top engineer

The Elomatic Magazine 1 · 2019

Visual communication can ease the burden on message receivers.
– Jani Moisala

Consulting • Engineering • Design • R & D • Innovation • Technical Solutions

Playing as a team

I had already penned the first draft of this editorial when an event of historical significance occurred: Finland won the World Ice Hockey Championship for the third time in its history on 26 May 2019! The previous victories were in 1995 and 2011. The significance of this event meant that it was back to the drawing board for my editorial.

So what makes this such a noteworthy event? Before the tournament, many local commentators had written off the team as no-hopers for its lack of big-name players. This made the victory so much more remarkable. Eighteen of the players were first-time participants at the World Championship and yet, by infusing the players with confidence and getting them to work for the team and each other, they became world champions.

Getting players from different clubs to come together for a tournament and pull in the same direction is no simple task. The coaches and management have a pivotal role to play in this regard. If they manage to get the players to play for each other, care for each other, and work as a team, they have given them the best chance of victory.

Teamwork is a key ingredient for success, but you obviously need gifted and skilled players too, even if they are not household names yet. The players, of course, did not fall from the sky. They are the products of good junior sporting systems that identify talent and nurture it to ready them for the big stage.

In the engineering and consulting business, we are equally dependent on our schools and universities to produce highly educated young designers and engineers. Once they make it into the professional world, it is the job of management to get them to pull together for a common cause. I think we do this particularly well at Elomatic.

It is important to give young engineers opportunities to develop themselves and gain confidence, while also providing guidance at the right moments. A great deal of the work done at Elomatic is completed in the form of projects where success is to a great extend dependent on how the project team functions and communicates. Collaboration and teamwork are key success factors in business too.

Teamwork is a theme in several articles in this edition of the Top Engineer. We see, for example, how important teamwork is in large distributed cruise ship design projects. We also learn how project participants can work as a team to create design requirements during a project.

I wish you happy reading and welcome your feedback.

Patrik Rautaheimo
Editor-in-Chief
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Contents

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Cover: Jani Moisala works as a Head of Elomatic Visualisation Services at the Elomatic Jyväskylä office. Cover photo © 2019 Niko Ihalainen / Elomatic.

Design requirements

A fresh set of values

Text: Rami Raute and Olli Peura

The consideration of product requirements as the starting point for design is an essential part of industrial product development. Project requirements or the set of requirements used in design guide the solutions developed. This is how requirements are usually described in engineering text books.

It is rarely considered that a design team's own experiences, knowledge, attitudes, political orientation, etc. have a strong influence on how the requirements are handled and approached during the design process. The interpretation of values is, nevertheless a key source of design requirements.

Values such as sustainability, inclusivity, accessibility and cultural acceptance are increasingly finding their place in an engineering world where product and other technical project requirements have traditionally been paramount in guiding design. A business-as-usual approach to engineering and design is no longer sufficient to meet future challenges driven, for example, by resource scarcity and climate change. Instead, a fresh and inclusive set of values should guide projects and product development.

The recent development, manufacturing and delivering of a modular school to Kathmandu in Nepal is a good example of how such a fresh set of values from different project participants can guide design in a new and sustainable way. It also indicates how design requirements do not all necessarily have to be set in stone at the outset of a project as is traditionally done, but that they can rather evolve and become more precise during a development project.

Combiworks Oy, international aid operator Finn Church Aid, and the Disability Partnership Finland teamed up with Elomatic to develop and manufacture a modular school to be used in disaster torn and undeveloped areas of the world. The SMILE (Sustainable Modular Inclusive Learning Environment) school is the first project where

companies and non-profit organisations have cooperated with financing from Finnpartnership. The purpose of the funding is to support the formation and continuation of such multidisciplinary consortia and promoting the activity as a business.

Unique environment leads to divergent design requirements

The different backgrounds and strongly divergent goals of the project partners created a unique design environment where design requirements were generated differently to traditional industrial design: In addition to traditional productivity, requirements regarding building use and sustainability were also taken into consideration.

Generally, the customer is responsible for product requirements documented in requirement specifications. On the SMILE project, the main requirements were defined only at a very general level. The solutions could be selected based on more precise requirements produced by the partner network during the design process.

The benefits of this method are openness and the ability of the partnership network to genuinely affect the solutions selected. Instead of individual decisions and thoughts that guide the creation of the product, the requirements and core contents are formed by a community brought together for the purpose. Despite possibly sounding like an unnecessarily complicated process, the goal is to produce a product with solutions that are simple, once the requirements have been clarified.

SMILE - Sustainable Modular Inclusive Learning Environment

The main design requirements on the project are contained in the product name SMILE. All the SMILE aspects were used to evaluate design solutions during the project.

The school building needed to be inclusive, i.e. accommodate all persons in teaching including persons with disabilities. Accessibility is often only associated with a wheelchair ramp. It is, however, a much broader concept when persons with disabilities are taken into consideration with the goal of ensuring that the space is easy and pleasant to use.

Modularity allowed the main dimensions and use to be changed easily with the same components. Sustainability was taken into account from environmental, societal and structural perspectives.

Transportation and erection in catastrophe areas

The starting point of the project was to create a school building that could be transported to and erected in catastrophe or otherwise undeveloped areas. The school would be manufactured in a factory and packed in a shipping container so that all the required components could be included in one delivery. Rebuilding after catastrophes is often hampered by bottlenecks in the delivery of materials. Delivering all the materials in one shipment would, therefore, ease the entire building project.

Erection needed to be possible without the use of special tools or skills as their availability could not be guaranteed. The building site may be in a remote and difficult-to-reach site and all components may even need to be carried by hand. Such conditions are found in the countryside of Nepal where the materials need to be carried along narrow paths up to building sites located on steep hills.

Natural catastrophes can occur anywhere on earth. For this reason the building had to be designed to withstand a wide range of different load conditions. Hurricanes in the Caribbean, earthquakes in Nepal and floods in Mozambique create their own unique set of design requirements. A sustainably designed school should, in addition to supporting the society to get back to its feet, also be able to provide support in the event of future natural disasters. After natural disasters or conflicts, going to school is the best child welfare possible: It supports the children's recovery and return to normal life.

During the reconstruction phase, it is particularly important that essential buildings are erected quickly. Typically, building use is only temporary or changes as reconstruction progresses. The ability to move the building to a new erection site and to change its dimensions increases its use possibilities and the entire product life cycle. The building's life cycle can be extended by enabling the replacement of sur-

Trial erection of the school at a Combiworks network factory.

The first smile school was erected in Nepal in March 2019.

Mr Viljami Kettunen from Combiworks inspects the first SMILE school in Kathmandu.

A business-as-usual approach to engineering and design is no longer sufficient to meet future challenges

face materials at the end of their lifespan with local materials.

Sustainability does not refer only to the sustainability and durability of the building against loads. Sustainability should also be considered from the perspective of societal and natural resource use. Delivering a school close to people's homes and living areas means that cultural acceptability affects the sustainability of the entire solution. Inclusiveness is an extremely important aspect in societal sustainability. The lack of appropriate sanitary spaces in developing countries is the single largest individual factor that hampers school attendance of girls and persons with disabilities. Accessible toilets are still rare in developing countries and their incorporation in the school building have added new and enduring value to the whole building.

First SMILE school built in Kathmandu

The first SMILE school was manufactured and trial erected at a Combiworks production network factory. After trial erection, the building was disassembled and delivered via shipping container to Kathmandu, Nepal. A school falling under the Underprivileged Children's Educational Programs, with whom Finn Church Aid has worked before, was chosen as the first erection site. The school was erected in March 2019 in about 2 weeks by seven workmen without the use of special tools as planned.

The building foundation was constructed with screw piles, which are well suited to the local soil. This sped up the building process as there was no need to wait for concrete to dry. Depending on the soil, the foundation can also be concrete or the building can be anchored to rocky ground. The unusual foundations, frame structure and the ability to disassemble the building was met with much interest by locals.

An accessibility workshop was also arranged with local disabled people's organisations during the project. Workshop participants were very impressed with the accessibility solutions and WC space of the school.

In addition to accessibility, solutions that support inclusivity and space use were also included in the school. The contrast differences of interior design elements, for example, assist persons with poor eyesight to operate and move in the space, while the walls' metal sandwich panels act as whiteboards and magnetic bases for affixing paper.

Sustainable development creates opportunities

Projects like SMILE give companies the opportunity to renew in a changing world and to build paths to overcome future challenges. Sustainable development goals bind companies, but also provide new business opportunities. Environmental catastrophes accelerated by climate change as well as problems associated with food systems and population growth create an increased demand for projects like the SMILE school where the requirements are built on future-oriented values. These values should be included as core drivers of product development and project implementation.

Naturally, changing values will change companies and at the same time their thinking, perhaps out of necessity, in a more sustainable direction. Supporters of traditional industrial values may oppose such thinking, but ultimately it will offer companies the possibility to regenerate their values and transform their operations for positive and sustainable outcomes.

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Project trouble-shooting

Checklist for successful project management

Text: Susanna Vähäsarja

Projects have become increasingly important and work is commonly organised in the form of projects. The success of projects is thus important for any company. But what does it take to manage projects successfully and how can we avoid errors that commonly lead to project failure?

According to an old saying "a wise man learns from his mistakes, but an even wiser man learns from someone else's mistakes". For project managers, the source of wisdom lies in their own experiences or experiences gained from projects both inside and outside their organisations.

PMI, the Project Management Institute, conducts an annual global survey of project management and analyses the key reasons for project success and failure. The top five reasons for failed projects according to the latest survey (PMI's Pulse of the Profession, 10th Global Project Management survey 2018) are:

1. Change in organisation's priorities
2. Change in project objectives
3. Inaccurate requirements gathering
4. Inadequate vision or goal for the project
5. Inadequate/poor communication

It is easy to list the reasons for project failure, but indicating what actions and considerations are really needed to avoid failure is not as straightforward. This article provides one perspective on the matter and features a simple check-list for project managers and people working on projects to avoid at least the most obvious pitfalls.

Check your instruments!

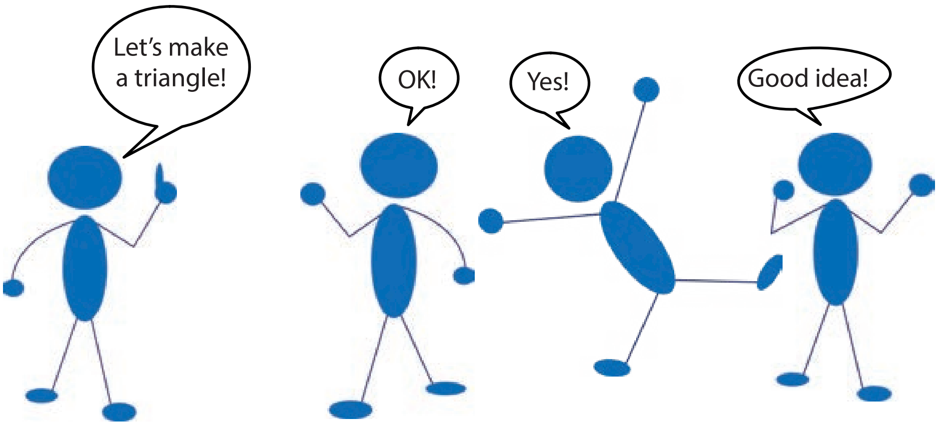
Traditionally, project performance is measured with the following metrics: cost (actual cost vs. budgeted), time schedule (actual vs. originally planned) and project outcome and/or quality.

These are useful metrics, but do they alone provide a trustworthy indication of project performance? According to the PMI survey, nearly 70% of projects worldwide in 2017 successfully met their original goals and business intent. However, only 57% finished within their initial budgets and 52% within their scheduled timetables. This means

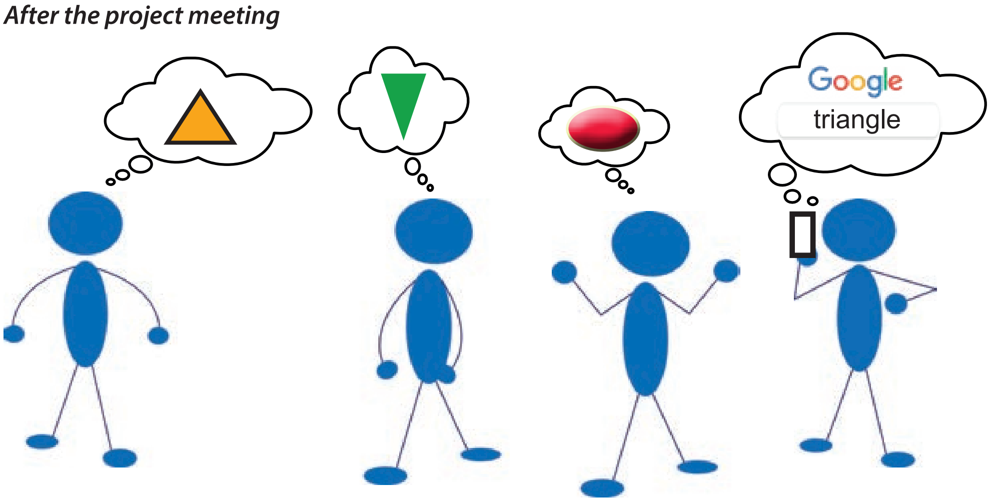
Project management checklist

1. Check your instruments!
2. Manage the project scope
3. Requirement specifications
4. Communication
5. Risk management
6. Lack of support for the project
7. Check the project manager's pulse!

At a project meeting



After the project meeting



An example of ambiguity. All the project members have a different idea of what they are doing.

that if we use only the traditional narrow textbook definition of project success, half of all projects fail.

The problem with using budgets and time schedules to measure project performance is that they are usually set before the project begins when there still is very little information about how the project will actually proceed and what the actual scope of the project will be.

According to the PMI survey, 37% of failed projects experienced changes in project objectives. When project objectives change, the budget and time schedule goals set for the project in the beginning might no longer be realistic or achievable. It is also noteworthy that 28% of failed projects had inaccurate cost estimates and 25% had inaccurate task time estimates.

If the cost and time estimates are inaccurate to begin with, the project budget and time schedule fail to be meaningful metrics for project success evaluation. The reasons for inaccurate estimations need to be analysed and recorded after the project. This allows better estimates to be made for future projects and calibrates the project performance metrics.

In order to properly evaluate whether a project is successful or not, other perspectives besides traditional performance measures should also be considered.

Manage the project scope

The scope of the project is agreed mutually with the client or person that commissioned the project. The project plan and time scheduling are based on the scope. According to the PMI survey, 52% of projects experienced scope creep or uncontrolled changes. Changes during the project are thus more the rule, rather than the exception.

Unmanaged scope changes lead to cost overruns, time schedule challenges and possibly also resource challenges. If managed properly, scope changes provide the opportunity to increase the value of projects.

Requirement specifications

It needs to be considered whether project requirements are specified accurately enough and whether they are

In almost 40% of failed projects the reason can be found in changes to the organisation's priorities.

understood the same way by all involved? According to the PMI survey, 35% of failed projects suffered from inaccurate requirements gathering.

This raises the question what can be considered accurate and adequate requirements gathering? There are bad requirement specifications and good ones, but there are never perfect specifications. The reason for this is that communication (written or spoken) is always ambiguous and people understand and interpret the message they receive based on their own experiences. Acknowledging this is important.

Ambiguity also explains many problems related to scope management: all project parties read and understand the scope according to their personal background and agenda.

Communication

According to Wiio's law: "Communication usually fails, except by accident". This is very true for project work. When talking about communication problems, one often hears that there is not enough communication. According to the PMI survey, 29% of failed projects experienced a lack of communication or poor communication.

Communication and requirement specification go hand in hand. If the requirement specifications are not defined and communicated well enough, nobody will know what to do and how to do it. Additionally, nobody knows that nobody knows, unless this is communicated.

Communication and conversation are also essential in tackling the ambiguity problem since they are the key to finding a common understanding.

Risk management

The PMI survey indicates that the risks and opportunities were not defined in 29% of failed projects. Managing risks starts with identifying and listing the risks and then planning adequate measures for risk handling. This alone is not sufficient, however, the risk management plan needs to be monitored and updated during the project.

Lack of support for the project

According to the PMI survey, 26% of failed projects experienced inadequate project sponsor support and organisations with actively engaged executive sponsors report 40% more successful projects than those with lower percentages. Project sponsors are thus crucial for project success and it is the organisation's responsibility to establish and maintain project sponsors.

A lack of support can mean, for example, that the project is inadequately resourced and that the project manager is left on his/her own to manage the situation. The only thing project managers can do to prevent this is to engage project sponsors and/or supervisors and communicate with them about the needs of the project.

In an ideal world, the importance of the project regarding the organisation's strategic and financial goals is evaluated carefully before starting the project and only projects that support these goals are undertaken. In the fast changing world, however, market situations change constantly and strategies and goals with them. This leads to the primary reason for project failures: 39% of failed projects do so because of changes to the organisation's priorities.

Check the project manager's pulse!

A representative of a big equipment supplier once said, that "the site manager's pulse is a good indication of project quality". This applies also to project manager's pulse. If the pulse rate is alarming, something needs to be done fast.

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Visual Communication

The power of visual communication in the age of information overload

Text: Jani Moisala

The amount of digital information generated on a daily basis is mindboggling. Information management and communication systems are currently coping, but what about human minds? Many are feeling the pressure of information overload; the ever-increasing volumes of data and the speed at which humans are bombarded with it can be overwhelming. Visual communication has the potential to ease the burden on communication receivers.

The information age has brought a sense that humans are surrendering to technology and hoping that artificial intelligence powered by quantum computing will fix human limitations. This means that humans are becoming obsolete, not just in information creation, processing and communication, but in decision-making too.

In the future, the perfect balance may be found by fusing the human brain, digital information and artificial intelligence with the use of technologies such as Neuralink. That will be a moment of transcendence and the path to the biggest jump in human evolution into the realms of the hive mind and singularity.

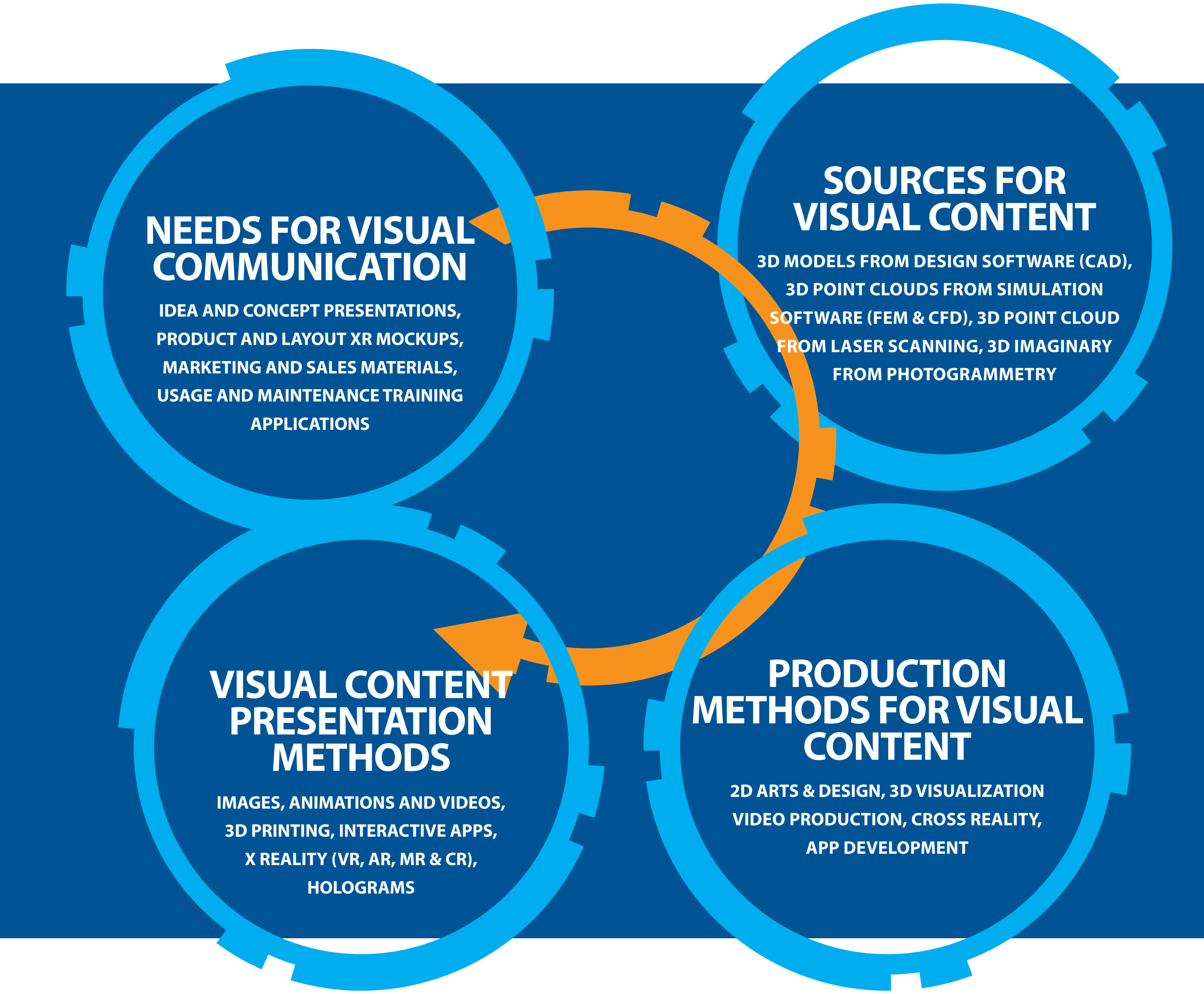
To understand the current and limited, but human-steered path, one needs to consider the root cause and need for information. If one simplifies the matter, the need to grow, learn and communicate is the driving force behind all related technological advances. The need for information has created an overload, which has led to the situation where humans are struggling to cope even with today's demands.

The future is set to be even more demanding. Unfortunately, there is no easy fix for limited human capacity. The best one can do is stop contributing to the global information overload, and relieve it by making information content and communication methods more suitable for humans. In the age of information overload, visual communication has powerful possibilities.

Taking on the information overload with visual communication

A picture is worth a thousand words is a commonly known phrase. A thousand words corresponds to around two pages of text. If the saying is true, a well-crafted three-minute video should be able to tell the story of a 300-page book with 600 words squeezed onto each page. Every second of the video would correspond to the informational value of one picture and a thousand words. The average adult can read about 300 words per minute, which means that the book would take 10 hours of continuous and uninterrupted reading to complete.

A professional three-minute 3D-animation with infographics takes around



300 hours to produce. Compared to the time-consuming book, this video content will start easing the collective information overload from the first view. After 30 views, it will start minimising the overload by 10 hours per view.

Even if one does not agree with the 3 minutes versus 300 pages theory, and considers it to be only a tenth thereof (30 pages), it would still correspond to one hour of reading. This means that information overload levels would start falling after just 300 views.

Most information is still produced and digested in the form of text or speech. These are easy and convenient ways compared to more informative and tightly packed methods like images and videos. Off course, basic daily communication should be handled in the most convenient way, but one should think twice if the information is meant for larger group.

Alternative product communication media

Many readers of this magazine are designers, manufacturers, and marketers of complex mechanical products that create value for end customers. The products are at the core of business communication to satisfy informational needs with all parties throughout the products' life cycles.

To make product information suitable and easily digestible for humans, the focus should be on visual communication; images and videos are a good starting point. Interactive content provides an efficient solution and a better experience as it can adapt to different situations and informational needs.

Many technologies and platforms support the creation and publishing of visual and interactive content. The aim of this article is not to delve into these elements, but rather to focus on visual communication from the end user's viewpoint and the alternative means of presenting visual product information.

When considering product communication media, printed content can-

Professionally crafted visual communication decreases the load on the message receiver.

not be dismissed. It still has its place and is a good platform to present images. Most visual content is presented and digested through displays, which in many cases allows for interactive content. 3D printing is fusing the digital and physical worlds, opening the door to new to new opportunities, while also providing an excellent product communication solution through scale models. At the top of the visual communication chain are different X Reality options all the way up to stereo imaging with actual scale and depth perception and the option to interact with the product.

Accurate and effective product visualisation

The starting point for product visualisation is always the same, regardless what technologies, platforms and media are used to present the content. The process should also be as efficient as possible. It makes sense, therefore, to collect existing information from high quality sources to kick-start visualisation.

The most important and well-known source for product visualisation is design software that contains detailed information about the product structure. Analysis and simulation data is another good and highly detailed source; the data can act as the base of a visualisation or as an add-on due to the fact that the data itself can be visualised. The actual physical product and its operational environment is also an excellent information source when it is correctly captured with the right equipment and expertise via laser scanning and photogrammetry. 3D models can also be created by using technical drawings and product images as a base.

All of these sources can be used individually or in combinations to create an impressive digital 3D environment, which reflects the product in the form of a highly accurate digital twin. This environment can be easily manipulated to set up and render high quality product images. It also creates a platform to add animations, visual and sound effects, infographics and functionality to the product.

The different product communication possibilities allow the creation of any kind of visual story in the form of images, animations and interactive content. Products can even be presented in the application environment with the actual scale, functionality and monitoring data. These visual and easily digested product communication methods can be used for any needs and target groups, throughout the product's lifecycle; from designing and manufacturing, to marketing and sales, all the way to usage and maintenance training.

Summary

In the age of information overload, the role of visual communication is coming strongly to the fore. Technological advances allow a myriad of possibilities to communicate information throughout a product life cycle. Professionally crafted visual communication content not only improves communication, but also decreases the load on the message receiver.

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Additive Manufacturing

Improving products layer by layer

Text: Petri Seppänen and Atte Rättyä

The term additive manufacturing (AM), also known as 3D printing, has gained a lot of popularity in recent years. AM has increased the possibility to produce complex shapes without being restricted by traditional manufacturing constraints. As a result, the functional requirements of parts have become the primary focus of design efforts.

Additive manufacturing (AM) is a term used to describe a set of manufacturing processes that progressively adds layers of material to manufactured products. AM makes it possible to design complex structures and gives the designer full control over the internal structure of the component. Designers can design voids, lattices, and other hard-to-manufacture structural components that can help reduce material use and increase functionality. Other benefits of additive manufacturing include:

- Subassemblies that used to require multiple parts can be combined into a single component.
- Heat exchangers can be designed to be small with great efficiency.
- Creates cost savings and flexibility for production. There is no need for large batches.
- Minimises amount of wasted material.
- Possible to print moving assemblies.
- Ideal method for customisation. For example, manufacturer can produce personalised earbuds that are

Industry	Old Method	Time saving with AM
Industrial design	Clay models	96%
Education	Outsourced machining	87%
Aerospace	2D laser cutting	75%
Automotive	Aluminium tooling	67%
Aerospace	Injection moulding and CNC tooling	43%

Table 1. Time saved in prototyping with in-house AM versus other methods.

Additive manufacturing processes

FDM Fused Deposition modelling/Material extrusion. Material is drawn via a nozzle, where it is heated. It is deposited layer by layer. Print material: Plastic & composites

SLA Stereolithography apparatus. Liquid (photopolymer) is selectively cured by light-activated polymerization. The structure does not need a structural support. Print material: Plastic (photopolymer resin)

SLM Selective Laser Melting. Thermal energy selectively fuses regions of a power bed. Print material: Metal & Plastic

SLS Selective Laser Sintering (SLS). Thermal energy selectively fuses regions of a power bed. Print material: Metal & Plastic

SLA and SLM are instants of the same concept but differ in technical details. With SLM the material is fully melted rather than sintered allowing different properties. SLM is used for rapid prototyping and low-volume production.

fitted to the shape of individual users' ears.

- Complexity of structures does not increase manufacturing cost as with traditional/subtracting manufacturing.
- AM can reduce or completely eliminate tooling cost.

When discussing future trends, AM is often mentioned since it is something of a novelty. In the wildest dreams, AM will change the last two centuries of approaches to design and manufacturing with fundamental geopolitical, economic, social, demographic and environmental implications.

Even with a "keep your head in the clouds and your feet on the ground" mentality, AM has a lot of potential. There have been claims that AM can cut new product cost by up to 70% and the time to market by 90%. AM holds great advantages for companies. Table 1 provides a comparison between different manufacturing methods in different industries.

The Aston Martin racing team, for example, succeeded in developing the LMP1 racing car for the Lemans in 2011 in just six months with the use of AM in the conceptual mock-up stage. This would not have been possible with traditional manufacturing methods.

A brief history

AM is not a new invention, it is almost 40 years old. In 1981, Hideo Kodama from Nagoya Municipal Industrial Research Institute published a rapid-prototyping system (photopolymers). The model was built up in layers, each of which corresponded to a cross-sectional slice of the model. In 1984, Charles Hull invented stereolithography (SLA). Stereolithography lets designers create 3D models using digital data, which can then be used to print an actual part. The world's first selective laser sintering (SLS) machine was produced by startup DTM in 1992. This machine shoots a laser to power and does not use a liquid to build up the model, In the same year, the patent for fused deposition modelling (FDM) was issued to Stratasys. An FDM machine extrudes the print material, which is usually plastic. This is the most commonly used 3D printing method. In 1995, the Fraunhofer Institute developed selective laser melting (SLM).

Large-scale production with the use of AM is impeded by low productivity and the size of printers. Despite the limitations, there is potential for industrial scale production in the long run.

Smart products are born when different manufacturing methods are skilfully combined.

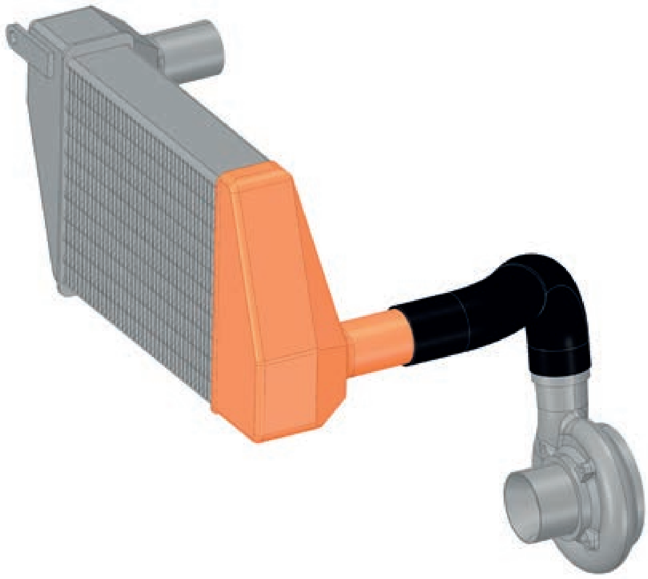

Figure 1. Original turbocharger and intercooler setup. The section to be optimised is highlighted in orange.

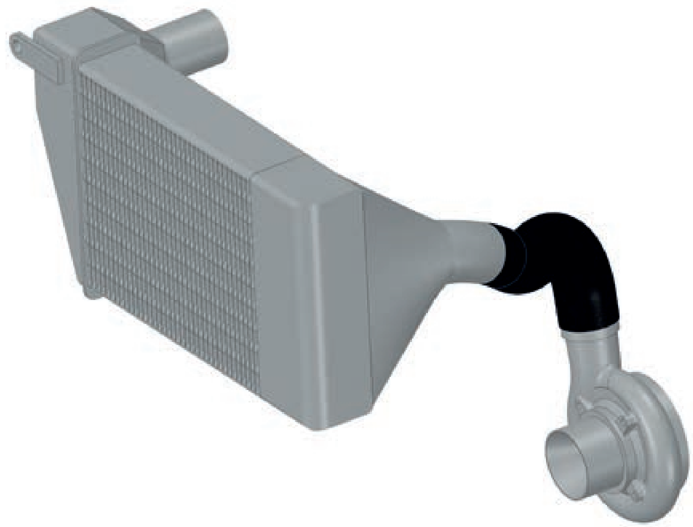

Figure 2. Optimised intercooler air supply.

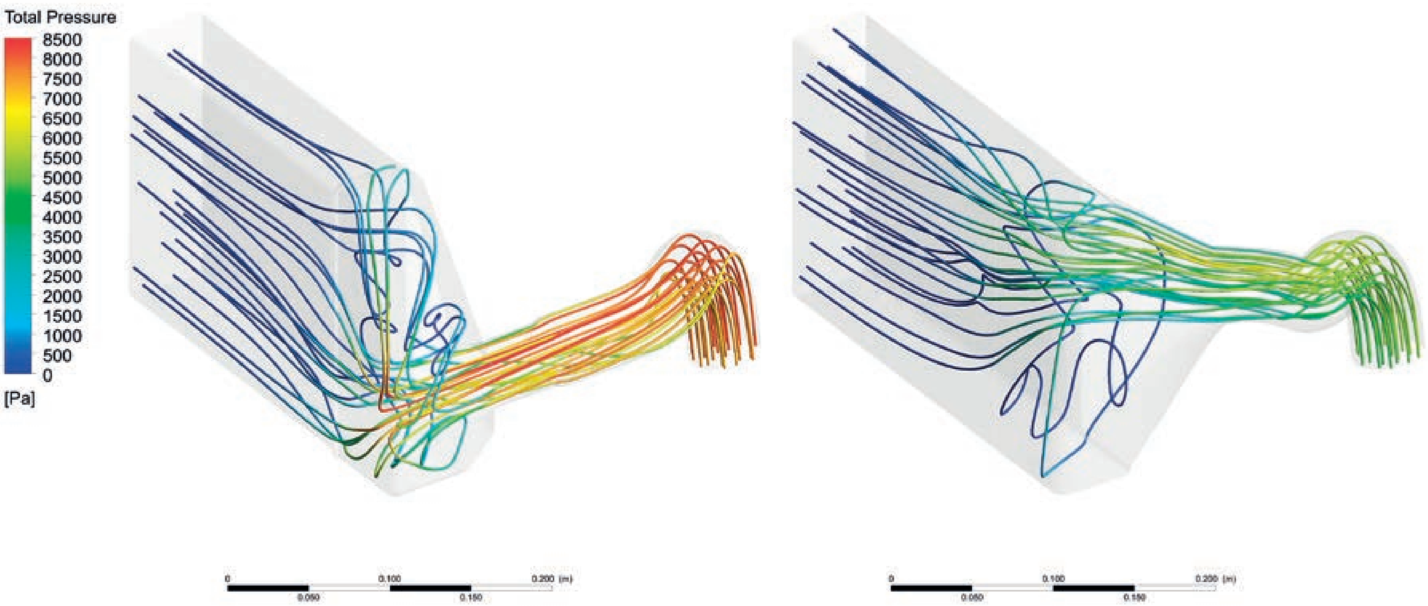

Figure 3. Pressure streamlines in the original (left) and optimised (right) geometry.

Redesigning intercooler air supply

In order to demonstrate the benefits of combining shape optimisation of structures and fluid channels, the authors of this article decided to redesign an intercooler air supply. The intercooler was designed for a high-performance motorsport application. The original intercooler is shown in Figure 1.

First, the original duct between the turbocharger and intercooler was simulated. The pressure drop in the duct was rather high and the velocity distribution at the intercooler inlet was not ideal. Thus, pressure drop reduction and better flow uniformity at the intercooler inlet were selected as the design objectives.

Before optimising the geometry, a few modifications to the structure were made. The enlargement was modified to be more symmetric. This was done to offer a better starting point for the optimisation. The rubber hose was also modified to fit the enlargement.

ANSYS Fluent was used in simulating the initial state of the setup and generating the optimised structure. In ANSYS Fluent, an adjoint solver was used to calculate sensitivity data for the defined design objectives. The geometry was then modified with design tools to achieve an improvement in terms of the defined design objectives. The flow solution was thereafter calculated for the new geometry. The procedure was repeated until the desired performance level was achieved.

After the final geometry modification, the pressure drop between the turbocharger and intercooler was reduced by 47 %. The flow uniformity at the intercooler inlet was also improved. The optimised intercooler air supply is presented in Figure 2. A comparison between the original and optimised structure is shown in Figure 3.

After improving the design, it is essential to consider what manufacturing method is feasible for the current case. The improved intercooler air intake could be manufactured by TIG-welding, casting or 3D printing. In most cases, the TIG-welded structure would be preferred. So, what is the role of 3D printing? In this case, the fluid volume could be printed, making it is easy to mould aluminium sheets into the optimal the shape.

If even better performance is desired, the whole intercooler could be redesigned. A 3D-printed intercooler could deliver a competitive edge in motorsport applications. The performance gains due to weight saving and improved air cooling will be significant, if the geometry is designed carefully. With more efficient cooling, it is possible to reduce the size of cooling air intake holes, which will improve vehicle aerodynamics. Efficient cooling also contributes to high intake air density, which is essential in high performance engines. Taking into account the structural strength of the intercooler in the optimisation phase, it is also possible to make tougher and more durable intercoolers.

Current state of AM

Additive manufacturing will not replace traditional manufacturing methods any time soon. It will, however, complement and coexist with traditional methods. Parts printed in metal often require machining before installation. When different manufacturing methods are skilfully combined, smart products that excel in competition are born.

It is not wise to print products only because it is possible. One should consider how printing can support manufacturing and what is needed to make the product printable. Printing will, however, change the way products are designed. Some companies have already introduced 3D printed parts in their products. Based on results, these companies will not be returning to traditional manufacturing methods. In that sense, the manufacturing revolution has already begun.

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Before joining Elomatic in 2015, Petri Seppänen worked as a technical consultant in the automotive sector (Consulted OEMs and tier-1 component suppliers) and at the Aalto University as a member of the fuel cell development team. Since 2008, Seppänen has researched, developed and commercialised new technologies for everyday use. Seppänen is specialised in multibody simulations (MBS) and optimisation (parametric and non-parametric). Additive manufacturing is a natural sequel to his previous areas of specialisation.

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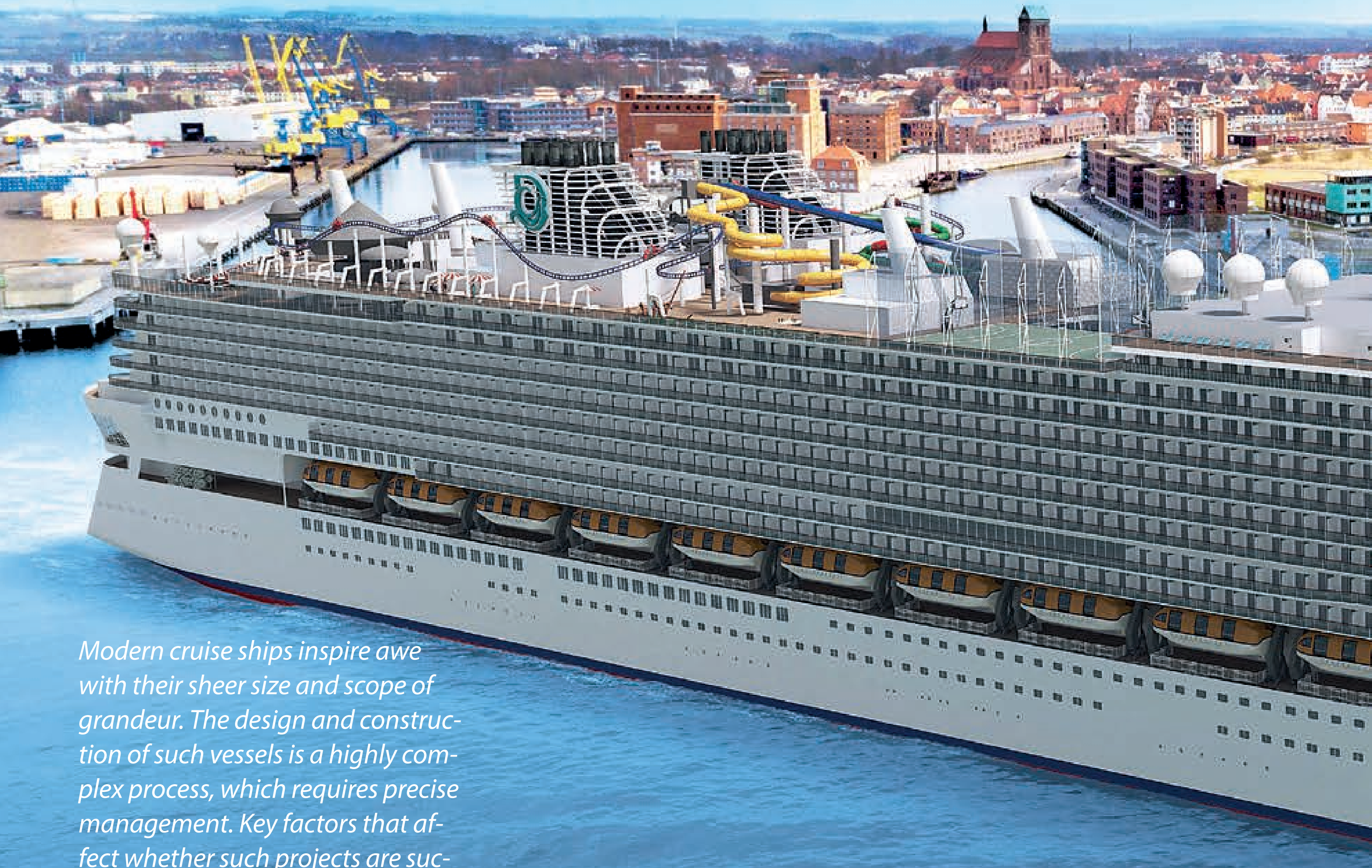
Managing large cruise ship design projects

Case: Global MV Werften Germany

Text: Vesa Haapala
Images courtesy of MV Werften



Modern cruise ships inspire awe with their sheer size and scope of grandeur. The design and construction of such vessels is a highly complex process, which requires precise management. Key factors that affect whether such projects are successful include, among others, how distributed design and changes are managed and how committed project participants are to working towards achieving common goals. The design and construction of a Global-class cruise ship for MV Werften in Germany is highlighted in this article as an illustration of how such projects can be managed.

The need for skilled and motivated persons cannot be overemphasized in large cruise ship design projects. It is also crucial to get these people to cooperate and work towards achieving the joint goals of the project. In large projects where design teams are potentially scattered around the globe, this is no simple task. Cruise ship design is also markedly different from the design of traditional trade vessels, which highlights the need for designers that have proven experience of actual cruise ship design.

One often reads about the crucial role of decision making in project management. On large and distributed cruise ship design projects, the speed with which decisions can be made is of critical importance. The project management team needs the ability and confidence to make quick decisions and avoid unnecessary bureaucracy. In this regard, a strength of the Finn-

Star Global Class Vessels 1 & 2

- Some of the biggest cruise ships in the world: 204,000 GT, 342m long, 46.4m wide,
- Passenger capacity: standard 5,000, max. 9,500
- Global 1 delivery: 2021
- Global 2 delivery: 2022

Elomatic scope

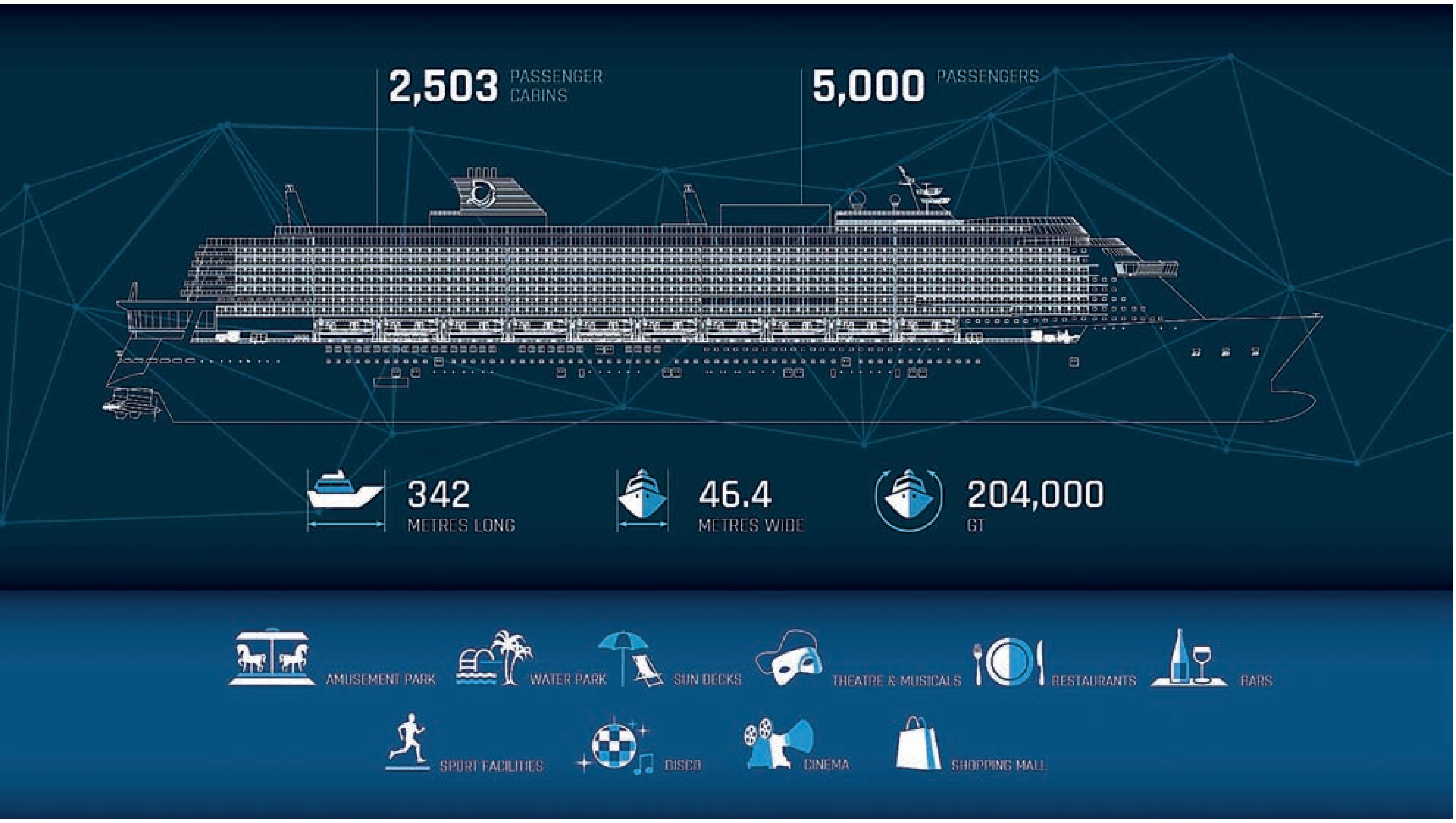
- Total project size: approximately 650 man-years
- Basic and detail design
- System engineering
- Site assistance during construction

ish corporate culture is its very low hierarchy, which supports fast decision making.

It is also important for responsibility and decision-making powers to be clearly allocated at different levels. Some decisions are taken by the shipowner or shipyard's top management, while others are taken by project managers or persons responsible for systems. There needs to be clarity as to who can make decisions regarding what in order to avoid any misunderstandings.

Managing design of Global-class cruise ship

The design of the largest cruise ship ever built in Germany is progressing at a rapid pace. The Genting Hong Kong owned MV Werften shipyards



The Global-class vessels are being built at MV Werften shipyards in Wismar, Rostock-Warnemünde (pictured) and Stralsund, Germany.

The need for skilled and motivated persons cannot be overemphasized in large cruise ship design projects.

in Wismar, Rostock-Warnemünde and Stralsund, Germany will build these high passenger capacity class ships for Dream Cruises.

The first ship in the series, Global 1, will be completed in early 2021 and its sister ship, Global 2, about one year later. The exceptionally extensive joint project between Elomatic, MV Werften and engineering company Deltamarin has brought together a large number of German and Finnish shipbuilding professionals over the last three years.

It all started with the signing of an agreement between MV Werften, Elomatic and Deltamarin in the summer of 2016 for the design of the first Global cruise ship (see the info-box on previous spread). From the outset, the spirit of the agreement was that Elomatic would act as the design department of the shipyard, and not as a traditional subcontractor.

The project is a bold undertaking by MV Werften, as it has not previously built such large cruise ships. The project participants together developed new ways of managing distributed design and of working as flexibly as possible. The project timetables were very tight right from the start and development work was conducted during the project, which placed further demands on the flexibility of the parties and their ability to make quick decisions.

Basic Design

In the basic design phase, the biggest challenge is usually finding different technical solutions so that the ship fulfils the contractual requirements. The design of a prototype cruise ship is always very turbulent: all project participants such as the shipowner, shipyard, equipment suppliers, turnkey suppliers, architects, as well as the classification society and authorities have to work together to ensure that the ship is completed according to the goals set, cost efficiently and within the agreed timeframe.

Modern design systems enable more efficient design that allows for the needs of different disciplines to be taken into consideration and possible contradictions and problems to be identified at a very early stage.

The role of persons responsible for systems is crucial in basic design. They have special expertise in the systems they are assigned to. It should also be noted that basic and detail design have overlapping schedules to some extent, which is challenging. Basic design should be able to produce sufficient initial data so that detail design can be conducted as planned.

The basic design of Global 1 was started in 2016. At the same time, more people were recruited and the internal instructions were updated to meet MV Werften's requirements. The ramp-up project was challenging, but also interesting because everyone had a positive attitude and a common goal.

The total workload for basic design is close to 200 man-years and Elomatic is responsible for approximately 420 basic design documents. Partners from Elomatic's subcontractor network from Poland and Croatia have also taken part in the basic design.

The basic design stage is one of continuous change. In order to be successful, the communication between the different parties should be very close and flexible. Communication on the Global project is handled by e-mail, Skype, telephone, and often also by organising joint project meetings where all participants are physically present.

Elomatic makes use of MV Werften's document management system as well as its own in-house EloDoc system. Initially, coordinating the systems was challenging, but once these challenges were overcome documents could be mass-driven. This guarantees the availability of the latest documents.

Detail design

The purpose of detail design is to produce materials for production according to the quality and schedule required.

Keeping to the timetable can probably never be emphasised too much in detail design; production does not wait. Change management has a significant role in this regard. Usually, the greatest challenge is prioritisation: Which changes can be incorporated in the materials without endangering the timetable, and which changes can be handled later via change management? Efficient change management requires a strong ability to react to resource needs, prioritisation, fast decision making and a working system that is used to manage change.

The detail design for Global 1 began in the fall of 2017. It will continue until the beginning of 2020, and for Global 2 until early 2021. MV Werften requires 3D models to be more detailed than is generally the standard in the industry, which has turned out to be a clear success factor on the project. It allows any discrepancies and contradictions to be detected already during the design stage. The challenge is to update

Building progress: On 1 March 2019, section 50 was lifted into the dock at the Rostock-Warnemünde yard.

The interior of a standard cabin on board Global-class vessels.

By distributing design, possible resource risks are shared and the best experts for different design areas can be selected.

and maintain the model in the design phase, which for prototype vessels is usually a rather turbulent period.

Exact models also require considerable design capacity and the ability to prioritize activities to ensure that they serve the next phase. The most important detail design task is to deliver the right documents for the production needs according to the schedule and to meet the required quality criteria. Elomatic has delivered over 1,000 detail design documents to the customer out of 2000, within the agreed schedule.

Distributed Design

In distributed design projects, it is extremely important that partners (subcontractors) are chosen based on their ability to manage the project. It should be established early in the contractual phase whether the party has the ability to manage the agreed design work. A common understanding regarding the work scope is required, otherwise a significant amount of time is wasted later handling additional work requests, which hinders project progress.

By distributing design, possible resource risks are shared and the best experts for different design areas can be selected. Design is conducted entirely via the 3D model, which means that designers do not physically have to be in the same place. The correctness of the model is verified with 3D audits.

For subcontracted work, the workload should be as steady and long as possible, which commits the subcontractor to the project. Subcontractors man the projects for their own areas. The implementation thereof is monitored in weekly reporting either in conference calls or face-to-face meetings. Very often, if the end result is not as agreed, the reason can be found in the lack of support that partners received.

In addition to designers, coordinators have a significant role in detail design where they supervise and manage subcontractors' activities. The better this is done the better the chances of success in the project. The best way to guide partners is to send a coordinator to their office.

In a project as large as the Global project, distributed design management plays a vital role. The project team includes ten partners, from one-man operators to partners abroad with more than 20 designers. Much of the co-ordination and hull design has been done at Elomatic's Gdansk office. The project is organised so that each disciple has its own manager who has to supervise and guide the partners. Guidance requires a very proactive approach and continuous monitoring and verification. A realistic assessment of the degree of readiness is also essential. In the Global project, there are department-specific monitoring tools, from which the information is fed into the client's own systems on a weekly basis.

Change management

Changes cannot be avoided in prototype cruise ship design projects. The manner in which changes are managed has a significant impact on whether the project succeeds. MV Werften has a well-developed process for change, but because some changes are made at Elomatic's or its partners' sites, Elomatic's own internal process for prioritising change management and managing resources has also been used.

Any late changes that affect the cost and/or schedule are recorded in the system. Change management is handled separately by a designated person. This allows the management to respond quickly to changes, without disrupting normal design work. They are able to share and predict design capacity and report systematically to the customer, which promotes transparency and removes any reporting uncertainty.

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Vesa Haapala has 20 years' experience in ship design, processes and production. Vesa started his career at Elomatic in 1998 as a designer. He was later promoted to project manager. From 2006 to 2017 he worked at the Turku shipyard in Finland in hull production as a project and department manager. He returned to Elomatic in 2017 and is currently the project manager on the Global project.

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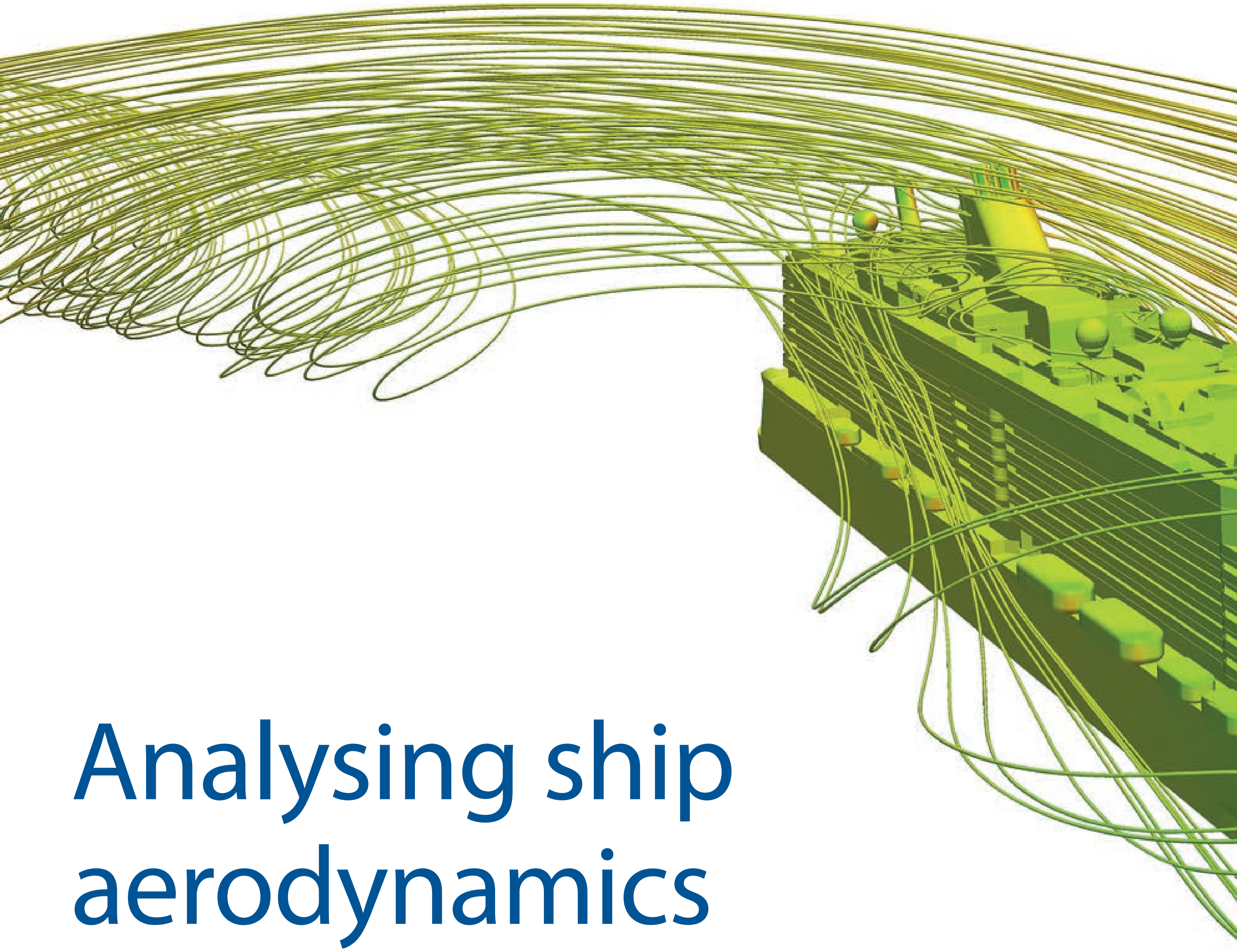


Analysing ship aerodynamics

Making the case for CFD simulation

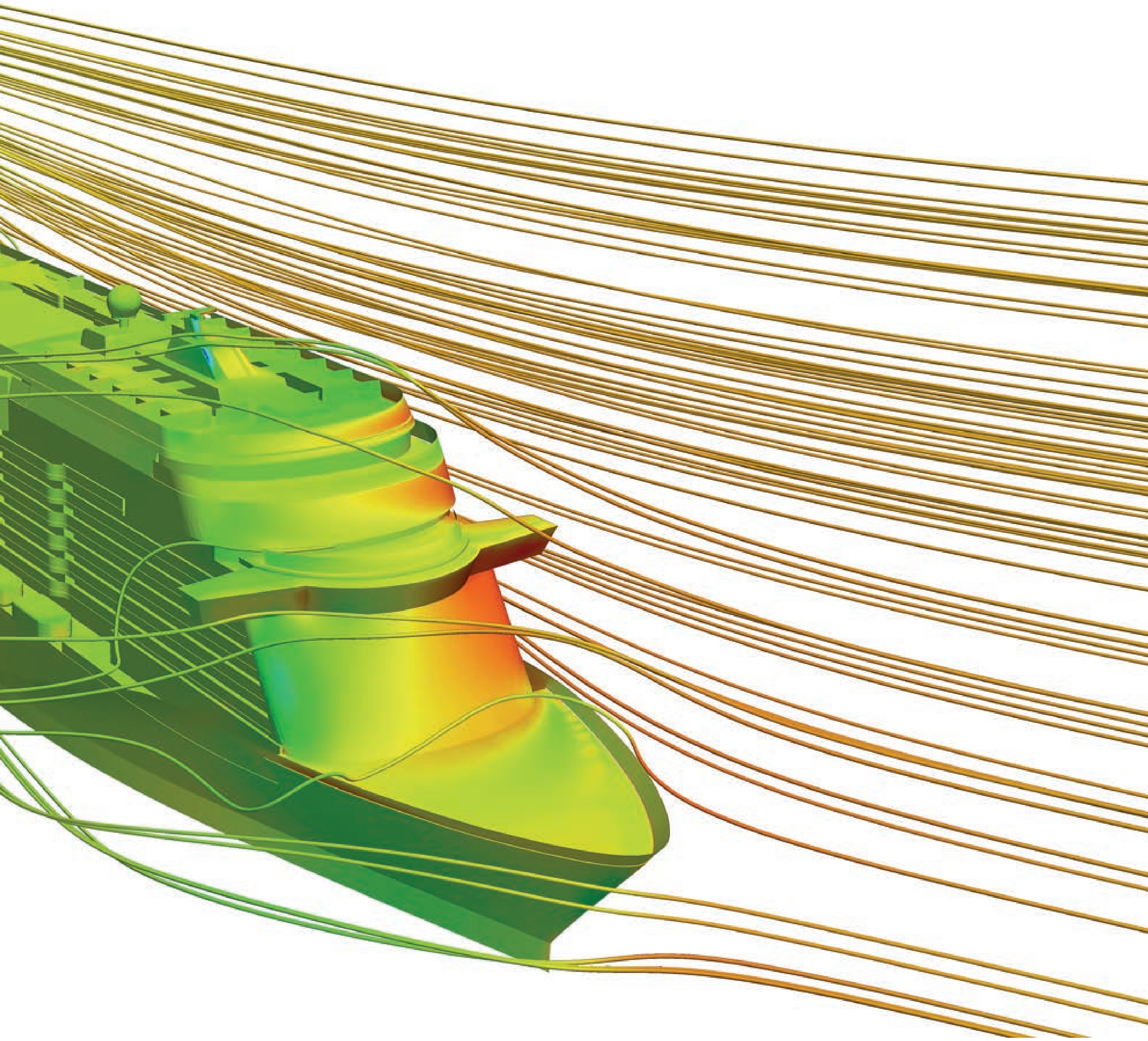
Text: Juha Tanttari
Images courtesy of Meyer Werft

All ships are required to undergo wind tests during design to ensure crabbing capabilities, manoeuvrability, and seakeeping performance. In some cases, smoke dispersion and passenger comfort also need to be analysed. Instead of conducting model scale testing in wind tunnels, computational fluid dynamics (CFD) can be used to achieve results that are more accurate.

Wind load tests are nowadays required to ensure the desired crabbing capability for ships, i.e. the ability to move sideways without forward movement. The side forces applied by the wind or sea currents on the ship need to be offset by side thrusters or another propulsion force to ensure manoeuvrability and seakeeping performance. The load tests can alternatively be conducted with CFD simulations.

Ship aerodynamics is still commonly analysed with the use of wind tunnel tests. Wind tunnel tests must be conducted on a model scale of 1:100, which means a much lower Reynolds number compared to the actual size of the ship. To compensate for the size and improve the Reynolds number (speed x size / viscosity), the wind tunnel air speed should be elevated or gas viscosity reduced.

Model scale tunnel tests lack the precision required by the actual scale Reynolds number, even though attempts are made to compensate for it with wind tunnel speed or viscos-



ity. It is also relatively challenging to achieve a tunnel wind speed profile that corresponds with the actual sea profile. More accurate results can be achieved with full-scale CFD simulations.

Making use of CFD simulations

Simulations are typically performed at least for wind loads and smoke dispersion. For cruise ships, the comfort level is also of interest and car deck ventilation analysis should be included for ferries.

A CFD simulation model includes the ship superstructures with all aspects that impact aerodynamics. The level of detail must be high enough to detect all the flow conditions of interest, while keeping the model size compact in order to calculate it in the time schedule required. The size of the surrounding area taken into the model is usually a few square kilometres.

Typically, simulations are performed for two main cases: for the ship at service speed and in port. One wind speed from all directions is sufficient with 15° staggering for the wind resistance coefficient. In most cases, ship symmetry can be taken into account to check dispersion and comfort values.

Most simulations are run as steady state calculations (RANS), while in some cases time dependent data is ensured with DES (detached eddy simulation).

Several parameters are required to achieve the required level of information from simulations. The wind speed is given as the typical standardised sea

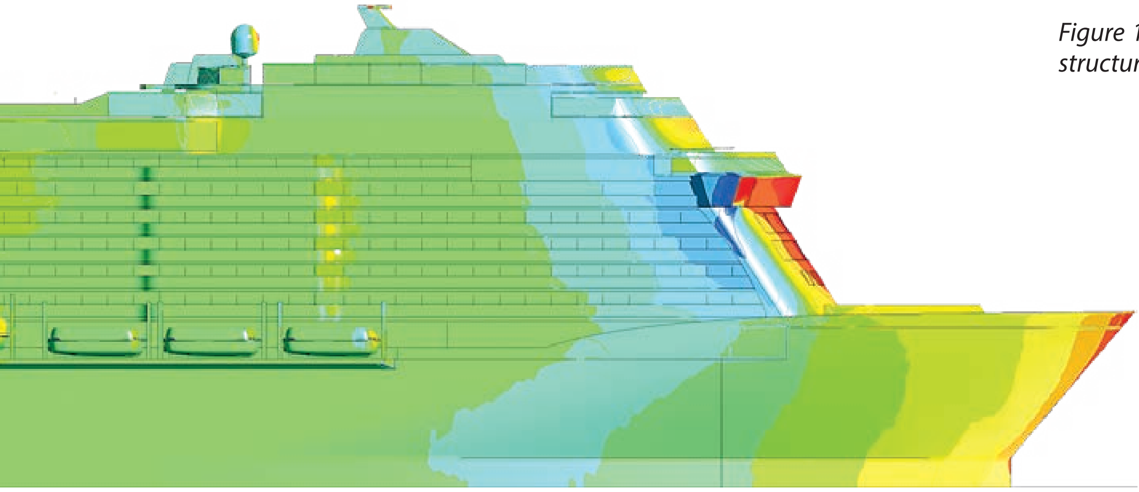


Figure 1. Pressure contours on ship superstructures

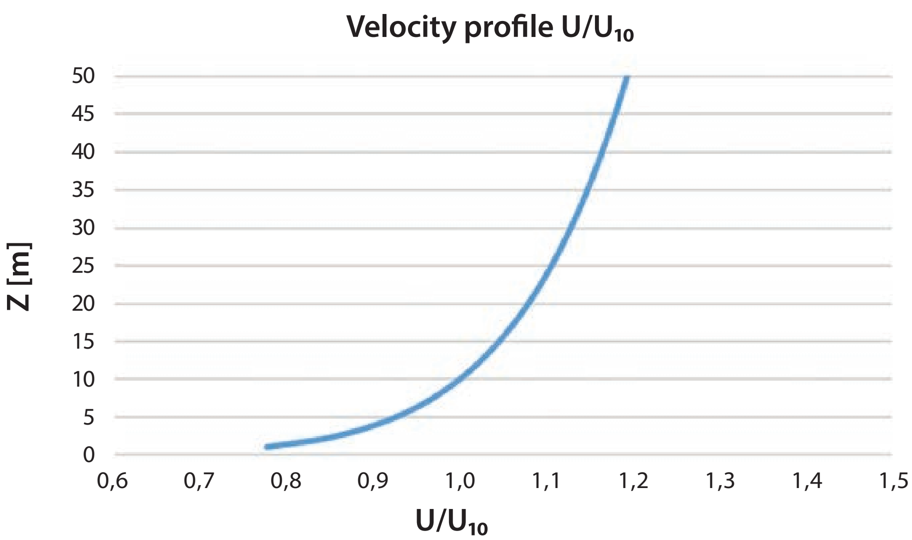


Figure 2. The sea wind velocity profile used in ship aerodynamics simulations

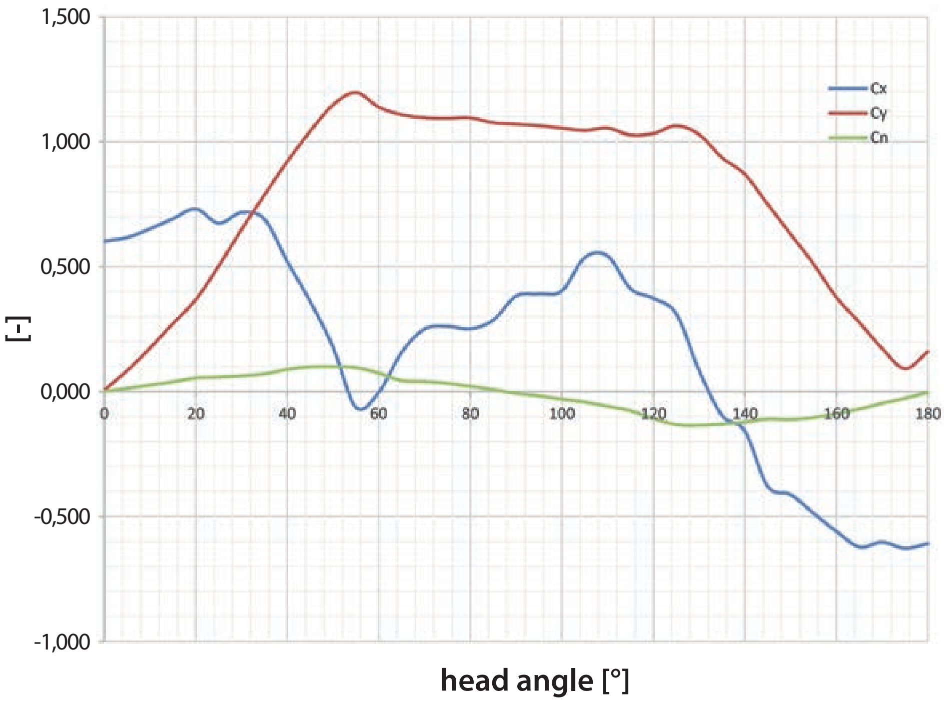
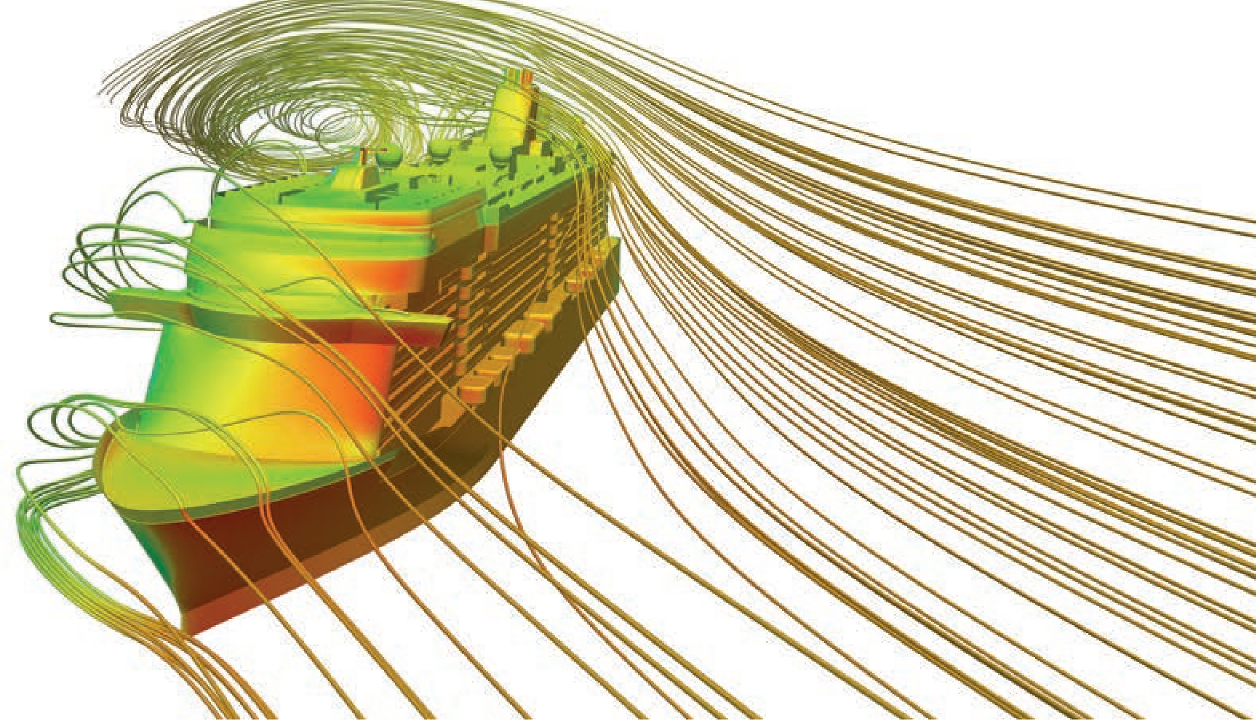


Figure 3. Typical coefficients for wind loads



wind profile, with the reference speed set at 10m altitude. The ship speed can be included with a moving reference frame, or alternatively by taking into account the wind speed relative to the moving ship. Smoke dissipation from each funnel and ventilation inlets is taken into account as designed for both main cases.

Wind velocity and turbulence parameters are considered for the wind profile, while the ambient temperature is given as constant according to the ship specifications. Real fluctuating wind conditions are simplified using constant wind conditions instead, with a sea wind profile.

Below altitudes of 50 m, the simple power law is empirically valid for both sea and land conditions and is generally used in emission dispersion studies. If greater altitudes are needed, log-law relations can be used, which are valid up to 2000 m. The power-law wind profile is shown in Figure 2, where U_{10} is the wind profile at 10m altitude and z is the distance from sea level.

The velocity increases rapidly after 10 m, which results in the emissions being emitted higher, transported further away, and mixed more with the surroundings than emissions at lower levels. Therefore, it is crucial that the emissions are emitted as high as possible. This can be done by increasing the emission velocity or increasing the temperature of the emissions.

The velocity distribution around a ship is shown with streamlines in Figure 3. The wind angle is 45°, and part of the wind starts to circulate in the ship direction. This starts to disperse the emissions and transport them further away downstream. The ship distorts the surrounding flow field, leaving larger areas where air circulates slowly. If the emissions are transported to these areas, they do not disperse effectively in the surrounding air and can be transported back to the ship decks. It is crucial to prevent this from happening by elevating funnel discharge above the ship boundary layer.

Wind load

Wind load coefficients can be defined based on the force components and moments on the hull at the given wind speed, taking into account the longitudinal and transversal projection areas for the ship geometry.

The ship's crabbing ability is highly dependent on side forces applied by the wind. The allowed wind speeds are determined based on these force coefficients and the moment coefficient with the specified thruster power available.

Typically, the highest coefficient values are detected for wind directions from the ship shoulder (~50–55°). Relatively large force fluctuations are typically due to unsteady downstream drag forces.

Emission dispersion

All gas flows to or from the ship are included in the modelling: ventilation in/out, galley, boiler, main engine, auxiliary engine, and AWP depending on the ship equipment. The flow rates, gas temperatures or number of engines in use is dependent on the main case definition: the power demand or ship use is different for service speed and port conditions.

Different emission types produced by the ship in service or port have different threshold limits, ranging from 10–3000 ppm; no exact values can be defined for the limits, as they vary from case to case. Sewage emissions are usually required to be low, so their thresholds are 10–100 ppm. For boiler emissions, the limit can be around 1000 ppm or more. The values are therefore relative to the emission values. The main engine concentration limits are dependent on fuel or flue gas treatment, the highest concentrations are allowed for LNG up to 3000 ppm.

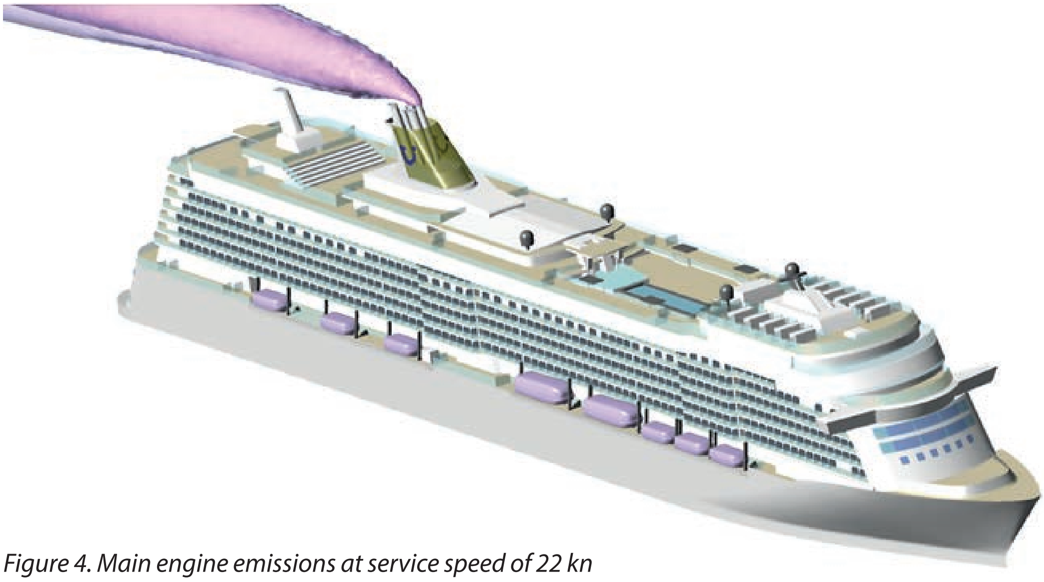
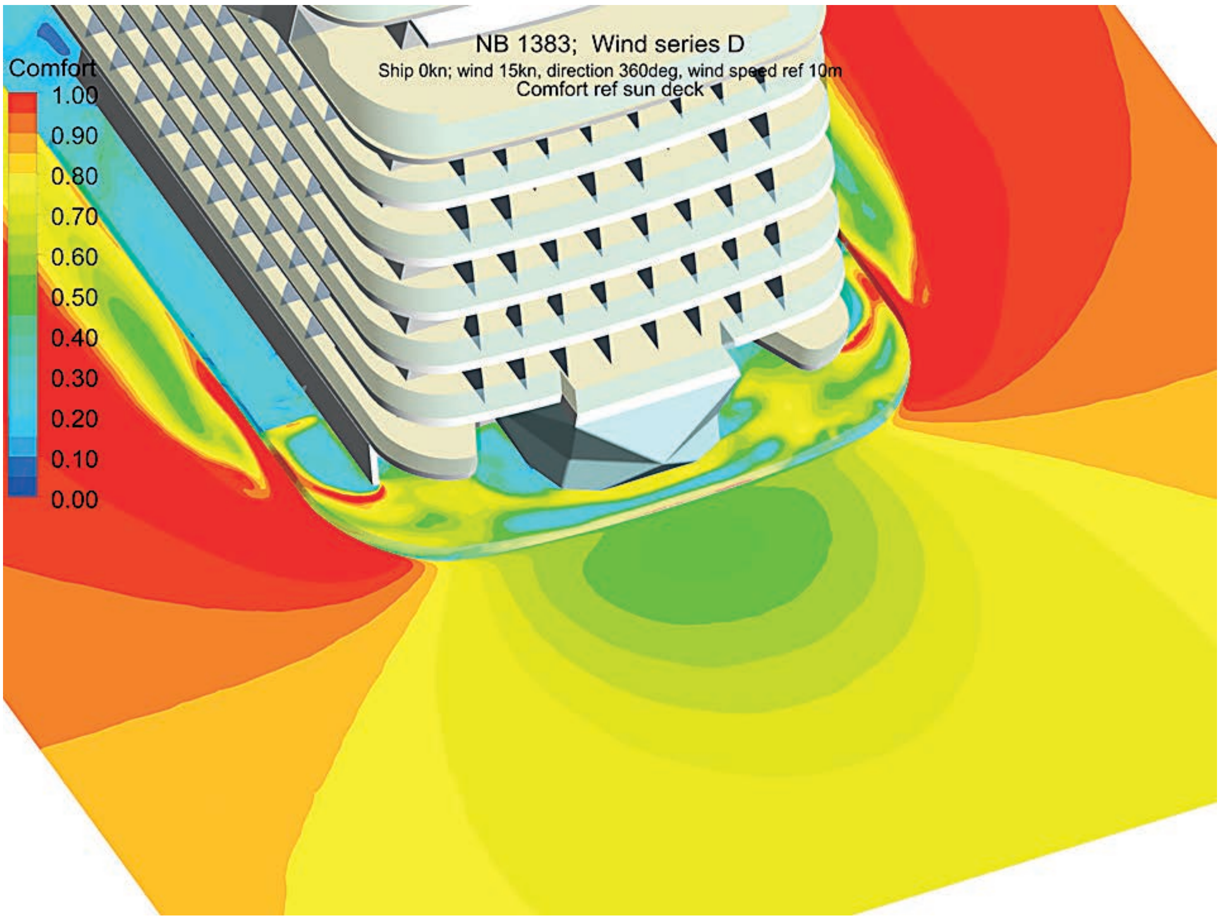


Figure 4. Main engine emissions at service speed of 22 kn

Figure 5. Comfort level on an aft sun deck



Full-scale ship wind tunnel tests run with CFD provide more realistic results for ship outer deck aerodynamics than model scale tunnel tests.

CFD simulations are done to identify the worst-case conditions where given limits may be exceeded and to help find solutions to avoid high concentrations. Ideally, emission plumes should move away from the ship. However, in some of cases, emission concentrations around the superstructures remain above permissible limits. In such cases, alternatives for improving dispersion should be analysed in order to find a solution. Simulations reveal these conditions quickly and allow the required adjustments to be made to the ship design. Typical solutions may include increasing the emission injection rate or increasing the height of flue gas pipes to force emissions higher, thereby ensuring that emissions do not land on the ship decks.

Figure 4 illustrates a main engine emission dispersion at the threshold limit of 100% and 50% concentration and at service speed with a forward wind. By testing all scenarios with different wind directions, the worst cases can be identified and the ship design, operating conditions or pipe setup can be optimised. At service speed and with a relative fore wind, the emission plume behaves as designed. The emissions are dispersed in the surrounding air where the cloud ends and the concentration is below the threshold limit of 2500 ppm outside the cloud.

Ensuring the required comfort level

The comfort level on a ship's outer decks is of interest in cruise ships, where passengers spend a lot of time outside. The level of comfort regarding wind conditions is specified according the use of each location on the outer decks. The most demanding locations are pool areas, sun decks and restaurants.

The wind speed and turbulence on outer decks are used to measure the comfort level experienced by passengers. Comfort can be assessed via the comfort level parameter, which takes wind circulation on the decks into account with the aid of turbulence parameters. This parameter describes how well the ship structure protects the passengers from outside wind, which can be very uncomfortable. The higher the parameter value is, the more uncomfortable people feel in that region. The values range from 0-1, where 1 corresponds to conditions similar to those outside the ship and 0 to an area that is fully protected from outside wind conditions.

The ship comfort levels on an aft sun deck are shown in Figure 5. There are small areas where the comfort indicator is high, indicating higher levels of discomfort, but in the major areas the comfort levels are in the desired range and no extra modifications are needed to the sun deck design.

Summary

Full-scale ship wind tunnel tests can be run with the use of CFD. It provides more realistic results for all ship outer deck aerodynamics compared to model scale tunnel tests.

The aerodynamic analysis can include many features of interest; most typically wind loads, smoke dissipation and comfort values, but helicopter landing platform wind conditions or car deck ventilation can also be analysed – all elements concerning wind impact on ship use or operability should be considered. The CFD model can include the environment to some extent as well, such as harbours or other vessels to combine the interaction of separate structures and see the vessel's impact on its surroundings – such as smoke dissipation in a harbour.

Wind tunnel test run with CFD provide a fast response and assist the analysis of all factors that lead to the detected behaviour of a domain. This achieves better solutions with reduced development work time.

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Juha Tanttari has 20 years' experience of working in fluid dynamics consulting. His experience covers a vast range of industrial segments including marine hydrodynamics and aerodynamics, project management and sales. Juha joined Process Flow in 1999, which was acquired by Elomatic in 2017. He currently holds the position of Lead Consulting Engineer, Technical Analysis.

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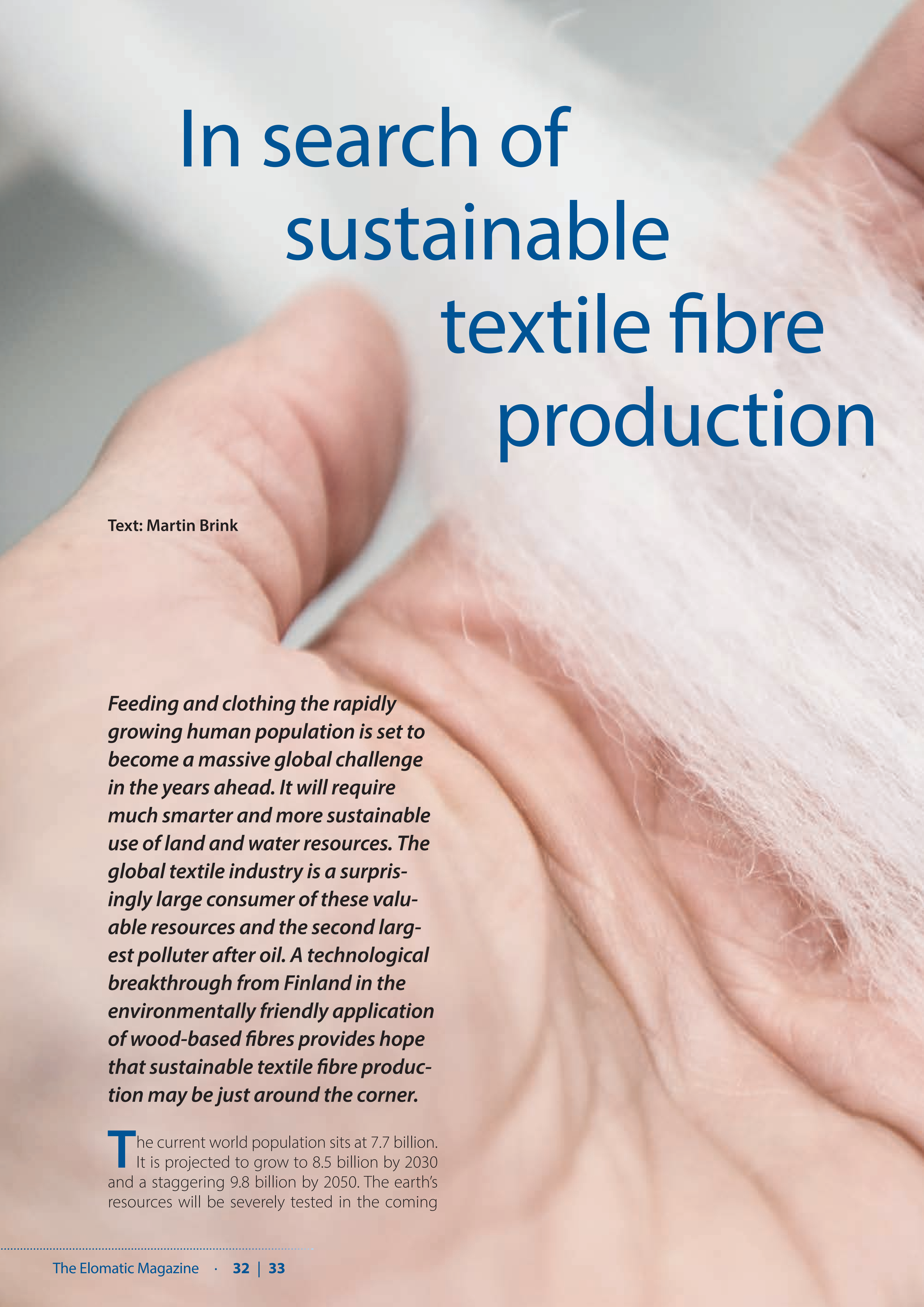

In search of sustainable textile fibre production

Text: Martin Brink

Feeding and clothing the rapidly growing human population is set to become a massive global challenge in the years ahead. It will require much smarter and more sustainable use of land and water resources. The global textile industry is a surprisingly large consumer of these valuable resources and the second largest polluter after oil. A technological breakthrough from Finland in the environmentally friendly application of wood-based fibres provides hope that sustainable textile fibre production may be just around the corner.

The current world population sits at 7.7 billion. It is projected to grow to 8.5 billion by 2030 and a staggering 9.8 billion by 2050. The earth's resources will be severely tested in the coming

decades to cope with the increased demand to feed, clothe and provide services and livelihoods for the growing global population. It is clear that humans will need to live, produce and consume more responsibly and sustainably in the decades ahead.

Pollution severely inhibits the ability of humankind to get the most out of natural resources. Fortunately, there are signs that many industries are moving to more environmentally friendly and sustainable production. The introduction of electric cars and the gradual phasing out of combustion engines on our roads in the coming decades is an example of this seismic shift. Pollution is nevertheless still a gigantic problem and much work remains to be done before humankind is on a more sustainable trajectory.

It may come as a surprise to learn that the global textile (fashion) industry is the second largest polluter in the world, second only to oil production. How is it that the fashion industry is such a large polluter and that clothing production accounts for 10% of global carbon emissions? At the risk of oversimplifying the matter, the answer is found in the raw materials used and the production processes employed, as well as the large distances between raw material cultivation sites, production sites and consumption points.

Houston, we have a cotton problem

Approximately half of all textiles are made from cotton. The problem with cotton is that it uses up large tracks of land that could be better used in agriculture to feed the growing population. It is estimated that approximately 3% of the earth's arable land is used in cotton farming. Cotton is also a notoriously thirsty crop; according to WWF, it takes 20,000 litres to produce 1 kg of cotton and 2,700 litres to produce one cotton t-shirt.

The extraction of water for cotton farming in dry areas coupled with poor water management is having a devastating effect on water tables. If a cotton field were replaced with wheat, for example, and just 30% of the straw was utilized in a bio-based ecosystem, the same amount of textile fibres could be captured as from of the cotton field with much less water use.

Cotton also requires more pesticides and insecticides than any other crop in the world; it accounts for 16% of all pesticides used worldwide.

America is ranked third in global cotton production behind China and India, but remains the largest exporter of cotton. Herein lies another problem. Cotton cultivated in America is shipped across the world to Asia where it undergoes chemical and other treatment before it is used to produce clothing. A large part of the clothing is then shipped back to America and other high-income countries. The carbon footprint of an average cotton t-shirt is completely unsustainable.

Man-made fibres to the rescue?

Several man-made fibres are available on the market. Should the production of such fibres be maximised in search of greater sustainability?

Oil-based synthetic fibres such as polyester are used widely in clothing, sometimes spun together with natural fibres like cotton (polycotton). The material is ideal as it is strong while being wrinkle and tear resistant.

Polyester manufacturing is a highly polluting, however, and the source of vast emissions. A further concern with such materials is that they contain microplastics that find their way to and pollute the oceans. Recent research suggests that microplastics are also present in the air across the globe.

The effects of airborne microplastics on human health is untested, but it is unlikely to be positive. In the oceans, their polluting effects are well documented; fish and other living organisms ingest microplastics that eventually end up on our dinner plates. The reliance on oil, a finite raw material, to produce these synthetic fibres is furthermore cause for concern and raises questions around their sustainability.

Cellulosic fibres from wood

Man-made cellulosic fibres such and viscose, modal and lyocell are produced mainly from wood pulp. The tex-

Cotton is a resource heavy crop. It takes 20,000 litres to produce 1 kg of cotton. Cotton also accounts for 16% of all global pesticide use.

The only side product of the Spinnova process is evaporated water, which is reused.

tile fibres produced have many advantages, but the production processes require the use of highly toxic chemical solvents to convert the wood fibres, thereby polluting both workers, water and the environment.

Lyocell production is not as highly polluting as viscose, but requires the use of chemical agents nevertheless. The increasing demand for fibre and the declining availability of cotton means that cellulosic fibres will have to make up about 33% of textile fibres by 2030. Is the only choice available between materials that are unsustainable and those that are marginally less so?

Fortunately, the situation is not quite this dire. Research and development is being conducted across the globe to identify more sustainable means of production. A recent innovation from Finland indicates that there is light at the end of the tunnel in search of more sustainable textile fibre production.

Elomatic provides engineering and consulting for Spinnova pilot plant

Elomatic's scope in the Spinnova pilot plant project included project management, conducting the preliminary study and comprehensive design: basic design, detail design, device design, plant design, process design, and electrical instrumentation & automation design. Elomatic was also responsible for technical analyses, building changes, risk evaluations and procurement, which covered specifications, offer documentation, comparison and the evaluation of offers. The EPCM assignment included the scheduling of the construction project, installation supervision and start-up.

Finnish innovation paves way to sustainable fibre production

Spinnova Oy from Finland has patented technology that provides a much more sustainable way of converting cellulosic fibres (from wood) into textiles. The crux of the innovation is that the production process does not use dissolved pulp like other cellulosics, or include dissolving at any point, and therefore does not require any of the harmful chemical solvents used in other cellulosic fibre production. The only side product of the process is evaporated water, which is reused. The manufacturing process is highly stingy with energy and water consumption and is suitable for wood-based cellulose and e.g. waste-based raw materials.

The Spinnova process is based on mechanical treatment of pulp, as well as fibre suspension flows and rheology. The finely ground pulp mass flows through a unique nozzle, where the fibres and fibrils rotate and align with the flow, creating a strong, elastic fibre network. The fibre is then spun and dried, suitable as-is for spinning into yarn and then knitting or weaving into fabric elsewhere.

In late 2018, years of research and development culminated in the unveiling of a pilot production plant in Jyväskylä Finland to test industrial-scale production. The maximum capacity of the pilot plant is 100–400 tonnes of textile fibre a year. It is estimated that the full-scale start-up of the plant will take place in mid-2019. Elomatic collaborated with Spinnova to provide engineering and consulting services in the design and construction of the plant.

Spinnova fibre also holds promise for high biodegradability and recyclability, on par with that of paper. Recycling generally downgrades the quality of materials, but as the Spinnova process uses minute fibres, the fabric can be recycled into high quality materials. Spinnova has collaborated with leading fashion brands and it is expected that fibres spun from their process will become commercially available in about two years.

Fibres produced from wood have enormous potential as long as sustainable forest management is practiced across the globe. Spinnova's raw material commitment is to use only FSC-certified wood or waste streams that would otherwise contribute to climate change.

Consumers have to do their part

Developments such as the Spinnova process provide hope for the future, but more sustainable and environmentally friendly production of textile fibres is only one part of the puzzle. Change is also required in human consumption patterns.

Consumers can make a difference by being more discerning when purchasing clothing and favouring more environmentally friendly and organic products, or buying second hand and recycled products.

A large part of the excessive carbon footprint in the clothing industry is due to the washing and drying of clothes. Here consumers can also make a difference by washing clothes only when necessary and avoiding the use of dryers where possible.

The recycling of textiles is also growing worldwide. Many retailers offer to recycle not only their own branded textiles, but also those of other manufacturers. These textiles can be reused, for example, in the automotive industry.

Every consumer needs to ask how many articles of clothing is enough? How often does one really need a new t-shirt or pair of jeans? What will the impact of the clothes I purchase be on the world? Everything starts with education. Once consumers know the environmental impact of their choices, they are able to make decisions that are more responsible.

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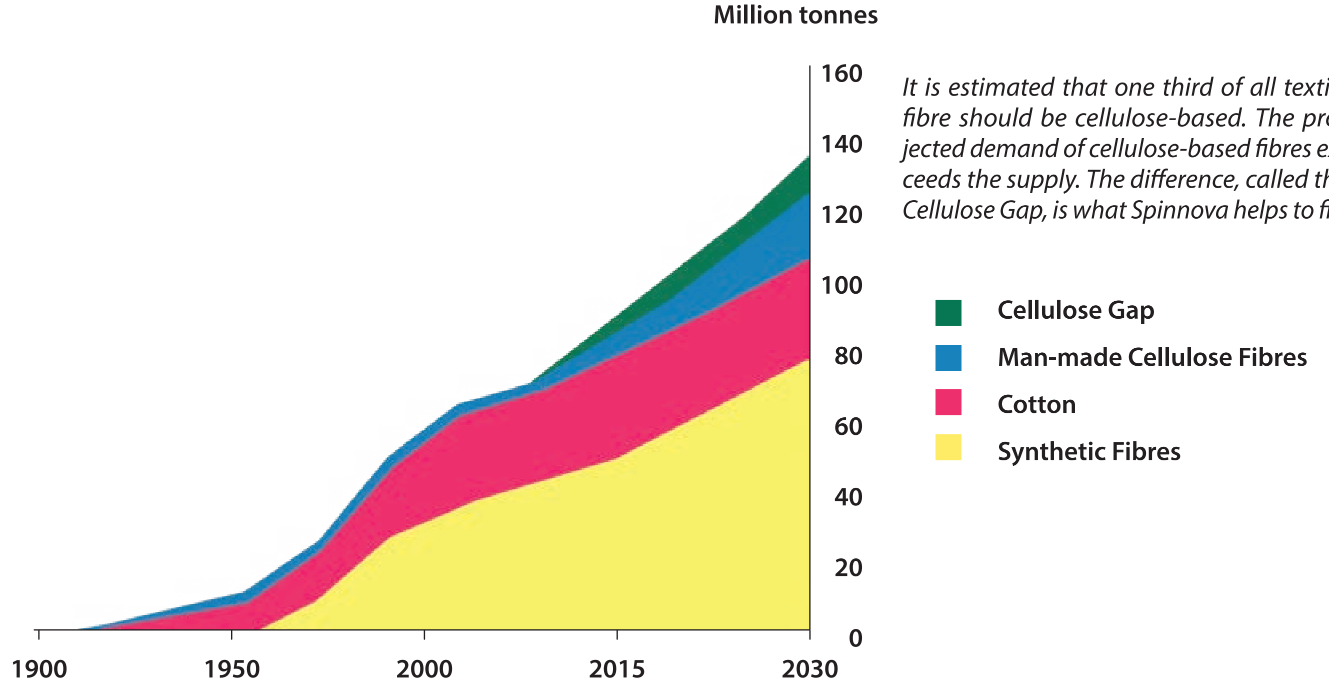
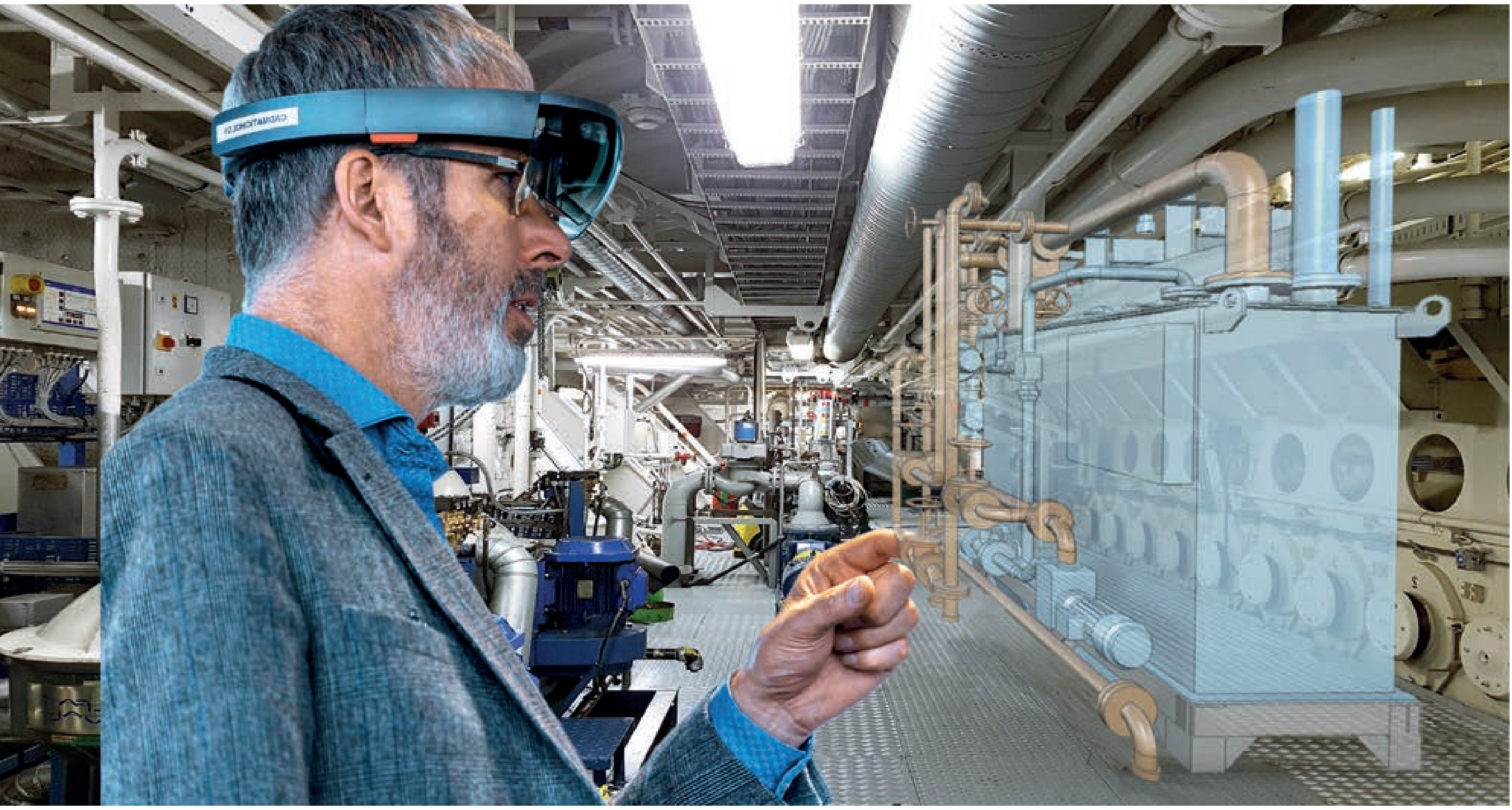


It is estimated that one third of all textile fibre should be cellulose-based. The projected demand of cellulose-based fibres exceeds the supply. The difference, called the Cellulose Gap, is what Spinnova helps to fill.

Photo © Spinnova

Spinnova conducted years of research and laboratory testing before constructing its pilot plant in Jyväskylä, Finland.



CAD models and augmented reality

eShare for HoloLens

Text: Mikko Yllikäinen

A great amount of interest has been shown in virtual and augmented reality technologies for some time in the fields of engineering and CAD. Typically, the interest has not been very specific. It has been fuelled by the development of new technologies and hardware, and a desire to try something new. An Elomatic subsidiary, Cadmatic, has developed its own AR technology application. This article traces the development that culminated in the launch of eShare for HoloLens.

In augmented reality, a headset projects computer-rendered 3D holograms into the user's view, but the users are still able to see their real environment, whereas virtual reality headsets show a 360-degree view of computer-generated content. The holograms hold their position as the user moves around them.

The launching of the first version of Microsoft HoloLens in early 2016 proved to be the point where augmented reality technology seemed mature enough to convince Cadmatic developers to try it. At the time, purchasing MS HoloLens was no easy task. The headset was not available in most countries and eventually had to be procured directly from Microsoft in Ireland. The idea was to investigate how well HoloLens would fit the company's information management applications.

Early experimentation and limiting scope

The Cadmatic product creation team started experimenting with HoloLens as soon as the package arrived, but the actual development had taken its first steps already before that: a prototype version had been developed that allowed users to see a 3D model in AR.

eShare for HoloLens – Key facts

eShare for HoloLens is an app that allows the user to interface Microsoft HoloLens with CADMATIC eShare. It offers an entirely new interactive design and engineering experience in Augmented Reality where digital 3D models reside in the real-world environment.

- Load models from the eShare server and use them offline
- Align 3D model with existing environment
- Load and visualize object data from eShare or any connected system
- Measure distances between digital items, digital and real items, or just real items
- Shared experience for collaboration in multi-user environment

It boosts the imagination when the actual scale of a design can be seen in a live environment.

As with many other high-tech gadgets, HoloLens created much excitement once it arrived. The technology was still very much state-of-the-art, despite the availability of several similar cheaper devices. In the beginning, the development team had a long list of ideas how CAD models could be utilised with the headset. They held many discussions with clients about the technology and development possibilities were considered before the scope was limited to a manageable size.

It became clear that the first priority was uploading 3D models to HoloLens and the need for basic model review functions. These included getting object attributes, measuring distances and aligning digital models with real objects, i.e. taking 3D models to AR and keeping information already available on top of the 3D geometry. The most suitable platform for this proved to be the server of Cadmatic's eShare information management product.

At the time, the development team were hoping to present the new developments at the company's bi-annual Users' Meeting in September of 2018. This posed some time constraints to get it ready and published to the Windows Store. Prior to the event, the team had several use cases in mind that are typical for reviewing 3D models of new and revamp design projects. There was already significant expertise in the company to create and use 3D data for various purposes. The developers simply needed to extend their imagination to see the 3D model in its real size and in a real environment, not on a screen.

The team noticed that HoloLens immediately changes the perception of 3D and space. For example, one part of a test model with a platform with some piping may seem like a small piece in a design application, but once loaded in HoloLens it was far too big for the spacious office corridor.

The whole idea of modelling, originally based on the "eye to hand to brain" concept, changes with HoloLens. When a designer sees the actual scale of the design in a live environment it boosts the imagination and the designer experience changes the project is about to bring.

Presentation to potential users

The development team presented the new HoloLens application in workshops at the Cadmatic Users' Meeting in the autumn of 2018. The immediate feedback was very positive. Several use cases were identified including using the product for design reviews, showing designs to stakeholders, involving people in remote locations, building process controls and simulations, replacing small scale laser scanner use, all the way up to abandoning the use of paper drawings, as well as installation and production instructions.

Even the most experienced designers like to see projects in the building stage, to get a real feel of what is being designed. It allows the designer to experience the actual environment and to notice mismatches, impossible designs or ergonomic issues. All of this is now possible without costly and often impossible trips to construction sites. A new project can be reviewed and presented in the most realistic way to stakeholders even before it is approved or constructed.

AR technologies are currently not the core focus of the team's development plans. The development adheres to agile principles, however, and they are always looking for new ways to add value. The current focus is solutions for design projects and enabling building and production in the most cost-efficient way. Time can be saved on engineering projects by extending the limits of traditional design solutions with information management platforms where all project-related data can be connected. It ensures the availability of data that is structured in a natural way with the 3D model as the hub. It also helps customers to eliminate costly design mistakes.

AR solutions open the door to challenging traditional design limits and truly awaken the imagination. New technologies are coming onto the market more quickly and conveniently than before and are set to become more mainstream in the years ahead.

About the author

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Mikko has spent his whole professional career working within ship and plant design information management. He has experience in software development on a vast range of platforms and technologies. He joined Elomatic subsidiary Cadmatic Ltd in 2007, where he currently holds the position of Product Owner, Information Management Products.

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Elomatic headquarters powered by solar energy

Elomatic has signed a deal with Areva Solar to install 216 solar panels on the roof of its headquarters in Turku Finland. The total output of the panels is 71280 Wp. The installation will reduce the load on the environment and decrease energy costs.

The panels and required equipment will be installed in the summer of 2019. The system's yearly output is estimated at 65 MWh.

According to building manager Petteri Elo, the use of solar energy has become more viable in recent years, even in a country like Finland where there is limited sunshine during the winter months.

"The cost of energy is increasing while at the same time the price of solar panels has fallen and the quality of the panels has improved. The technology is very developed and its reliability is markedly better nowadays," says Elo.

A large part of the energy consumed at Elomatic's headquarters is used for cooling. It is not clear yet how big an effect the placement of solar panels on the roof of the building will have on the temperature of the upper floors. Elo speculates that the effect may even be significant, which will further reduce the need for cooling and energy use.