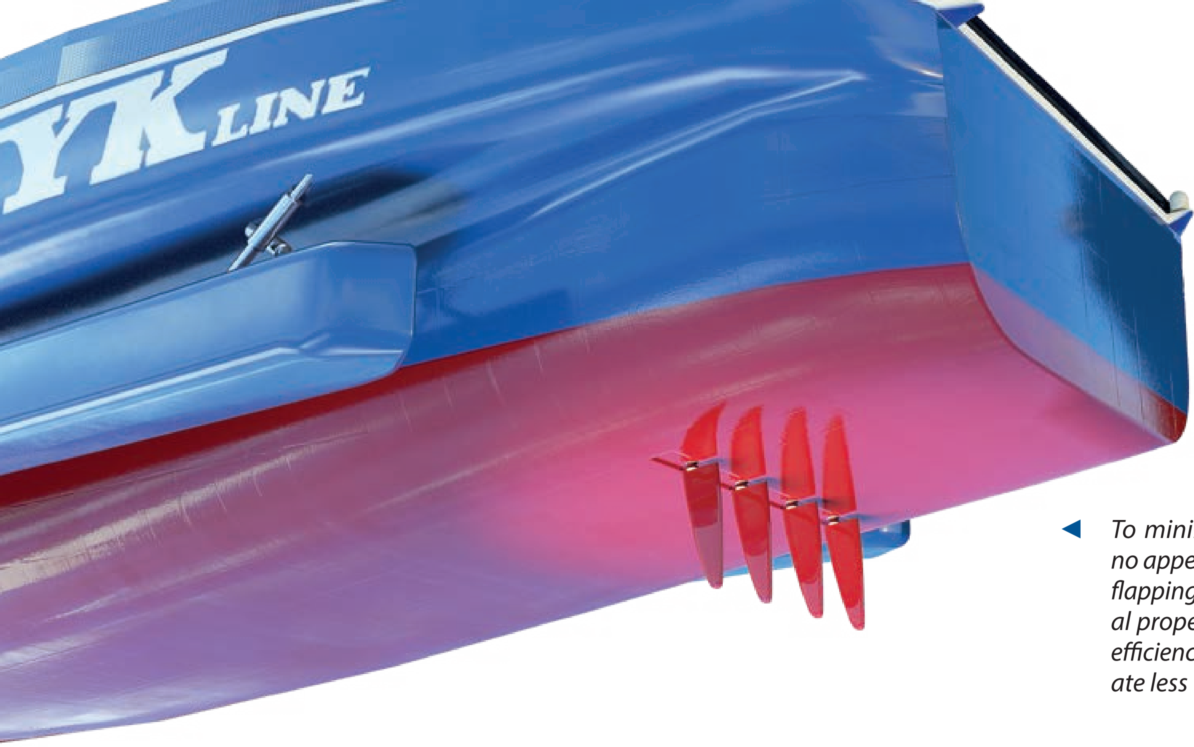
The vessel is equipped with pontoons that can be deployed if required. This allows it to remain stable during blackouts and other abnormal situations. These developments will allow hull shape optimisation to be done differently, with a greater focus on resistance. Overall, the reduction in vessel resistance is 35%.

Machinery and propulsion

Efficiency is key when it comes to prime movers, power distribution and propulsion equipment.

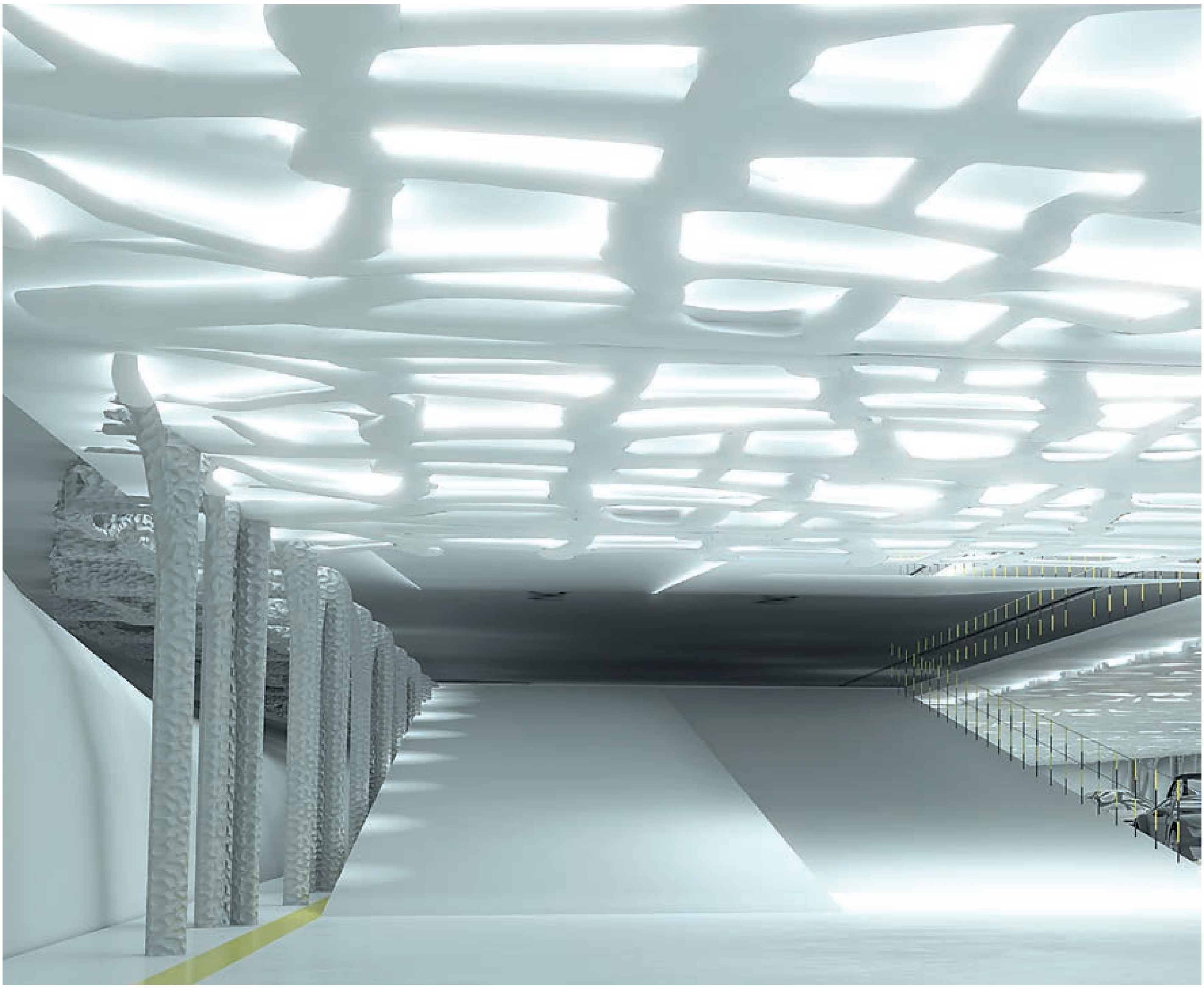
Hydrogen fuel cells were selected as the prime movers of the vessel. Because the only bunker fuel on board is hydrogen and the prime movers are fuel cells, a lot of auxiliary equipment can be removed and the maintenance requirement reduced.

The electricity from the fuel cells is fed into a highly efficient DC grid, which distributes low-voltage electricity throughout the ship. Savings throughout the electrical distribution have been achieved by minimising electrical components, utilising permanent magnetic motors, advanced



◄ *To minimise resistance, the hull has no appendages or discontinuities. The flapping foils that replace conventional propellers do not only improve the efficiency, but are also expected to create less waterborne noise.*

▼ *The pattern of the structure has been optimised with computer simulations utilising deck and wind loads. Lighting is integrated in the structure.*



power and consumer management and superconductive transmission.

Conventional propellers have been replaced by flapping foils that mimic the movement of dolphins to deliver greater efficiency than screw-type propellers. The efficiency gains originate mainly from the efficient blade operation of the flapping foils.

Another important aspect is the creation of renewable energy on board the vessel. By 2050, solar power will already have been the most cost efficient new source of energy at land-based installations for many years. The same will be true for maritime applications. Therefore, the ship area is optimally utilised for highly efficient solar panels that can move on two axels for the best possible efficiency. On a roundtrip basis, 15% of the vessels energy demand will be covered by solar panels.

Zero waste

One way to increase efficiency is to eliminate all sources of waste. Excess heat from machinery is already utilised today to produce electricity, but NYK SUPER ECO SHIP 2050 will go one step further. Because there is no need to use waste heat on NYK SUPER ECO SHIP 2050 to heat bunker fuel and due to its more streamlined crew, the need for heating is further reduced. At the same time, with emission-free exhaust fumes consisting only of water vapour, the temperature of the fumes after heat recovery can be as low as desired, which means that more heat can be recovered. These two developments will increase the potential of heat recovery.

Waste cold is a new stream of waste that originates from cryogenic bunker fuels such as LNG or liquid hydrogen. Excess cold originating from the consumed fuel can be utilised in several ways. It can reduce the required power consumption on board when used for air conditioning and cold equipment in the kitchen. It can also improve the efficiency of power distribution through superconducting and reduce the surface temperature of solar panels.

Other sources of waste originating from ship operation are stored on board the vessel and offloaded in port. This not only improves the environmental footprint of the vessel, but also reduces the amount of equipment required on board and minimises the required energy and maintenance demand.

Operation

The effect of operation on emissions from shipping should not be underestimated. Weather routing, just-in-time arrival, as well as advanced power and energy management will be standard procedures by 2050. However, optimisation will be done on a larger scale. Port arrival will be optimised between all vessels heading towards port and shore-based logistical chains will be aligned with the arrival of vessels. Cargo for feeder vessels will not disembark to the port, but will be moved directly from one vessel to another. This will reduce the port stay for the vessel and the lead-time for the cargo.

Time between bunkering will be another important change in vessel operation. As most alternative fuels are more complex and require more storage space compared to current fuels, bunkering will need to be more frequent than current practice. The vessel will require an endurance of 21 days compered to several months for current vessels. This will keep the costs and space demands affiliated with liquid hydrogen at manageable levels.

Conclusion

The NYK SUPER ECO SHIP 2050 is a source of inspiration and a basis for further discussion. The vessel clearly demonstrates the importance of energy efficiency for the adoption of alternative fuels. To achieve the 2050 target, ship owners need to follow the example set by NYK and start planning already today. They need to map the availability and matureness of technology already available, that which is currently being developed, and technology that is only at a visionary stage.

The NYK SUPER ECO SHIP offers a 35% reduction in resistance and a 70% reduction in energy originating from bunker fuel. This opens the door to the use of completely emission-free and greenhouse gas free or neutral fuels, thereby achieving a truly zero emission vessel.

Watch video of NYK SUPER ECO SHIP 2050: www.youtube.com/watch?v=Jq_MDPzYTWs

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Tomas Aminoff graduated from the Helsinki University of Technology in 2002 with a major in Marine Engineering. He has worked for 15 years for a major marine equipment supplier with a special focus on alternative fuels, machinery solutions and portfolio management. Tomas has extensive knowledge of LNG as a marine fuel and has played an important role in introducing several gas powered engines to the market. Today, Tomas works as a Senior Consultant in Elomatic's Marine Consultancy and Life Cycle Solutions department.

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Selection and refinement in developing production wide performance monitoring

Reducing thousands of measurements into a handful of key parameters

Text: Jussi Parvianen

Industrial digitalisation has left factories with copious amounts of measurement data. A single production line can have thousands of measurement tags, each capable of producing a nearly continuous stream of information. This data is utilised, above all, in operating the process, but can it also be combined with smaller entities to aid in determining the state of the whole process?

Typically, in graphical user interfaces of process automation systems, measurements are grouped in frames according to what part of the process they are positioned in. Usually, these measurements are placed on top of a crude drawing of the part of the process to illustrate where the measurements are physically positioned. Depending on the process, several frames might be needed to cover a whole production line. On the one hand, this kind of representation is easy to interpret and serves the needs of process operators. On the other hand, critical information can be sparse and hard to find. Locating bottlenecks in the process can be difficult in this kind of system. Tracing the effects of a change in the quality of a raw material on the process can be even more cumbersome.

Obtaining critical parameters for performance evaluation

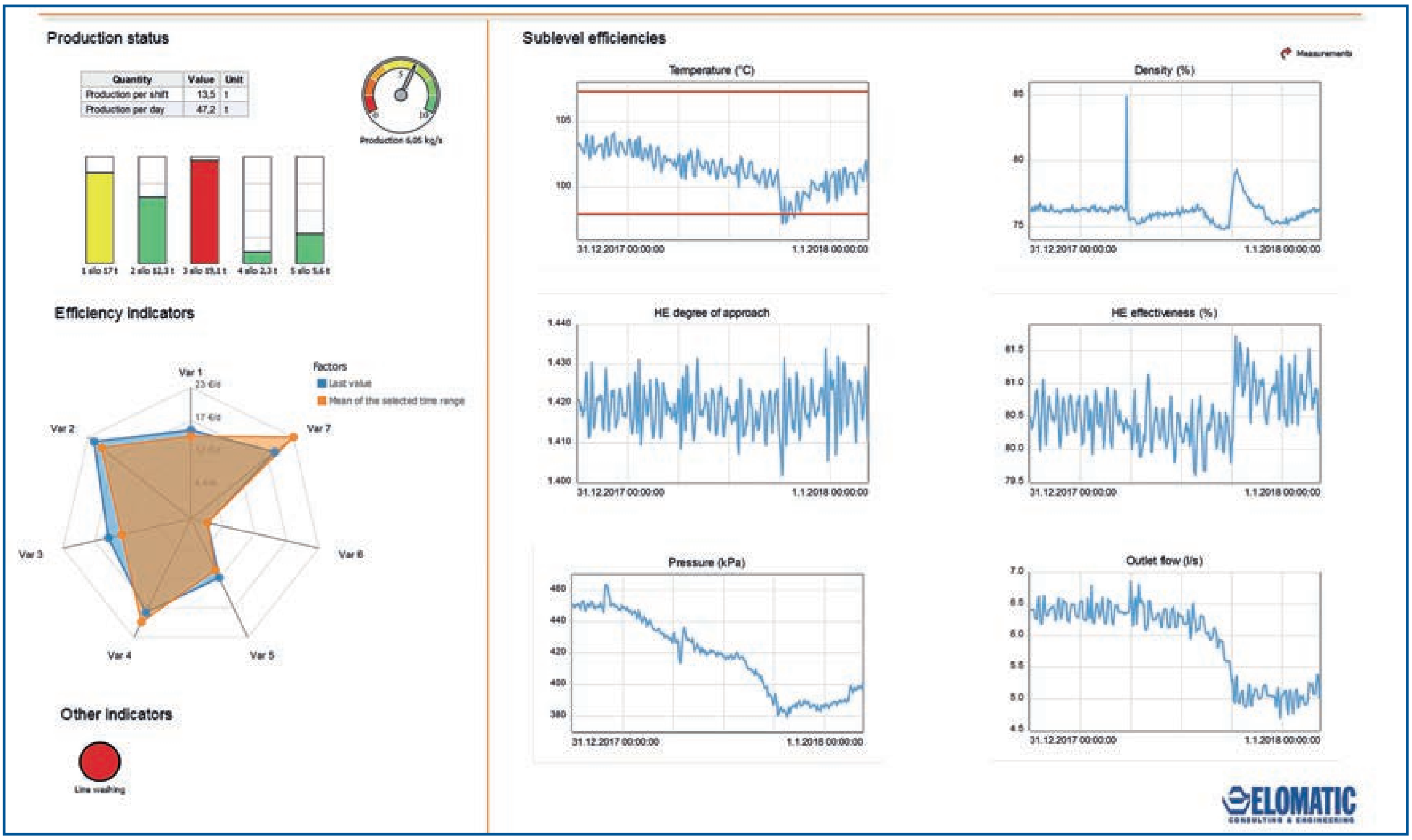
It is obvious that, in determining the state of a process, some information is more critical than the rest. For example, a drying process that utilises steam for heat can be seen as a bottleneck of the process when the steam valve is open wide enough so that the steam flow has plateaued, indicating that the dryer has reached its full capacity. Thus, this simple limit value of the steam valve at the start of the plateau can indicate the state of the drying process as a whole.

Critical process information can also be a combination of measurement data. In a wire filtering process, for example, the mass of a filtrate cake per area on the wire filter is a critical parameter. Assuming constant mass across the width of the filter, the mass of the filtrate cake per area can be calculated from the:

- Width of the wire
- Diameter of the drawing roll
- Rotational speed of the drawing roll
- Mass of solids in the feed per volume
- Flow rate of the feed

As can be seen in this example, several data points can be combined into a single and easy-to-understand figure, thus lowering the amount of figures to be monitored. This information-combining effect can also be achieved when efficiencies, specific energy consumptions and other key figures are calculated for different parts of the process, e.g. heat exchangers, grinders and dryers.

Photo © depositphoto.com/photollurg2



▲ *Figure 1. An example of a performance-monitoring display.*

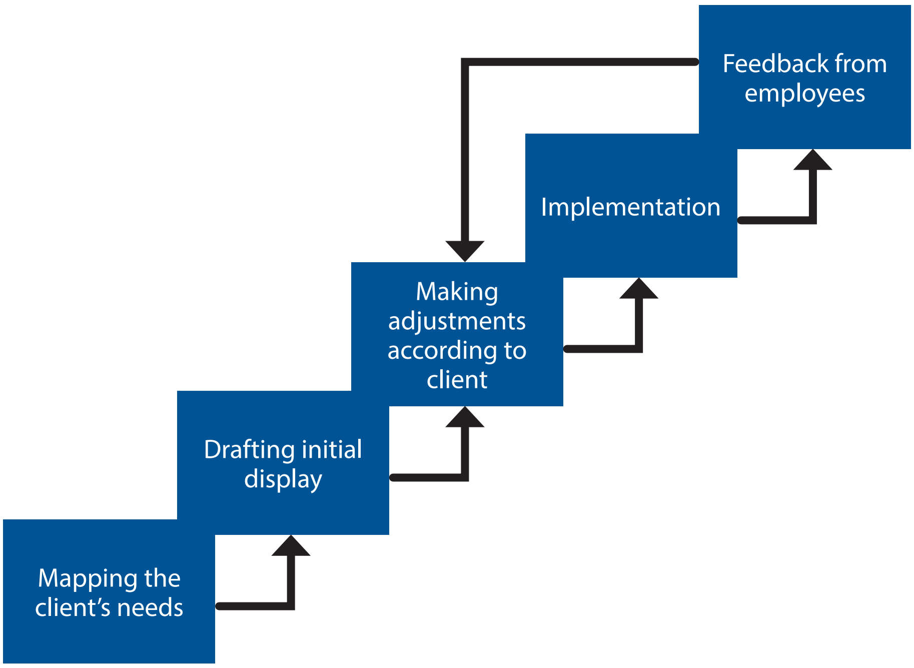
It is easy to see that finding the parameters that best describe the performance of the process requires insight into the process at hand. Therefore, discussions with factory staff are crucial in choosing the parameters for performance monitoring.

After the parameters for performance monitoring have been selected, they can be visualised in a performance monitoring display (See Figure 1). This way, the crucial parameters that indicate the efficiency of production are all in the same place and the state of the whole production line can be easily interpreted.

Matching contents with needs

As described above, measurements can be used as is, or in combination with other measurements to indicate the state of a process. In addition to these parameters, a performance monitoring display may consist of:

- Waiting times and delays
- Rate of production in different parts



▲ *Figure 2. Execution of a performance-monitoring project.*

Enhancing performance monitoring is a natural first step towards more efficient production.

of the process converted into the same unit, e.g. metric tons of product per day
- Current production rate in relation to the theoretical maximum
- Energy of raw material consumption in relation to production rate
- Cost of non-optimal operation
- Other key indicators, e.g. Overall Equipment Effectiveness (OEE)

These figures can be displayed either as their current values, or as a short trend. They can also be visualised as gauges or traffic lights to ease interpretation.

The content of a performance monitoring display should be designed according to the needs of both operators and engineers. Operators can use it to evaluate the best ways to drive the process and engineers can use it to find the root causes of malfunctions. A well-executed performance monitoring display may serve several purposes, depending on the needs it was built.

Use of a performance monitoring display

A performance monitoring display can help or even add communication between shifts. At the start of their shift, operators can easily see the overall status of the process. It also helps to see how previous shifts have played out. This is useful especially when carrying out long operations that can span over multiple shifts, e.g. the ramp-up after a stoppage. Bringing in versatile methods for monitoring process performance can also help paint a clearer picture for shift supervisors and other staff of what is actually taking place in the process.

From an engineer's perspective, having all the key parameters in one place makes it easier to dive into the root causes of factors and events that hinder production. This in turn speeds up problem solving and reduces downtime. Having all the crucial figures in one place also facilitates reporting.

Refining existing resources

Many production facilities already have the prerequisites for the contents of a performance monitoring display. Measurement positions are abundant and the data they produce is digital and is stored on servers. The existing automation system can be used as a platform for execution but ideally, there is some other software for data analysis and visualisation, such as Wedge, that is more suitable for execution.

The execution of a performance-monitoring project is presented in Fig. 2 as a continuous cycle of improvement. The process starts with understanding the needs of the client, after which an initial draft of the display is made. The draft is then improved with the changes decided upon with the client until it is implemented. After implementation, employees that make use of the display are asked for feedback. The feedback is then compared with the needs of the client and the display is further improved accordingly.

Conclusion

Building a performance-monitoring display on a production line is a simple and effective way to highlight the efficiency of production. It is a way of compressing online measurements into an information dense presentation. It also enables shedding light on the most important factors that have to be kept in check in order to ensure safe, reliable and profitable production.

Performance monitoring must be executed in close cooperation with the client to ensure that the needs are met. Choosing the parameters to be displayed also requires a deep understanding of the process, a fact that further underlines the role of the client.

Enhancing performance monitoring in production is a natural first step towards more efficient production.

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Jussi Parviainen graduated from the University of Oulu in 2018, majoring in process engineering with a focus on process automation. He has gained experience in process efficiency monitoring and data analysis since he joined Elomatic in 2017. Jussi currently works as a Senior Design Engineer at Elomatic's Jyväskylä office.

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Intellectual Property Rights

Ensuring protection in distributed CAD environments

Text: Ludmila Seppälä

Due to the growth of project complexity and the rising demand for digital 3D models and production data, the most valuable intellectual property of organisations is increasingly stored in digital project environments. This raises a critical question: How can we best protect intellectual property rights (IPR) in distributed CAD environments?

Simultaneous access to 3D models and the ability to share designs through viewer files are some of the most important features of modern CAD systems. These features are business-driven: organisations often need to outsource parts of design work to niche specialists or make use of the most competitive resources around the world. The implementation of distributed design systems allows these goals to be achieved.

Access to highly valuable assets in distributed environments

Through sharing 3D models and related data, companies provide access to their most valuable assets. At the same time, they also gain access to external knowledge and expertise. Besides well-known concurrent design tools, most modern CAD software enable work in a distributed environments where participants from different companies and locations have access to the same CAD project data. This process is normally backed up by various legal agreements and contracts, often including a Non-Disclosure Agreement. Are these measures sufficient though, and what role can CAD play in this regard?

It must first be acknowledged that CAD software providers are no longer only suppliers of design tools. They have become deeply embedded in the value created during the life cycle of a design project and beyond: CAD software has evolved into being a hub of knowledge. It stores libraries of parts and fittings according to various standards, in-built design rules and specifications, predefined modules and parts of vessels.

Photo © depositphotos.com/Jirsak. X-BOW model courtesy of Ulstein Group ASA

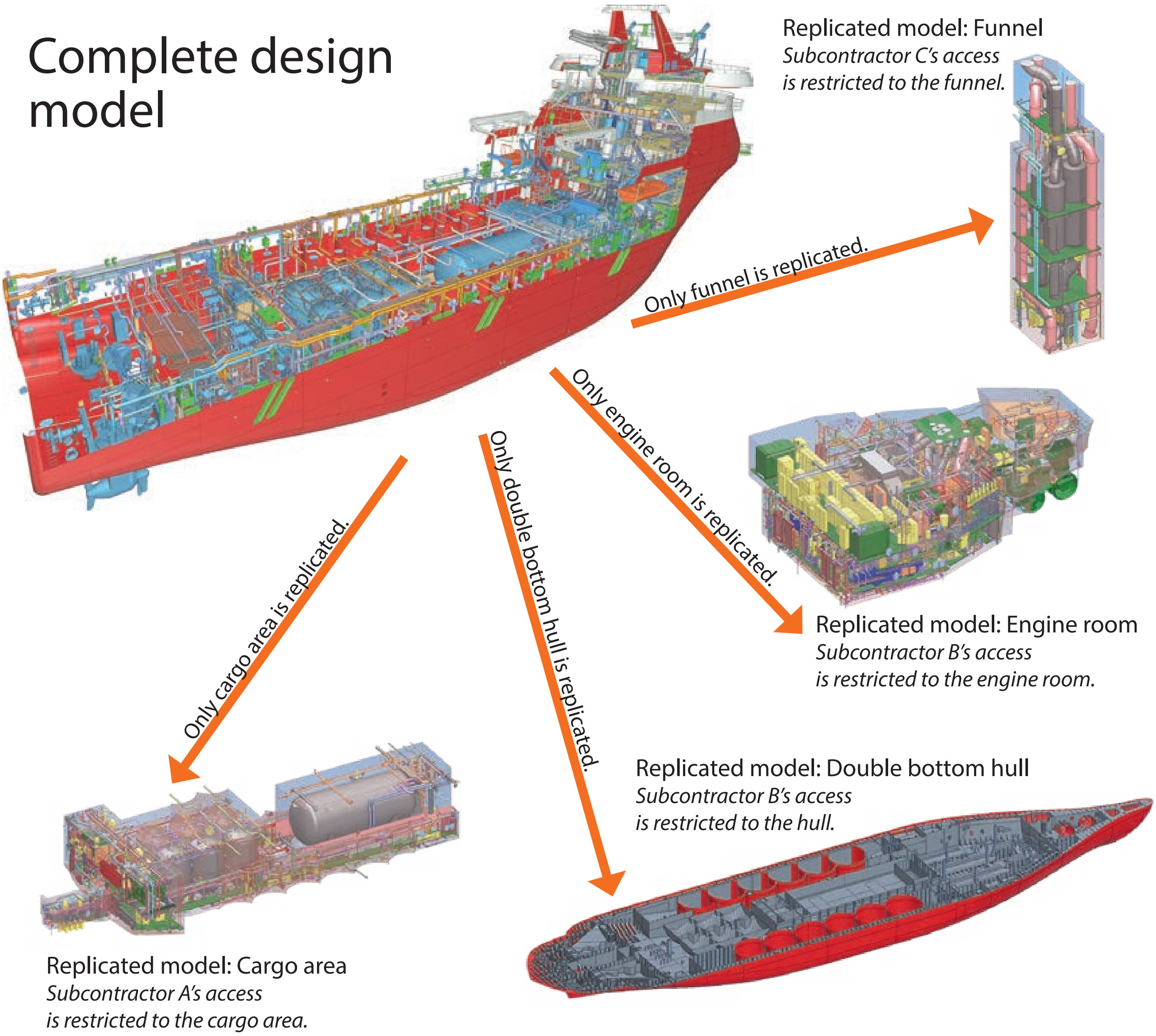
The role of CAD in Marine design projects and asset management is evolving slowly, yet steadily. There is a shift from knowledge facilitation or simple modelling to knowledge sharing, and in this context, also knowledge protection.

IPR in CAD distributed projects

Developers of Marine CAD environments have to balance the conflicting needs of facilitating knowledge creation and information sharing and the need to provide IPR protection. Little help is being provided by regulatory frameworks. The EU regulations for IPR in the shipbuilding industry, for example, do not set particular conditions for data sharing within distributed CAD environments. This leaves CAD providers to decide how to ensure customers' IPRs are protected without damaging the fragile value co-creation process in design and subsequent asset life cycles phases.

Through sharing 3D models and related data, companies provide access to their most valuable assets.

The first port of call is identifying possible sources of information leaks. The amount of interfaces between software tools has grown strongly in recent years and naturally deserves scrutiny. Traditionally, software vendors have avoided building interfaces to other vendor's products, precisely as they have tried to avoid disclosing their database structures and providing



access to their core data. However, the development of neutral data formats such as IFC, JT or STEP has mitigated these concerns. The interfaces are often separately licensed and can be easily controlled with simple administration settings.

A similar process was seen with mechanical CAD, albeit a significantly simpler one. Mechanical CAD models are "lighter" and do not contain as much topological data as is commonly found in ship design. It is, as such, much easier to integrate Mechanical CAD with PDM/PLM software.

Restricting access to project data

The most common mechanism used to safeguard sensitive information is to restrict access to certain areas or parts of databases. So-called filtered replication provides access control to connected sites.

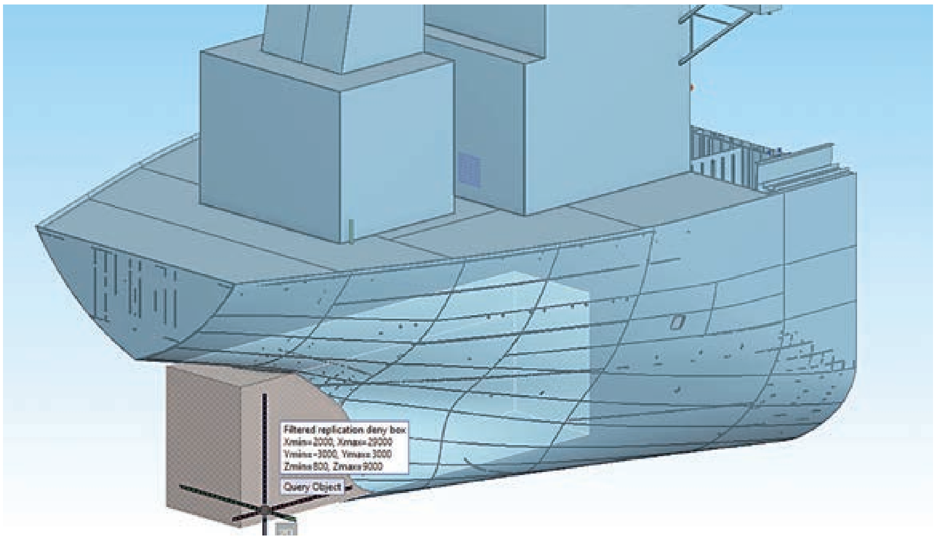
The main design company in a project, for example, can control what parts of the project are visible to other participants. This process is often complex and requires additional definitions and system setup. However, it could be approached from the designer's perspective: using 3D spaces to define an area. This approach is familiar from the way a design team's work is separated. It ensures the integrity of the design by placing the responsibility for each area inside the team and controlling only overlapping areas where all teams are involved. See figure 1.

Controlling content of viewer files

Business managers and other participants less involved in the core design process commonly make use of

◄ *Figure 1. Illustration of distributed design based on design areas: different parties access only designated areas of the whole project. Project model courtesy of Wärtsilä Ship Design Norway AS.*

► *Figure 2. A visual deny box in 3D view for filtered replication in a distributed project.*



3D viewers to access design features. These files contain a limited amount of data and do not pose a large IPR risk. Design solutions used in particular areas may nevertheless be considered valuable assets to the design company, and should be protected.

A filtered replication process, as described earlier, can be used to restrict the content of viewer files on a particular site only to selected areas. The validity of viewer files can also be restricted to provide an additional security layer. The owners of designs often require access via 3D virtual walk-around during the design and building phases, but wish to restrict access to the entire model after the project is completed to avoid copying of their design solutions.

CADMATIC approach to IPR

CADMATIC's distribution design solution is based on a smart database-centric client server system that efficiently stores 3D ship models, documents and component libraries in master and replica databases hosted by a database server system.

In globally distributed projects, data is updated at set intervals between remote design sites via an online network such as a secured internet connection, or by simply exchanging the file in an email attachment.

Filtered replication is provided to protect intellectual property rights. If a company prefers a subcontractor to have access only to their own parts of the project, it can be implemented without additional licensing or tools.

With filtered replication, subcontractors have access only to designated areas of the project, and cannot publish viewer models of the whole project. When drawings are created, it is possible to use drawing mask boxes to restrict visibility in drawing views. Objects that are completely inside a mask box are not shown in drawing views. Objects that are partially inside a mask box are clipped in the visualisation and the part of the object inside the box is not visible. Expiration dates for viewer files provide the possibility to control access to the design solutions after completion, which ensures that outdated files are not used.

Conclusion

The increased sharing of data during and after design projects, as well as the growing amount of integrations between software products have enhanced the need for IPR protection. Providing efficient mechanisms to protect IPR within distributed environments and ensuring data filtering according to access rights are non-negotiable.

This article is a shortened version of the paper: 'Protecting Intellectual Property Rights in Distributed CAD Environments' by Ludmila Seppälä (MSc, MBA) presented at the 18th International Conference on Computer Applications in Shipbuilding (ICCAS), Singapore, 2017.

About the author

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Ms Seppälä has over 15 years' experience in the marine and CAD software fields. Besides technical expertise in Finnish CAD, she has traveled to over 60 countries to meet with CAD users. Her previous experience includes marine engineering, basic, detailed and production outfitting design, project management, international business development, and marketing. Currently, she holds the position of Product Marketing and Information Manager at CADMATIC Oy.

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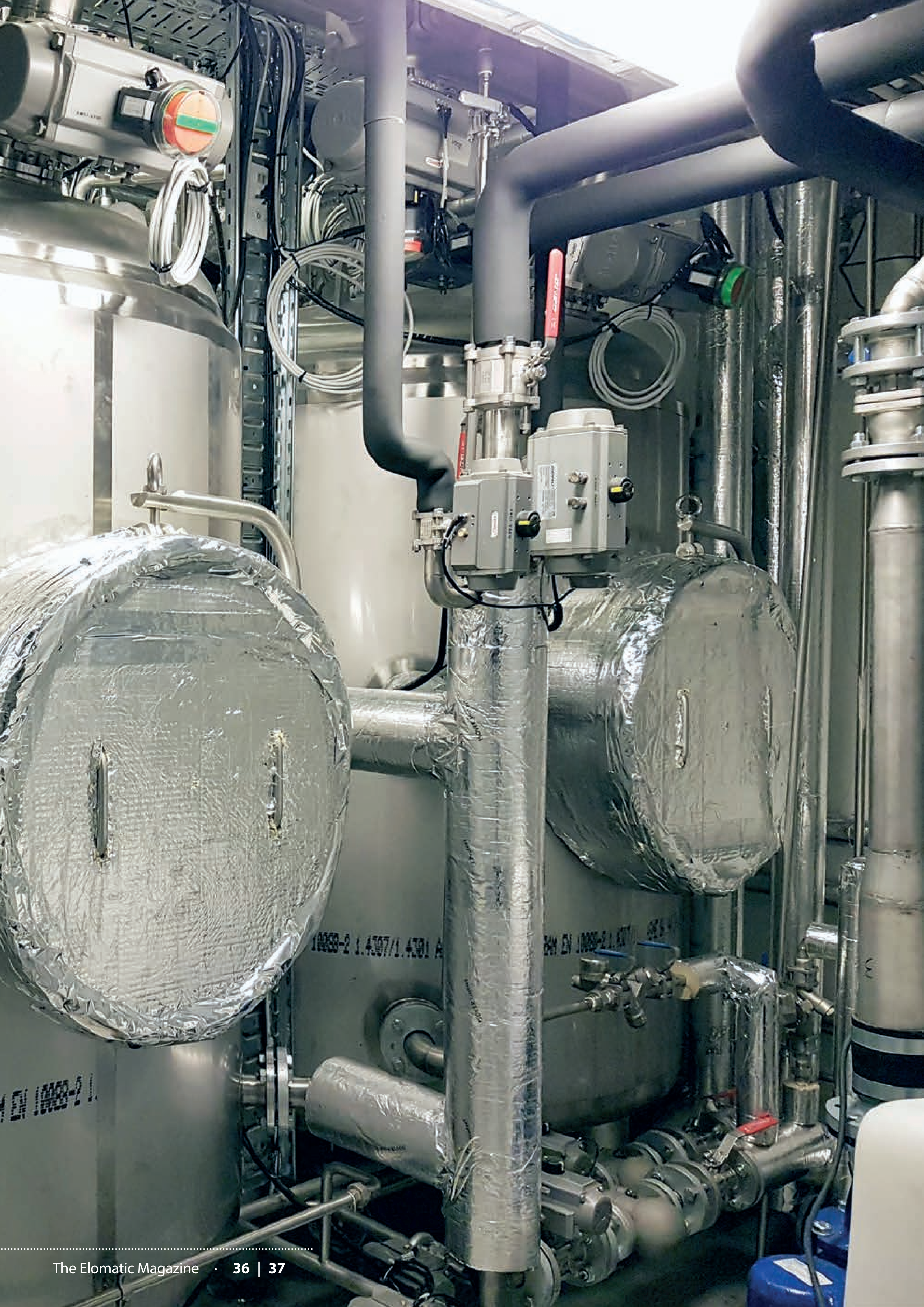

Active Waste Decontamination

A batchwise approach

Text: Manne Savioja

In production processes where biological active materials are handled, special care must be taken to protect workers and the environment from contamination and cross contamination. In this respect, the safe and effective decontamination of active waste is crucial. Test runs at FinVector Oy with a robust decontamination process based on a batchwise concept has achieved excellent results.

Production that involves biological active materials is distinct from traditional pharmaceutical production. The main difference lies in the inherent variability of biological processes as opposed to chemical and physical processes that can consistently produce the same results. In cell or viral cultivation, for example, the by-products produced in the process can vary significantly. In such cases, risk management of the entire production process becomes particularly important.

Biological active materials are normally decontaminated in so-called kill tanks or active waste decontamination (AWD) units.

Adhering to standards in AWD unit design

The design of AWD units is governed by EU Good Manufacturing Practices (GMP) and several standards. Any AWD system should be designed to meet the most stringent demands for biosafety and decontamination.

The EU GMP (Annex 2 Manufacture of Biological active substances and Medicinal Products for Human Use) states that "Drainage systems must be designed so that effluents can be effectively neutralised or decontaminated to minimise the risk of cross-contamination. Local regulation must be complied with to minimise the risk of contamination of the external environment according to the risk associated with the biohazardous nature of waste materials."

The following EU standards regulate the design of AWD equipment:

- SFS EN 13311-5 (Biotechnology. Performance criteria for Equipment. Part 5: Kill tanks): The standard specifies performance criteria for kill tanks used in biotechnological processes with respect to the potential hazards to the worker and the environment from microorganisms in use.
- SFS EN 12297 (Biotechnology. Equipment. Guidance on testing procedures for sterilisability): This standard gives guidance on general testing procedures to assess the sterilisability for microorganisms or equipment (components and units of equipment) use in biotechnological processes.
- SFS EN 12461 (Biotechnology. Large scale process and production. Guidance for the handling, inactivating and testing of waste): This standard supports industrial activities in the area of biotechnology covering operations both non-genetically modified and genetically modified microorganisms and with both not-pathogenic and pathogenic microorganisms.

Batchwise concept for automatic waste decontamination

To achieve a reliable and robust decontamination process, Elomatic selected a batchwise concept for the development of its AWD system (See Figure 1 overleaf). It consists of a batchwise-operated agitated tank where liquids or slurries that need to be inactivated are collected.

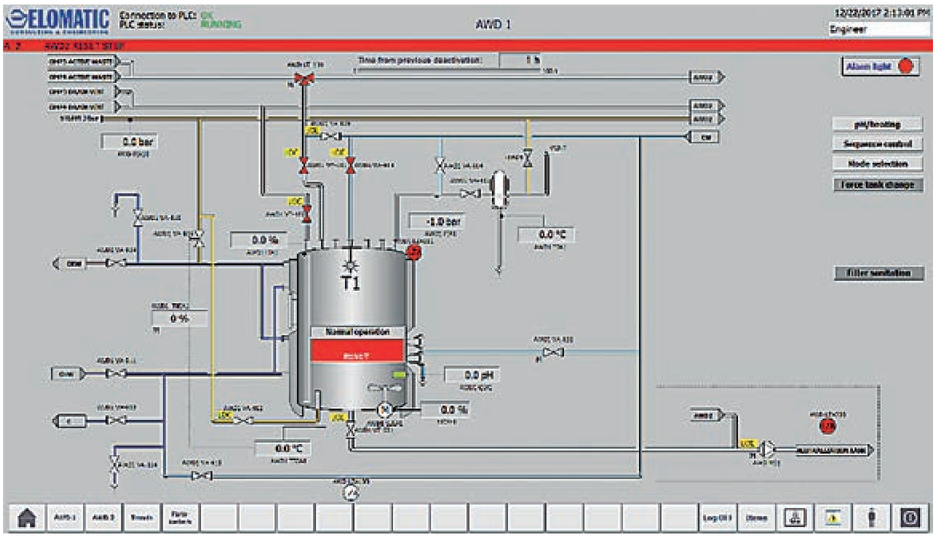

Figure 1. Liquids or slurries that need to be inactivated are collected in the AWD's batchwise-operated agitated tank.

Figure 2. Bio-indicators in the test ampoules after the performance test.

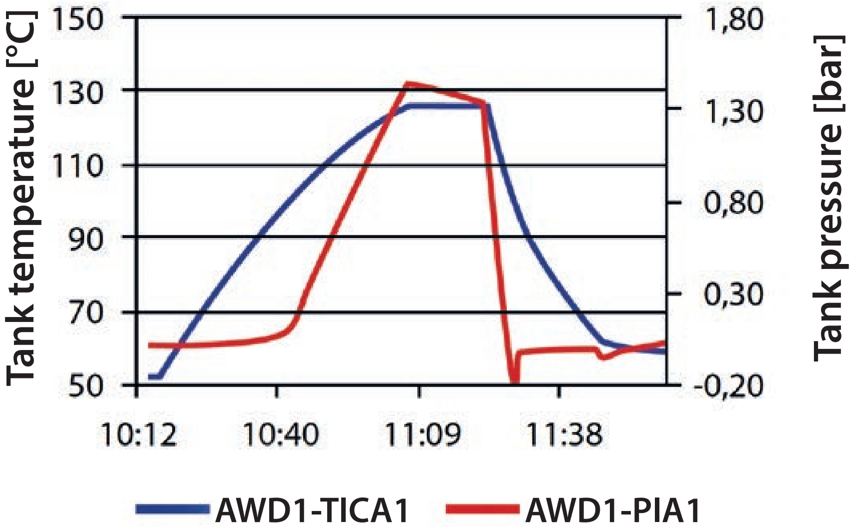

Figure 3. Temperature and pressure trends from test runs conducted at FinVector Oy.

Batchwise AWD units offer reliable decontamination for biological active production.

Due to the typical residence time distribution, the exact time of application of physical and chemical parameters can be guaranteed. All parts are subjected to the application of physical and/or chemical parameters for similar treatment times in the agitated tank.

For the system to work continuously, two kill tanks are combined so that one kill tank always runs in inactivation mode, and the other in collecting mode. This has the added advantage of allowing the discharging of the tank load after an explicit decision about the correct inactivation has been made.

Since some biological waste liquids might form solids during heating, the discharge of deactivated waste is done with a diaphragm pump. The tanks are equipped with a spray ball for rinsing after each decontamination cycle, which ensures that the tank is always clean when collection starts.

The tank vent filter is sterilised separately when filter maintenance is needed (manual operation). The AWD unit is fully automatic, which means that the operation of the plant does not require the presence of operating personnel or other actions under normal running conditions.

Implementation at FinVector Oy

In 2017–2018, Elomatic delivered an AWD unit on a turnkey basis to FinVector Oy in Kuopio, Finland.

FinVector is a world leader in the research and development of viral-based gene therapy products. The company is authorised under the EMA for the production of gene therapy products for clinical and commercial supply.

In test runs conducted at FinVector, G. stearothermophilus ampoules were placed in the tank headspace for a minimum (half) batch and a maximum batch. After the test, the EzTest ampoules were placed in an incubator at 55–60°C for 24 hours. The bio-indicators in the test ampoules after the performance test indicated that the test runs were successful.

Figure 2 illustrates the temperature and pressure trends from the test runs. The tank temperature remained above 121°C for the specified time (20 min in this case), which indicates that the deactivation was successful.

Conclusion

Batchwise AWD units offer reliable decontamination for biological active production. The main advantages of such systems are that they are robust and do not depend on the properties or purity of the processed liquids. The unit is also scalable depending on the customer´s capacity needs.

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Manne Savioja joined Elomatic in 1989. He is a skilled and versatile project manager specialised in pharmaceutical projects. He has particular expertise in project managing, coordinating and leading demanding turnkey projects both in Finland and abroad.

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ELOMATIC
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Scientia vires est

At Elomatic we believe that our human capital is our most precious asset. With knowledge comes the power to shape the future.

We continuously develop our employees' know-how and strive to be leaders in our respective technical fields. We focus on packaging and delivering this know-how to ensure that our customers stay ahead of their competition.

The Top Engineer magazine offers our experts the opportunity to share their expertise and knowledge and to engage other technical experts with their writing. It is a publication by engineers, for engineers, and other technically-minded readers.

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Christmas gift funds donated to HOPE

This Christmas, Elomatic has decided to donate its funds normally earmarked for customer gifts to HOPE.

Hope was founded in 2009 to provide children with more equal opportunities in everyday life. It supports financially strained families and those in crisis with clothing and material donations. It also provides support for the affected children's hobbies and free-time experiences.

According to HOPE, there is no threshold to how much one can help, and no threshold to asking for help. We can all work together for the common good. Elomatic is proud to be contributing to this worthy cause.