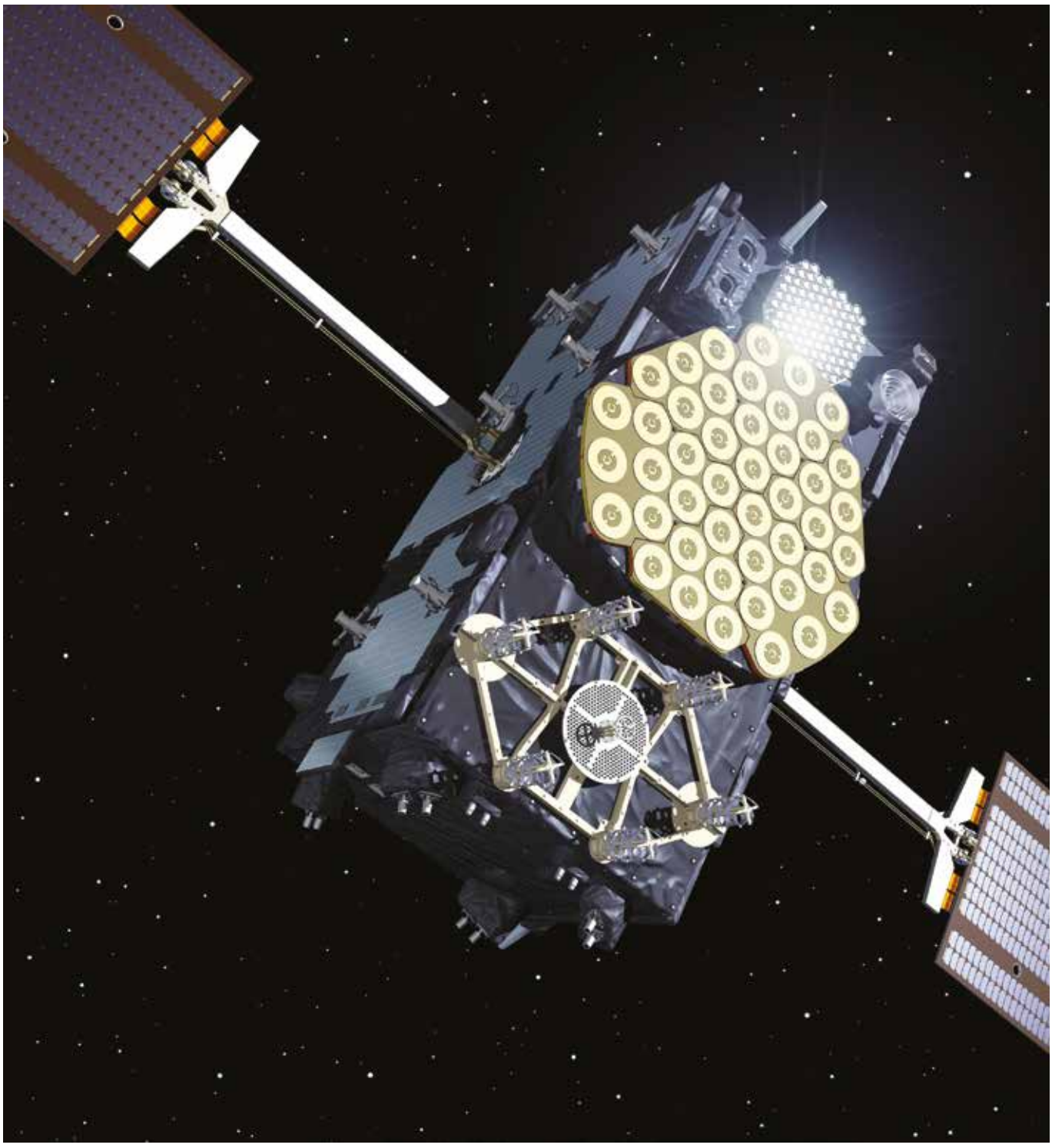
INNOVATION+ RINA

RINA MAGAZINE - INNOVATION EDITION



INSIGHTS
from innovation leaders

DIGITALISATION
& how it drives development

TECH TRANSFER
from space to earth

Welcome to Innovation+, RINA's new magazine covering promising trends and groundbreaking ideas in industries from space and defence to steel, manufacturing to digital applications. In this issue, leading innovators present their visions of the future - as well as the practicalities and challenges of innovation in their field. Meanwhile, RINA experts offer insights into topics including training, decision-making, smart sensors and the power of advanced digital technologies such as blockchain and modelling.

Many thanks to Tokyo Steel, Prysmian, GEIE-TMB, Avio, Hitachi Rail Europe, Niteworks and the North Adriatic Sea Port Authority for their valuable contributions.

Survival of the innovators

"Survival of the innovators" describes today's global markets. Being "fit" enough to follow others is not enough. To stay in the game, companies need imagination and ideas that drive positive change and bring competitive advantage. But innovation is not just about having good ideas. It's about identifying new solutions to real needs, transforming them into reality, testing them, industrialising them and verifying that they meet the required standards.

We think a lot about innovation at RINA because its key aspects - solving complex technical issues, prototyping, testing, implementing, validating, certifying - are things we have done for decades, across many different industries. We are lucky enough to have both competencies: firstly to support the innovation process, secondly to verify the process and the end result. This is really valuable for our clients, who benefit from more innovative solutions, faster development and smoother implementation.

Clients' needs, whether expressed or not, are usually the spark for innovation. Digital technologies help us to understand these needs better nowadays. We can collect masses of new data with advanced sensor systems and analyse them with the help of AI. But while data and algorithms are essential, they're useless without expertise in the industrial processes involved. Expertise comes from people and is not something you can buy in a box or download.

Every day, I see the benefit of RINA's strong network of experts collaborating across industries and disciplines. We often find that innovations developed for one industry can be adapted for others. Take our experience in applying technologies and materials intended for space exploration to industries on Earth. Our expertise in cybersecurity is another example: we originally strengthened our cybersecurity capabilities for the defence sector, but they are now in huge demand to protect business continuity in all industries.

Innovation isn't just about new products and processes, but about new ways to support and train people. For example simulators, long used by the airline industry to train pilots, can be adapted to help train oil and gas plant workers, ships' crews, metro drivers, emergency staff and many more. Innovative e-learning solutions complement on-the-job training and make sure people are competent to operate safely in all situations.

Innovation can be disruptive, as we see in sectors such as retail and the media. Of course, it's harder to disrupt heavy industries, shipping, transport, infrastructure - you can't just build a new factory like you can build a website. But with the right expertise and data, we can identify innovative upgrades that give a real competitive advantage by saving costs, improving efficiency and reducing wastage.

Some upgrades are real game-changers, like additive manufacturing. Imagine how much marble Michelangelo wasted when carving his David statue. With a 3D printer, he would have wasted nothing. Our clients may not create marble statues, but embracing this type of innovation may be the difference between struggling, surviving and thriving. Our mission at RINA is to help provide innovative solutions to our clients' needs and support the entire process, from the first spark of an idea to its smooth implementation.

This makes our clients stronger; this makes us stronger.

■ andrea.bombardi@rina.org
Executive Vice President, Industry

Transforming scrap into high-end steel

Interview with Toshikazu Nishimoto, President, Tokyo Steel

The economic case for steel recycling is clear. Global demand for steel products is high and despite current political uncertainties in some areas of the world, we believe it will remain strong. Supply is limited, so the market is tight. Moreover, Japan is self-sufficient in scrap steel, in fact exporting millions of tonnes of it each year. Making smarter use of steel scrap within Japan offers great opportunities in business terms.

The environmental case is also clear. We need to stop abusing natural resources and instead try to circulate existing resources through recycling. We have the potential and the moral obligation to proactively address climate change and reduce CO_2 emissions. Steel production with an electric arc furnace process generates only one fourth of the CO_2 per unit of production compared to the standard blast furnace process used by most steel manufacturers. With increasing use of renewable energy sources, we would be able to reduce those emissions even further.

So as a pioneer in steelmaking using the electric arc furnace process, it is clear what we at Tokyo Steel have to do: develop innovative ways to create more high-quality steel products with a low carbon footprint.

That means using our electric arc furnace methods to transform low-grade scrap into value-added products such as high-tensile steel for the automotive industry, electrical appliances and construction machinery. It is a form of horizontal recycling that we metaphorically call “Car to Car” because end-of-life cars are reborn as new steel car parts. The scope is much wider than just the automotive industry. These products are also used in everything from construction machinery to electrical appliances. But first we have to overcome the technical challenges of using low-grade scrap to make high-end steel products.

We were the first to establish the technology to produce flat steel products from general heavy scrap without using blast furnace pig iron or less high-grade scrap such as bushelling scrap. Back then, many people said it would be impossible to produce even H-beams using this process, never mind hot rolled coils. Yet with strong investment in research and development, today we have

Courtesy of Tokyo Steel

Courtesy of Tokyo Steel

become Japan's leading manufacturer of H-beams and supply millions of tonnes of hot rolled coils both within Japan and abroad. As new manufacturing and digital technologies appear, we are constantly upgrading our processes and production facilities in order to improve quality, minimise costs and boost efficiency. We not only wish to stay ahead of the market, we wish to drive progress in this market.

Our past success makes us confident that we can overcome the challenges of using low-grade scrap to make high-quality steel products. In some cases, such as the presence of tramp elements like Cu and Ni in general scrap, we have even managed to turn potential disadvantages into benefits. To accelerate our innovation in this area, we rely on support from expert partners such as RINA. Applying a through-process innovation approach, they are helping us with two projects related to the operational optimisation of high-grade steel production at our plants in Tahara and Okayama. RINA's expertise complements our internal resources, especially in cases where we don't have specialist competencies. Japanese steelmakers like to keep their know-how secret, so we rely on independent third parties for objective and knowledgeable advice.

Some customers may worry that producing high-end steel products from low-grade scrap will lead to quality issues. Others may have been shaken by recent data falsification scandals affecting certain manufacturers, not only in Japan but worldwide. Customer confidence is vital to us and to the growth of sustainable steel recycling in Japan and across the world. In addition to ISO 9001 quality assurance certification, we conduct regular internal audits and accept customer audits if desired. We have nothing to hide and much to be proud of. I certainly feel proud to see our high-quality operations with my own eyes during my regular visits to our plants in Tahara, Okayama, Kyushu and Utsunomiya.

Our efforts at Tokyo Steel to develop innovative technologies in steel recycling should be seen in a wider context. Renewable energy is becoming more accessible. In fact, we already provide the land for solar and wind power installations to generate electricity at our Tahara plant. Within our plants, we re-use and recycle all by-products such as slag, dust, sludge and waste brick. Our Okayama plant is authorised to treat waste dry-cell batteries, meaning that we can recover iron, zinc and other valuable metals from these waste products. If other companies in Japan and across the world make similar efforts in their own industries, we can together achieve our dream to become a truly low-carbon, recycling-based society.

TOSHIKAZU NISHIMOTO

Toshikazu Nishimoto has been President of Tokyo Steel since 2006, helping to drive innovation in steel recycling and implement a vision of long-term sustainability.

He started at Tokyo Steel in 1984, becoming the General Manager of the Steel Making department at Okayama Works in 1999. In 2001 he became General Manager of the Rolling department at the same plant, before transitioning in 2004 to become the Plant Manager of Takamasu Works.

www.tokyosteel.co.jp

Connecting the world with innovation

Interview with Marcelo de Araujo Andrade, Senior Vice President R&D, Prysmian

I have been called an "innovator and a dreamer" but the truth is less romantic – innovation at Prysmian is firmly linked to customer needs and developments in the energy and telecoms industries. Innovation is valid only if someone wants to buy it, either now or in the future. So I don't dream of a blue bird and then tell our R&D teams we have to start developing a blue cable. Instead, I listen to what customers say and what the markets whisper.

Our telecoms customers are talking the loudest right now. One thing they want, for example, is extremely compact fibre-optic cables. The cables should fit into existing pipeline systems yet be able to feed today's bandwidth-hungry internet applications. So far, we have managed to fit 3,456 fibres into a cable and are now working with RINA on a related customer need: splicing those thousands of fibres quickly and efficiently using a specially developed technique based on ribbonisation.

What are the markets whispering? We see a growing trend towards automation, smart grids and self-driving vehicles, all of which require high-tech sensing and monitoring solutions. Cable systems are no longer simply pieces of copper or fibre that send power and data between two points. They need integrated sensing and monitoring capabilities that can detect failures and continuously optimise performance. So we are working on a lot of projects in this area.

We also see growth in remote monitoring and control. A future use case might be subsea factories and O&G platforms operated by humans on the mainland. But even now we offer many advanced remote monitoring and control services, like detecting and repairing faults in submarine cables. This is an example of how the scope of our innovation has expanded to include not just cables (although we still produce 30 million km of optical fibre a year!) but the whole ecosystem around cables. In fact, we have just ordered our fourth cutting-edge cable-laying ship. Delivered in 2020, it will be capable of handling complex deep-water installations of up to 2,000 metres.

The renewable energy industry is bringing fresh impetus to innovation in power cables and systems. Countries

Courtesy of Prysmian


Courtesy of Prysmian

and continents need more sophisticated, integrated and stable power connections in order to take advantage of renewable energy sources. Just look at the weather map: some areas are sunny, some are windy, some have water and some have nothing. All these areas need to connect their power systems using advanced cable systems, and this trend will only grow.

What we love to do at Prysmian is develop technologies that make it possible to achieve impossible tasks. Our deep-sea submarine cable project is one of these. The current market record for a single-core submarine cable is 1,600 metres, and we are aiming for 3,000 metres. This technology will enable our customers to connect points across the globe that nobody thought could ever be connected. It will be good for our customers and good for Prysmian, but even better for the world.

Speculative projects, like our 3,000-metre subsea cable and our research into graphene and carbon nanotubes, benefit greatly from collaboration with external partners such as universities and consulting engineers. In fact, the subsea cable project was sparked by a collaboration with Politecnico di Milano to devise a "design-driven funnel method" for developing new cable systems solutions. External partners help us to scout technologies and gather market intelligence, thereby feeding our R&D department with fresh streams of new ideas.

When it comes to developing and prototyping, we sometimes need support in particular technical areas. We may have 17 research centres and a total of around 700 R&D employees, but we still value external partners who can bring specialist expertise to the table. One of these is RINA, of course. The ribbonisation project is interesting because it's a global team developing a solution for the global market. Our other projects with RINA, including the design of sampling and testing equipment for optical fibre coating characterisation, or the engineering support for testing, characterization and failure analysis of cables, have a similarly worldwide reach.

During the development phase, we create and validate digital models to help test new materials and systems. When I started at Prysmian as a young mechanical engineering graduate, we used to talk about mechanical stress and elongation. Now we are able to simulate the effects on cables of different temperatures, the presence of gas, humidity levels and many other variables. Digital technologies are helping us to optimise our products and systems to add value for our customers.

When all these factors connect - customer needs, market trends, ambitious ideas, high-tech facilities, digital technologies, internal expertise, trusted partners - that's when we can turn dreams into real innovation.

MARCELO ANDRADE

A graduate in Mechanical Engineering from Universidade Federal de Santa Catarina in Florianópolis, Brazil, Marcelo Andrade has developed his entire career at Prysmian Group, which he joined in 1988.

Over the years he has served in various roles, initially relating to R&D and then to Quality, Plant Management and Sales, dealing with all of the Group's main business units in various countries. Since 2012 he has been Senior Vice President of Research & Development. He heads up a team of over 550 people operating in 17 R&D Centres around the world, with day-to-day responsibility for developing new products and systems and the goal of increasing the level of competitiveness and innovation of products, technologies and materials.

www.prysmiangroup.com

Keeping the Mont Blanc Tunnel safe

Interview with Maurizio Cipollone, Italian Director, GEIE-TMB

Ever since it opened to traffic in 1965, the Mont Blanc Tunnel has been vital to tourism and trade between Italy and France. So it is a great responsibility for all of us at GEIE-TMB, the organisation in charge of managing the tunnel, to ensure its continued smooth operation. The safety and security of the 5,000 or more users who pass through the tunnel each day, as well as of the 250+ people who work there, are a major concern. Thankfully, we have two powerful tools: our skilled operations staff and our high-tech monitoring and control systems.

At the heart of our safety installations is an innovative IT system, LOGOS. This basically processes tens of thousands of data points from a network of sensors in real time, enabling us to continuously monitor how the tunnel is working and how the traffic is flowing. If the system detects an anomaly, it can automatically implement the appropriate measures or alert human operators in the control centres.

Keeping the Mont Blanc Tunnel safe and secure means keeping the LOGOS system secure against software failures and hacking. We have always recognised that while digital technologies help us protect against physical threats, we have to protect those digital technologies against cyber threats. Our access controls and IT security policies are extremely strict and up to date with the latest developments.

In the context of SCADA (supervisory control and data acquisition) systems for motorways, we were the first to implement advanced technical features in our automatic monitoring systems. To verify that we are up to date with the latest security and safety developments, we recently submitted LOGOS to Safety Integrity Level 2 (SIL2) certification. RINA conducted the certification procedure for the system's supplier, Giordano & C. Spa. The results were really positive: they showed clearly what a high level of security we have achieved through developing and implementing this innovative software.

We are currently working with RINA on a separate project related to safety and security. Part of the project involves demonstrating compliance with the EU Directive 2008/114/EC on European Critical Infrastructures. But the scope of the project is much wider, including an

Courtesy of GEIE-TMB


Courtesy of GEIE-TMB

operational security plan for the tunnel that covers both physical and cybersecurity aspects. We are also working on an integrated system between France and Italy that protects all monitoring systems against any attempt at unauthorised access.

So while we can never sit back and relax, I'm pleased to say that the Mont Blanc Tunnel is currently at the cutting edge in terms of the quality of its installations, technologies and security procedures. What we are now focusing on is the civil engineering aspect of the tunnel, which remains the same as when it was designed and built at the beginning of the 1960s. We are currently developing a plan to review and reinforce the tunnel's structural elements in order to align them with the most recent construction standards. The works will be carried out over the next few years.

As I mentioned, the efficiency and quick reactions of our skilled personnel are vital to safety and security. Continuous training is therefore another area in which we employ innovative techniques and technologies. Some of our training solutions would be unrecognisable 50 years ago, such as our interactive 3D simulator to help train operators to manage emergency situations. Of course these are virtual – with video screens and buttons – but the representations are extremely realistic. By simulating different emergency situations, our personnel can practise their interventions and are therefore better prepared for a real-life emergency.

The 3D simulator complements our real-life training exercises, some of which take place in the Galerie de Sorreley-Meysattaz training centre in the Aosta Valley. The centre is specially equipped for training the Italian fire service and others responsible for dealing with emergencies and fighting fires in confined spaces. Four times a year, we also carry out safety training exercises in the tunnel itself. This gives our personnel a regular chance to apply their theoretical and practical knowledge to complex and realistic situations on the ground.

Managing such a logistically important tunnel between two countries will always have its challenges. Different countries have different needs, different priorities and different ideas about how to do things. But that is also positive, meaning that we have to evaluate each decision really carefully with our colleagues across the border, searching for the most appropriate and innovative solutions possible. It is interesting, enlightening and – especially when you look up and see the snowy peaks towering above you – really exciting.

MAURIZIO CIPOLLONE

Maurizio Cipollone has been a member of the Management Committee of the European Mont Blanc Economic Interest Group (GEIE-TMB) since September 2009 and is currently its Italian Director. Before joining the Management Committee, he spent six years directing and coordinating the group's IT and automation department.

Prior to relocating to Courmayeur to join the GEIE-TMB, Mr Cipollone spent eight years in different departments of Autostrade per l'Italia, the company in charge of Italian motorways. His responsibilities during this time included safety and security as well as electrical equipment.

Born in 1968 in the eastern Italian region of Abruzzo, Maurizio Cipollone has a degree in Computer Science from Montani Technical Institute in Fermo and an MSc in Electrical Engineering from the University of Bologna. As well as Italian, he speaks fluent English, French and German.

www.tunnelmb.net

Launching innovation in aerospace

Interview with Pierluigi Perugini, Head of Mechanical and Propulsive Systems Design, Avio

Aerospace is an incredibly exciting industry to be in right now. There are attractive opportunities in interplanetary exploration, "mega constellations" of thousands of small telecommunications satellites, on-orbit satellite servicing and experiments... and countless more.

But the market is as demanding as it is dynamic. New private players are stiffening competition in the space propulsion sector. In Europe, high labour costs and strict regulations add an extra level of challenge. Cutting costs is important, but as with all high-tech industries with stringent safety regulations, there is a limit to the cost reductions we can make. Unless we can develop materials and processes that are radically cheaper yet still 101% reliable, of course.

So the real answer has to lie in technological innovation. To grow sustainably and continue to play a leading role in the industry, we must differentiate our products from those of competitors. The service we provide must be more sophisticated, more reliable, more flexible and higher performance.

Our Vega launcher embodies these characteristics. Produced by Avio in Colleferro, near Rome, Vega has launched 11 times since we introduced it in 2012, with every launch a success. Vega, along with our next-generation launcher Vega C, are scheduled to launch three or four times per year, with the calendar already booked out until 2021. Vega C can carry 2,300 kg of payload into low earth orbit, 800 kg more than Vega.

As I said, the market is demanding. To catch the opportunities, launcher systems should be as flexible and cost-effective as possible, ready to launch whenever needed. Our medium-term development programmes reflect this. Vega Light, a pared-down version of Vega C without the first stage, is designed to launch 300 kg of payload into low earth orbit at a competitive cost. It is scheduled to enter into service in 2021. In 2024 we plan to release Vega E, which will include an innovative upper stage based on cryogenic liquid propulsion (oxygen/methane). This will make it more flexible and help it to deliver satellites to a wider variety of orbits.

Courtesy of Avio

Many in the European aerospace industry are surprised that we managed to develop such a reliable launcher system as Vega in just a few years, and without the huge financial resources that are usual in projects of this type. I put this success down to three factors, all of them based around our people. First, our people are highly skilled. Our facilities are located close to important universities in Rome, Turin and Naples, and aerospace attracts many of the best engineering graduates. Second, we are passionate about what we do. This is one of the most important parts of my job: sharing passion, enthusiasm and humility for the projects in which we are involved. Third, we have a short decision-making chain and are not restricted by heavy layers of internal management.

Industry 4.0 promises to help us develop our launchers and other space propulsion technologies faster and better. For example, we plan to manufacture the thrust chamber of our new Vega E launcher using additive manufacturing. The thrust chamber is a critical component of the launch, in some ways the heart of the system. Additive manufacturing allows us to use a single-material, single-part approach. This eliminates traditional processes like brazing, electrodeposition or welding and their associated ongoing and one-off costs. The result: significant cost reduction and a higher-performance component.

Vega E's large tanks will be made using specially developed lightweight composite materials. Our aim is to achieve cryotanks that are more than 30% lighter than current state-of-the-art metallic tanks and cost 25% less to manufacture. RINA's competencies in advanced materials, as well as its various experimentation and testing facilities, are key to our cooperation in this area. Our collaboration with RINA is also helpful in maintaining quality. Avio is certified AS/EN 9100, the key quality management standard for the aerospace industry, so we periodically submit to audits of our design, development, documentation and configuration management processes.

In addition to these larger "headline" programmes, we are also working with RINA to develop a special process based on plasma sprays for coating graphite and carbon-carbon structures exposed to high levels of thermal flux. A particularly important use of this technique would be at the throat insert of a solid rocket motor nozzle. We have successfully performed a firing test on a small-scale component in a fully representative environment, confirming the potential of this new technology. This kind of collaborative development is one small part of what makes aerospace innovation so exciting and rewarding.

PIERLUIGI PERUGINI

Pierluigi Perugini is Head of the Mechanical and Propulsive Systems Design department at Avio. Avio is an aerospace company that designs, develops, produces and integrates space launchers as well as solid and liquid fuel propulsion systems for tactical missiles and satellites.

Mr Perugini has worked in the field of composite materials for more than 25 years and has been involved in several high-profile projects, such as the design of insulated motor cases for the Vega launcher. Currently, he coordinates Avio's technical activities related to the design of mechanical launch systems, propulsive systems and components.

www.avio.com

Competence management made easy

Interview with Mark Hughston, Technical Training Manager, Hitachi Rail Europe

Complex rail projects require skilled workers with up-to-date competences, qualifications and licenses. When those projects are coordinated from one location, a low-tech solution for managing the ongoing competence of the workforce is just about sufficient. You record essential information about competence assessments, qualifications and licences in a spreadsheet and check it manually when you need to identify a worker with specific skills. During audits, you consume time accessing office cabinets to find the requested hardcopy documents. But it's clear why this low-tech, isolated and paper-based system is not fit for purpose as the complexity of the business and workforce increases.

Hitachi Rail Europe's first major project in the UK, the Class 395 Javelin serving stations between London and East Kent, started in 2009 and was coordinated from one location in Ashford, Kent. We've since won major contracts for the Intercity Express Programme and Edinburgh Glasgow Improvement Programme, replacing hundreds of ageing trains with state-of-the-art rolling stock and turnkey Train Maintenance Centres. We manage these complex projects from various maintenance centres around the UK and have been hiring, training and assessing employees nationwide in a range of technical and operational tasks. It was clear that we needed a robust, flexible and above all compliant system to capture the competence of our workforce.

The Competence Management System that we developed in collaboration with RINA is designed to facilitate our workforce training and management systems, streamline our operations and support our audits and compliance procedures. By standardising and centralising all competence-related information and documentation, we've been able to significantly improve our efficiency when organising maintenance projects and planning training programmes. And when it comes to audits, it's a great relief to be able to pull up records and documents in seconds from a central digital system.

Based on RINA's Competentis® tool, the CMS was relatively quick to develop and tailor to our needs, which

Courtesy of Hitachi Rail Europe


Courtesy of Hitachi Rail Europe

included harmonisation with Rail Safety and Standards Board (RSSB) standards and best practice guidance. The paperless aspect alone provides many benefits, and not just in terms of data sharing, storage and consistency. The system demands evidence such as certificates or assessments to support an individual's skills records. That makes it impossible to bypass requirements or cut corners, giving both us and our auditors confidence that every single person working on our fleet of trains is competent to do their job. With assessment evidence automatically uploaded and stored in real time via tablets, we reduce errors in data entry, vastly ease the job of administrators and can rely on the system always being fully up to date.

While the CMS clearly makes it more efficient to manage competence across the organisation, it also makes it easier for individual team leaders to plan skills development for their team members. We can configure interactive dashboards for each team leader, allowing them to quickly determine what kind of further training or refresher courses are needed. To make this even quicker and more accurate, we can configure specific role "profiles" indicating which tasks, qualifications and licenses a particular role title requires.

All this makes it much more efficient to organise training and assessments. It's like predictive maintenance for your workforce. Instead of waiting for an individual's qualification to lapse – only realising when they need to work on an urgent task – you can proactively schedule their training in advance. Of course, the CMS has sophisticated filtering and reporting mechanisms to help with this.

As with any centralised system, we are well aware of data privacy and cybersecurity concerns. Here again, the CMS has major benefits over low-tech solutions. Configuring permissions allows us to control who can see what, so individuals can only access the information they need to know. Although RINA offers a hosted solution, we chose to store everything on our own servers with strong cyber protections in place. Cybersecurity is a major aspect as we plan our next upgrades, which include a dynamic link to our SAP system and integrating external competence information from Sentinel, a UK "identity card" system for railway workers.

Time - and cost-savings, greater accuracy, better compliance, a safer workforce - and no paper. As Hitachi Rail Europe's business increases over the UK, we have the challenge of harmonising old and new practices and keeping pace with the constant evolutions in technology and standards. Our Competence Management System is a major step in this direction and we look forward to working with RINA on more exciting projects to come.

HITACHI RAIL EUROPE, LTD.

Hitachi Rail Europe, Ltd. is a wholly owned subsidiary of Hitachi, Ltd. and is a total railway system supplier offering rolling stock, traction equipment, signalling, traffic management systems and maintenance centres.

The company's Global Head Office is located in Central London and currently operates from project offices across the UK, several depot locations and a new state-of-the-art rail vehicle manufacturing facility in Newton Aycliffe. Its Class 395 Javelin trains currently in operation on the HS1 route have proven the company's capability in the UK, based on a blend of British and Japanese technical expertise.

The Intercity Express Programme, Abellio ScotRail franchise and contracts with First Group for their West of England and Transpennine routes will see Hitachi Rail Europe deliver over 200 new trains over the next two years.

www.hitachirail-eu.com

The port of the future

Interview with Pino Musolino, President, North Adriatic Sea Port Authority

The port of the future will be increasingly integrated into the city in which it is located as well as the wider system of trade and transportation. A port's relationships with citizens, urban and transport infrastructure, and other ports in the area, should be symbiotic and characterised by the mutually beneficial exchange of resources, knowledge and expertise. In order to achieve this vision and innovate around key issues such as efficiency, access, the environment and security, we therefore need to consider not just one port in isolation but the entire port ecosystem. We must work together to share best practices and achieve a stronger voice on the international stage.

The Venetian port system is recognised as crucial by the EU for the movement of goods and people. It lies at the centre of two strategic corridors of the Trans-European Transport Network (TEN-T), the Baltic-Adriatic Corridor and the Mediterranean Corridor. In this context, we are working to create an ever-closer synergy between the ports of Venice and Chioggia. The aim is to improve access and interconnections, as well as increase the competitiveness of the area's entire port system.

This involves developing the multi-purpose potential of the Port of Venice, enhancing infrastructure and the efficiency of intermodal transport of freight and passengers. We are also developing the potential of the Port of Chioggia for river connections. At the operational level, we are implementing various projects to improve the "port from the sea", i.e. access for ships and boats, and the "port from the land", i.e. the surrounding road, rail and river infrastructure.

Working together means listening to stakeholders and building consensus. Only then do the best suggestions rise to the surface and translate into useful projects at the local, national and international levels. Ever-closer collaboration between the North Adriatic ports led to the formation of the North Adriatic Ports Association (NAPA) in 2010. Comprising the ports of Koper, Rijeka, Trieste, Venice and Ravenna, the strategic alliance aims to harmonise organisational aspects and improve information sharing in order to attract more shipping to the area.

The environment is a clear example of our need for

Courtesy of North Adriatic Sea Port Authority

Courtesy of North Adriatic Sea Port Authority

collaboration. We are constantly exploring innovative technologies to reduce atmospheric pollutants, build new facilities and manage existing ones. Our Environmental Management System includes commitments to developing a sustainable supply chain, reducing waste and pollution, and maintaining infrastructure with the lowest possible environmental impact. Shipping companies operating in the Venice lagoon comply with the Blue Flag voluntary agreement to use low-sulphur fuel. Our plans to create a coastal LNG warehouse and a means for gas distribution and bunkering will help to support all shipping lines wishing to use LNG as a low-impact fuel for shipping.

Through constant collaboration with other public and private players, we are lucky to have access to many innovative projects at the cutting edge of research and technology. We regularly seek assistance from experts during the certification and consultancy phases of a project, when specific expertise is required on issues such as industrial risk, protection of sensitive sites and security. Security in particular is an area in which we work closely with experts as well as port authorities and the border police. New technologies are helping us to improving access control and video surveillance, but we must also consider the growing issue of cybersecurity. Over the years we have collaborated successfully with RINA in several areas, in particular risk management for major accidents and updating our Port Security Assessment following changes in EU regulations.

It is probably clear by now that one of my main aims as President of the North Adriatic Sea Port Authority is to increase collaboration with other port authorities worldwide, sharing information and best practices. Since taking office, I have been clearly focused on the need to put the North Adriatic Sea Port Authority back at the centre of the international debate over trade and infrastructure. In addition to boosting cooperation at the local level through NAPA, and at the regional level through our participation in the MedPorts Association, we play an active role within EU institutions.

Helping to facilitate the development of the ports of the North Adriatic is a continuous and exciting challenge that fills me with pride as a professional and as a Venetian. With the close cooperation of colleagues, experts and other public and private stakeholders, we can together work towards a shared vision of the port of the future

PINO MUSOLINO

Pino Musolino, President of the North Adriatic Sea Port Authority, was born in Venice in 1978. He graduated in Law from the University of Bologna in 2006 and achieved a Masters degree in International Commercial and Maritime Law at the University of Wales in the UK in 2010.

Before taking on his current role, Pino worked as Corporate Insurance Risk Manager for the Middle East at Hapag Lloyd, with responsibility for the management, development, coordination and control of claims and P&I complaints. From 2012 to 2016, he worked as Senior Claims Manager and Average Adjuster at Atlantis International Services NV in Antwerp. His previous career includes Sales and Contracts Manager at Mechel Service Belgium BVBA and Assistant to the General Manager of the Venice Provincial Administration.

Since 2014, he has been a member of Belgische Vereniging voor Zeerecht (BVZ) and of the Association of Average Adjuster, UK.

www.port.venice.it

Space & Defence drive innovation

Can you imagine life without jet engines, satellite navigation or even the internet? So many everyday technologies were first developed for the space or defence industries.

Innovation in space and defence is different from other sectors. For a start, competition is not only between companies but between countries and continents. There is much more at stake in gaining a competitive advantage. However, it is increasingly difficult to justify a fiscal return on investment for military or space innovations. At RINA we have the experience to help shape these investments and provide the justification for doing so.

These are all challenges to those of us trying to drive innovation in space and defence. But perhaps the biggest challenge is the long lifecycle of projects. Imagine buying a laptop now and starting to use it five or ten years later. Some elements of these projects become obsolete and need upgrading even before delivery. Smart use of off-the-shelf systems can help us speed up development times – and that can't come fast enough.

So innovation in space and defence projects is surprisingly difficult – but there are things we can do to smoothen the process. RINA's expertise spans many sectors and countries, and that is really helpful when innovating. Smart people in one industry always look over the fence to see what best practices they can pick up from other industries.

The services that we're focusing on developing right now are about information systems and cybersecurity. This fast-growing area of innovation is driven primarily by the defence industry but has implications for all industries worldwide. Over the next months, our ICT security experts in Italy will support the expansion of our cybersecurity services here in the UK, to meet demand from our government and defence clients. At the same time, we are promoting the use of our Decision Support, Competence Management and Training consultancy services, including simulation and virtual reality solutions for our clients across all industry sectors.

Successful innovation in space and defence is about providing practical, reliable solutions that are both effective and cost-effective. They must take into account the entire lifecycle of a project and the people involved in it. The best innovators are therefore those who can see not just the detail but the bigger picture, which is something I'm proud to say we do particularly well here at RINA.

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Reshaping training in the workplace

What does "innovation in training" bring to mind? Virtual reality, perhaps, or headsets, simulators, educational video games, interactive mobile apps? High-tech resources like these can be an important part of an innovative training solution, but technology is only one part of the story. Innovation is about new ways of adding value that are relevant and appropriate for a company's needs and expectations. With budgets tightening every year, companies rightly want to measure the cost-effectiveness of any new training solutions, but they also want to know that it is going to deliver results.

We work with our clients to identify innovative solutions that make the best use of resources, engage employees and, most importantly, have measurable results for the organisation. We design our solutions with training effectiveness and cost-efficiency in mind and apply a well-established, results-based method to evaluate whether learning has been translated into behaviour on the job. This helps our clients measure their Return on Expectations (RoE) and take informed decisions based on that.

Workplace learning is one trend that is still surprisingly innovative. Companies across all industries are only just starting to recognise the benefits of including workplace learning as part of their training strategy. Research tells us that employees prefer learning in the workplace, at their own pace and at the point of need. Small, "just-in-time" chunks of learning are easier to digest and employees can apply their new skills to real work situations straight away, so it is more relevant and they are more engaged. That means they don't forget it all after a week, so companies see a better return on their investment in training.

The output of training is competence in the job, so innovative solutions don't only look at ways of developing competence but also maintaining it through performance support, refresher training and assessment. The results – perhaps recorded in a mobile app – can be added to a central competence management system. Bringing training and assessment into the workplace also encourages managers to engage more with skills development, becoming "leaders of learning" in their companies and developing a culture of continuous learning. The benefits for human resource planning and talent management are clear.

So "innovation" in training is not something shiny off-the-shelf, but a carefully thought-out, holistic solution to a real need; a continuous learning process that is integral to the company's successful day-to-day operations. It is measurable and brings demonstrable benefits to both individual employees and the company's bottom line.

At RINA, our "through life" approach to innovation is the framework for bespoke training programmes that are perfectly appropriate to our clients' needs. New technologies help: time and location are no longer constraints to training, and intelligent use of data can dramatically improve talent management. But what's truly innovative is not the technology but the thinking behind how it is used.

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PREEcept™ for smarter decision-making

It's a common scene in war films: a group of military personnel standing around a large paper map arguing over tactics. In comparison, RINA's PREEcept™ toolset sounds like science fiction. Its three components - a high-fidelity map, 3D scale model and synthetic environment - can be adapted to any place or facility, real or imaginary. Together, they allow users to visualise complex situations, experiment with ideas and come to informed, consensual decisions. Less dramatic cinema, perhaps, but quicker, easier and smarter decision-making.

Jim Sanderson, who supported the project's development within the framework of the UK Ministry of Defence Niteworks partnership, explains how it worked during a collaborative exercise to explore the capabilities of armoured vehicles in different scenarios. During the planning stage, the high-fidelity map and 1:300 scale model made it easier to see quickly what was possible and what was not.

"Compared to a similar 'flat map' exercise last year, we saw more engagement from participants, less disruption from disagreements and more collaboration," says Mr Sanderson. "The physical mapping brought the participants to the same level of understanding right at the start. It provided a new level of collaboration over tactics and processes."

Participants could then refine these plans using quick simulations in the synthetic environment. "This immerses people in the reality of the environment they'll be operating in, making their thought processes and reactions more realistic," notes Mr Sanderson. The simulations can be used to answer specific questions or clarify points of disagreement. The next stage in this type of capability experimentation is a "war game" or full-scale simulation in which participants can execute their plans - before evaluating them afterwards with the help of recordings from in-built cameras.

PREEcept's most obvious use outside the military is for ports, shipyards, large factory sites or sports arenas. Using a map, model and synthetic environment of their real facilities, decision-makers can talk through current processes and streamline their operations or safety and evacuation procedures.

Training is another key area. We've found PREEcept™ to be engaging and effective in orientation training for new staff joining a large cruise ship or offshore rig, for example. Business continuity or area-specific emergency training can use highly customised models, whereas generic training uses imaginary environments incorporating real-life elements such as roads, buildings and parked cars. These models can be used over and over again as new staff come on board.

Surprisingly given its many benefits, PREEcept™ is vastly more cost-effective than the alternatives, described as Mr Sanderson as "agile, flexible, quick and cost-effective compared to previous tools." War-gaming is the part that sparks attention, but what's more exciting about PREEcept™ is how dramatically it supports decision-making and training in practically any area of defence and industry.

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Exploring the capabilities of armoured vehicles

Building a business case for change

Making a business case for change is one of the most fundamental steps in any project, programme or portfolio and one not unique to any single sector or industry. When you have a major transformation programme underway within an existing portfolio, the magnitude of the business case is immediately multiplied ten-fold. How do you manage and advance multiple cases while keeping the business strategy aligned across the overall portfolio? How do you ensure you are taking decisions based on accurate, up-to-date and transparent information?

A major UK government agency with more than 40,000 staff and 90 large transformation projects across 12 major programmes recently engaged our Decision Support Services team to help them with a consistent and integrated approach to business case development. The aim was to maintain vital public-facing services while reducing expenditure. A logical and accurate approach to analysing and realising benefits was therefore essential.

The solutions we developed took a bottom-up approach to individual projects while maintaining the strategic emphasis of the portfolio. One of our first and most immediately valuable projects was the development of a Portfolio Cost Model to collate cost and benefit data from around 90 projects into a single, user-friendly analytical tool. By improving visibility and comparability, our client could then analyse actual versus estimated costs, prioritise projects effectively and gain a realistic idea of how much change was affordable and achievable in a single financial year.

As with any large organisation, our client had several IT providers with varying fixed-price and variable-price contracts. We developed a Charging Model to help them fully understand the drivers of their fixed and variable IT costs, such as the number of users, devices and applications. The model allowed them to explore the potential financial impacts of increasing or decreasing these drivers. Models such as this - which can be adapted to any service in any industry - are essential in making a business case for change.

Shortlisting bidders during a tendering processes, selecting the preferred provider and getting buy-in from stakeholders are major issues for all companies. To help our client assess the Value for Money of different bids during an important tendering process, we developed a cost-benefit model compliant with the UK Treasury's Green Book of guidelines. This tool helped our client to identify areas of budgetary pressure, making it easier to evaluate the bids and communicate the financial position to senior stakeholders and decision-makers.

RINA's analytical skills and deep understanding of complex organisations and IT service provision are key to our ability to provide business case development services on such a large scale. In addition, we have the benefit of being an impartial business, free of commercial restrictions and cultural resistance to transformation.

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Industrial uses of space technology

Space exploration technologies benefit our daily lives in numerous ways, from fire-fighting equipment to solar cells. Many more technologies developed for space exploration almost certainly have valuable applications for industries here on Earth. What other technical developments can we repurpose from space programmes, and what innovative solutions can we exploit?

The European Space Agency Technology Transfer Programme (ESA TTP) was established in 1992 to facilitate innovative uses of technologies developed as part of the ESA space programme. Since then, D'Appolonia and now RINA have been responsible for its Italian activities as part of a team of 16 brokers across the EU.

The space technology transfer programme is valuable for many reasons. Firstly, the technologies themselves are mature and resilient. Secondly, the ESA facilitates access to its own intellectual property. Thirdly, the fact that a space-based technology is embedded in a new product offers great visibility and publicity.

Both providers (technology owners) and receivers (companies with specific technical problems to solve) stand to gain by transferring innovation from space to terrestrial industries. RINA and other brokers in the programme facilitate the transfer by mapping the space assets in a functional way, i.e. describing the technology's innovative capabilities and advanced functionalities. RINA experts also add value by suggesting adaptations to respond more closely to industry needs. The aim is to connect both ends of the tech transfer in innovative ways and smoothen the entire process.

Space technology owners are welcome to join a community of more than 300 unique space developers, now mapped and interactively searchable through the portal spacesolutions.esa.int. The platform is aimed at both technology enthusiasts and industries seeking to find new answers to their needs with the help of brokers. So far, thanks to RINA's structured approach, more than 40 transfers of technologies from the space industry to terrestrial industries have taken place. The transfer covers the whole process from preliminary opportunity identification to feasibility studies and finally the transfer and adaptation to the industrial application.

Recently, industrial companies like Electrolux and Ansaldo Energia have taken advantage of assets made available thanks to ESA space research. They seek – and have found – concrete opportunities for innovation to increase the quality of their products and services, embed new features and raise global competitiveness. The final benefit is for citizens all around Europe: access to assets that represent the most advanced technologies, in a reliable framework and under favourable conditions.

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How and why to protect OT systems

As cybersecurity breaches of industrial control systems (ICS) continue to increase, two things are clear. Firstly, information technology (IT) is converging with operational technology (OT) - hardware or software that monitors or controls physical devices and processes. Secondly, while most companies now take IT cybersecurity seriously, many underestimate security risks from the OT in their industrial control systems.

Inadequate protection may cause significant financial loss, injury or environmental damage. However, ICS are often considered safe as they are "not connected to the internet" and are therefore not subject to updates or security assessments. For operational reasons, though, systems are occasionally connected to a network or PC. If these are not fully secure, opportunistic malware can easily penetrate the ICS and damage or block the system. A targeted attack, perhaps designed to steal data or blackmail a company, would be child's play.

There are four key elements:

1. OT cyber threats increasingly resemble those of IT systems: dynamic, constantly renewed and exploiting vulnerabilities in individual components;
2. Vulnerabilities may derive from interdependencies or operational changes. Initial checks and certifications do not ensure security during the system's entire life;
3. Continuous system security management and staff training are essential;
4. A series of measures must work in combination to increase resilience and protect critical components.

These four elements point to one conclusion: we need to consider the system throughout its life. When advising on IT/OT security at RINA, we focus on developing a cost-effective approach that is tailored to our client's specific needs and covers the system's entire lifecycle.

Some principles are:

1. Ensure that everyone involved in the system lifecycle, including manufacturers, integrators and users, contributes to managing system security;
2. Extend security assessments beyond the initial system release phase;
3. Make the supplier responsible for continually assessing cyber risks to the system or components;
4. Develop a robust cyber risk analysis process;
5. Conduct regular staff training and checks;
6. Regularly assess cyber risks for producers, integrators and users to verify the system's protection and resilience;
7. Implement a two-way process for recording incidents and sharing information between the contractor and the client.

RINA's services cover the whole engineering process, from the definition of the security requirements to the design, implementation and verification of measures to mitigate the identified risks. Following a "through-life" process and methodology, we ensure that the security of the system is achieved by design and maintained throughout the whole lifecycle and contractual chain.

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Bravery in industrial innovation

Innovation is about bravery. I think that every time I look around one of RINA's R&D facilities, like our renewable technologies laboratory in Lamezia or our Advanced Materials competence centre in Castel Romano.

Why bravery? Well, firstly because competition is fierce. Every player can become a global player. Tiny companies with revolutionary business ideas now threaten to disrupt established industries. Innovation has become more accessible, as new technologies help to spread information, speed up development and reduce costs.

To compete, innovation to make existing materials and processes faster, cheaper and more efficient is essential. More interestingly, however, with new technologies and a touch of bravery we can also develop solutions that were impossible before. Industry 4.0 expands our opportunities to turn crazy ideas into practical solutions. For example, additive manufacturing can speed up product development, make manufacturing more flexible and save raw materials. Very good. But when we help our clients create new, high-performance components that can only be produced through additive manufacturing, that is the real breakthrough.

Knowledge of materials and processes is fundamental to industrial innovation. Enabled by supercomputers and advanced modelling, this knowledge makes it easier and quicker to take decisions that affect product quality and costs. We can even install advanced sensors along a production line to empower models and form a "digital twin", allowing us to identify possible improvements in real time.

With advanced predictive models, we can investigate the behaviour of components and complex systems more extensively than in real life. This is crucial when we help companies increase the performance and safety of plants, pipelines or gas turbines, or guarantee that a material can withstand the stresses of a specific application in space or at sea or in the air.

Bravery and creativity speed up innovation. They help our multidisciplinary teams do what they've been doing for a decade: scouting to identify new applications for mature technologies in different industrial fields. We have applied space technologies to traditional industrial sectors, for example, and even applied a solution to verify the quality of steel wires to a spaghetti-making machine.

Beyond computers and high-tech testing equipment, the main assets in our research facilities are our brave teams of people. They channel their passion into a practical, holistic Total Innovation Management approach that supports clients through every stage of the innovation process, from strategic analysis to end-of-life management. Working across countless sectors, countries and types of companies gives our people deep and wide-ranging expertise, along with a sharp eye for potential new applications of mature technologies. And most importantly, an open mind for new ideas and the bravery to try them out.

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Blockchain is transforming industry

Blockchain was originally developed as an open-source technology for handling transactions of the crypto-currency Bitcoin. As a peer-to-peer network, it removes the need for a central authority or third-party intermediary such as a bank. Industry is now waking up to the fact that the impact of this technology is far wider than crypto-currencies. Blockchain has the potential to affect all business sectors and transform the way we trace and verify transactions of all types.
Whether public or private, blockchains are distributed ledgers that record "blocks" of information. Each block is linked securely to the previous block using cryptography. The chain cannot be modified. The blockchain is therefore secure by design, an essential feature in a world where hacking and falsification are real risks.

Without getting too technical, it is important to highlight four key features of blockchain. First, **consensus**. All participants ("nodes") must agree that a transaction is valid. Second, **provenance**. Participants can find out where an asset came from and how its ownership has changed over time. Third, **immutability**. If a transaction was made in error, a new transaction must be made to reverse the error, with both transactions visible to all parties. Lastly, **finality**. There is one single place to determine the ownership of an asset or completion of transaction: the distributed Blockchain ledger.

Blockchain is interesting for businesses because it enhances the traceability and security of transactions. Supply chains are one key area where the technology provides great added value. For example, take food production. The global trade in food products is becoming increasingly complicated, which is good for consumer choice but results in long, complex supply chains that are difficult to audit. Information is often kept on paper, while the lack of transparency means different parties hold different and sometimes contradictory information. Do you want the ability to know where your food comes from? Blockchain makes this possible. Every transaction or process involving a product and its components is recorded in a distributed ledger. The supply chain is permanent, verifiable and complete, bringing a new level of trust and transparency to the network of growers, processors, retailers, regulators and consumers.

Blockchain and the more recent IOTA - a next-generation technology with greater applicability for the Internet of Things - are elevating the traceability and transparency of industrial manufacturing to a new level. They are reshaping business models and making requirements such as regulatory compliance quicker and more cost-effective. At RINA, we have seen enough technologies come and go to know that one shouldn't overestimate a new technology in the short term. But it is equally important not to underestimate the long-term potential of blockchain. That is why we are committed to staying at the forefront of innovation in this area, identifying practical ways in which it can help our clients enhance their businesses.

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Modelling boosts product development

The ability to reduce production costs decreases rapidly during the first phases of a project. In fact, roughly 80% of the development cost and 70% of the life cycle cost of a product are determined during its conceptual design phase. Changing the design during the engineering and manufacturing development phases is difficult due to the project's maturity. Moreover, the product development phase is more influenced by industrialisation best practices, which are less prone to time compression. So the need to reduce R&D time is really high.

The more effective and powerful our design tools, the more we can shorten the time it takes to acquire physical knowledge of a product and then to reduce production costs. In such a challenging design scenario, modern modelling methods and tools such as Computer Aided Engineering (CAE), Computational Fluid Dynamics (CFD) and Computational Structural Mechanics (CSM) have become essential thanks to their accuracy and reliability.

Proper use of CAE modelling allows us to reliably predict system responses and explore the influence of parameters like material properties and working conditions. It can be used to test some things that often cannot be checked even with experimental testing. A simulation-driven approach enables us to reduce lead times, increase quality and reduce development costs, while limiting costs related to trial-and-error test methods.

During the last decades, CAE modelling has grown rapidly in importance and relevance. Experimental testing used to be the only way to validate algorithmic solutions and computational outputs. Now that CAE modelling has been extensively validated in production design, it is seen as complementary to physical tests and even in some cases as an alternative.

CAE modelling consistently helps us to accelerate industrial product development. This is even truer if we exploit advanced techniques such as CAD-based and/or mesh morphing and parallel computing using a High Performance Computing (HPC) and/or Graphics Processing Unit (GPU) system. This type of technology gives analysts really powerful tools for effective design and optimisation of the product. Promising techniques such as Reduced Order Methods (ROM) can also reduce the complexity of mathematical models in CAE analyses and suggest ways to improve a system.

CAE modelling may enhance and speed up development, but skill and experience are needed to exploit its full benefits. Our creative, multidisciplinary Industrial Design & CAE team at RINA has deep and wide-ranging expertise in CAE modelling and other advanced design techniques. We have helped clients in many industries – defence, aerospace, aeronautic, O&G, energy, marine, transport – with their product development, testing and optimisation processes. Recent examples include Finite Element Method (FEM) design activities for the European Space Agency (ESA) and a medical CAE simulation that was awarded "Best in Class" in the ANSYS Hall of Fame 2018 competition.

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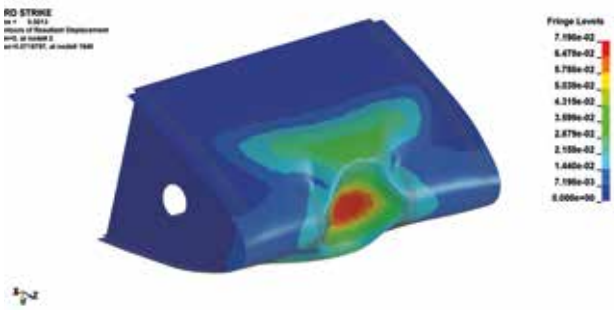

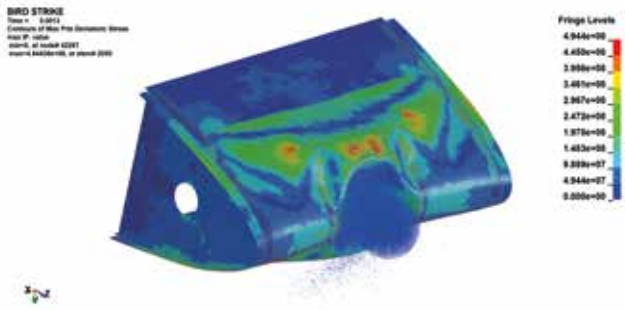

The need for full-scale testing

A deepwater offshore pipeline in the Mediterranean delivering sour gas at high pressure. An aerospace component subject to cyclic loading under extreme thermal excursion. These applications require an advanced safety and reliability evaluation in real operating conditions. There are countless examples of such scenarios across the O&G, aerospace, energy and other sectors. Key factors are temperature, pressure, loading and environmental conditions.

Special testing, particularly full-scale testing, enables us to verify the actual performance of components, accounting for the real operating conditions and possible scale factors. Special testing also enables the technical qualification of components for specific applications and, in parallel, the evaluation of safety and reliability factors that have a direct economic and social impact.

Modelling is a valuable tool for helping to design a special testing process. However, despite the high level of accuracy achieved, and the dramatic increase in computer calculation capability, modelling cannot replace special testing. On the other hand, experimental results can be helpful to parameterise numerical models more accurately. These models can then be used to extend experimental results through sensitivity analysis around test conditions.

RINA's technology and innovation centre in Rome has wide-ranging experience in developing solutions to test materials and components in project-specific conditions. These conditions take into account the actual operating parameters, e.g. related to the environment, fluid composition, temperature, pressure and loading. We perform not only standard special tests but also customised tests. In our laboratories and full-scale testing facilities, we evaluate material creep behaviour, fracture mechanics response and control, strain capacity, corrosion and stress-corrosion performance, and many other aspects.

Objectives may include supporting component design, qualifying innovative technical solutions, verifying the operating performance, safety and reliability of structures, enhancing the life prediction of a component... Along with our facilities and our experience, we offer the added value of numerical modelling and non-destructive testing capabilities for post-test measurements.

For example, RINA recently developed a unique offshore test to investigate and enhance the control of ductile fracture propagation on a pipeline transporting anthropogenic CO2 in supercritical conditions. At the same time, the test evaluated the impact of CO2 dispersion in the environment. Other special projects envisage testing materials in extreme sour/HPHT conditions to extend their operating scope.

These are complex projects with direct benefits to help reduce costs and improve safety and reliability for the surrounding environment and human beings. RINA's experience in the interpretation of experimental results is key to full understanding and, more importantly, actionable insights.

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Smart sensors meet spaghetti

Pasta production is one of those sectors in which industrial methods and automation meet artisanal skill. It is also a sector in which there can be no compromise on quality. The human touch adds value to the end product. Would you prefer "handmade Italian pasta" or spaghetti that is advertised as "produced entirely by machines"? Yet smart use of new industrial technologies can help improve pasta quality while reducing production costs.

Millions of spaghetti per hour are delivered from extrusion machines to the final package via a long and delicate drying process. The drying process is a crucial part of pasta production and key to reaching the desired quality level. Until now, quality control over this process had to be performed by humans - a slow, costly and sometimes inaccurate process.

RAM Elettronica, supplier of the most well-known Italian (and hence worldwide) market leaders of high-quality pastas, has engaged RINA to combine its own expertise in food processing equipment with RINA's in-line inspection and sensor capabilities.

The result is a spaghetti production line fitted with advanced machine vision systems. These perform real-time recognition of defects that until now only a human eye could see. The sensors acquire images during production, process these images in real time and identify any imperfections by analysing alterations in colour shades. Imperfections could be due to overheating, imperfect drying or contamination.

If the system identifies imperfections in small quantities of pasta, it can discard the affected pasta in real time without delaying production. In the case of persistent errors and quality deviations, the line is stopped. Alerts and notifications allow the process settings to be adjusted quickly and accurately, thereby greatly reducing wastage and costs.

Tight specifications, reliability constraints and strict regulations on food manufacturing were key concerns of RAM Elettronica when launching this innovative project. It is a pleasure to have been able to develop the in-line system and see it promptly identifying and discarding every single non-compliant spaghetto. Next steps? Penne, fusilli, tagliatelle... and beyond food production lines, other sectors where in-line inspection is crucial for the production process, such as manufacturing and pharmaceuticals.

The next time you taste a good dish of spaghetti, you know what is behind it. Not just the chef's skill but advanced image-processing algorithms, high-resolution cameras, custom lighting systems, specially designed process layouts for better image acquisition, flexible installations and immediate rejection of any item that does not meet the desired quality standards.

The system offers great added value to manufacturers, who can guarantee rigorous quality checks even during high-velocity, high-volume production. The days of slow, costly 100% manual inspections will soon be in the past. This project is a good fusion of RINA's slogan, "Excellence behind excellence", with RAM's claim that "We know automation".

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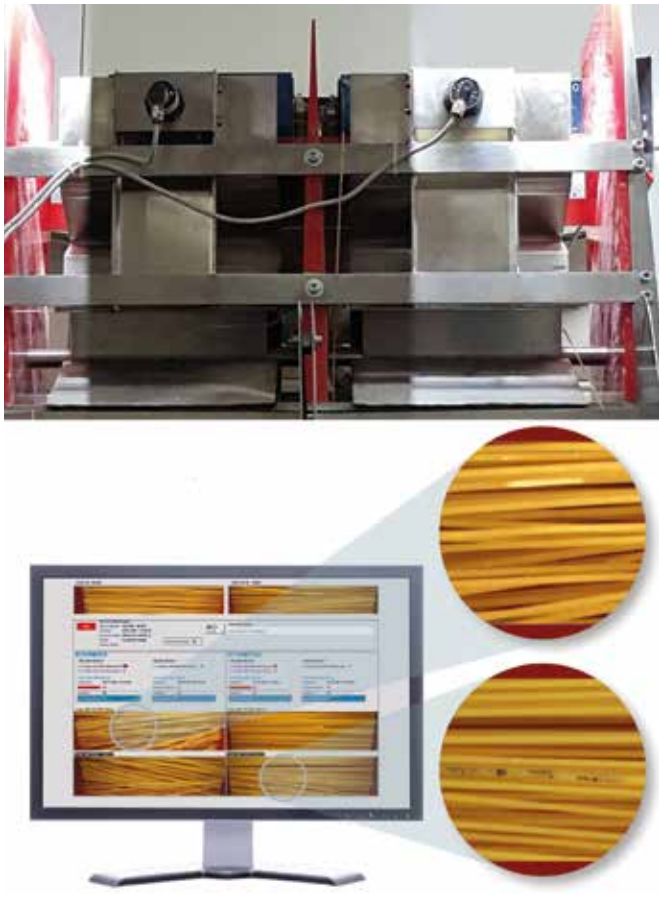

A business strategy for success

There are many ways to define innovation, but one of our preferred is: innovation is a new or modified entity capable of creating or redistributing value. This definition, stemming directly from the work we are doing as Italian delegates in the ISO TC 279 "Innovation Management" technical committee, highlights the strong link between innovation activities and business strategies. In other words: innovation is valid and sustainable only if someone wants to buy it, or its results, either now or in the future.

On that basis, is it possible to establish an innovation process that minimises the risk of failure and maximises the business output of the investment? The short answer is yes. However, this strongly depends on the effective implementation of a suitable business strategy at the company level. This means correctly planning, executing and monitoring strategic actions at all levels, from the executive board to operational staff. It means collecting, analysing and actioning all available information useful for shaping the business solution around each innovation idea, in line with the overall vision and leadership model.

RINA's Innovation Management methodology is based on this approach. We deploy this methodology in our innovation services, tailoring it carefully to customer needs and priorities. In this framework, it is worth addressing two key components of a successful business strategy: Strategic Intelligence and Business Modelling.

Strategic Intelligence is a core process tailored to the company's Innovation Management System. It is the primary tool enabling valuable information and ideas to flow vertically across company functions, with the aim of helping the management board take the best strategic decisions possible. For more than 15 years, we have been providing Strategic Intelligence services to support the R&D investments of market leaders in a wide spectrum of industries. For example, we are currently engaged in the analysis of competitive and technology scenarios for a major global mining firm. In addition, we are scouting and evaluating new product development opportunities for several large companies and SMEs in the manufacturing sector.

Business Modelling helps decision-makers to correctly shape the business idea around the relevant factors affecting its success, whether they are technical, economic, social, environmental, legal or political. Business Modelling primarily involves the capability of identifying and leveraging value within the information gathered through the intelligence process. Using well-established tools and methods, this guides the definition of the business idea. For example, we have applied Blue Ocean strategy tools to design the value proposition of innovative imaging services. We have also used the Business Model Canvas methodology to help identify and evaluate alternative investment opportunities in the construction sector, integrating our Business Modelling capabilities with our IP Management and Value Chain Analysis expertise.

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Additive manufacturing, certified

Additive manufacturing (AM) is one of the so-called Industry 4.0 technologies with the potential to transform industry. In addition to saving costs and reducing waste, AM allows rapid prototyping, immediate implementation of design changes and the ability to produce a wider range of shapes than before. Thanks to its wide-ranging industrial experience, RINA has long recognised the benefits of this technology and has the ability to manage the entire AM value chain, from the raw materials (powders) to the end products and components.

Since AM is a relatively new process, standardisation is still ongoing. Several organisations, including ASTM, AWS and ISO, are busy defining and adopting guidelines and recommendations. However, the market need for qualification and certification is undeniable, in particular when "fitness for purpose" is required.

To meet this need, RINA has defined a "Guideline for the certification of metallic parts made by additive manufacturing (AM)". This describes the process to obtain the certification of components made by AM, following a systematic approach through the different stages of design and production. The purpose is to support the use of AM technologies as an alternative manufacturing method. It will also provide industry with a guideline for the certification of parts, components and products made by AM processes.

A major differentiator of RINA's new AM guideline is its comprehensive approach. Rather than focusing on a particular market, such as shipping or steel products, it can be applied wherever additive technology is used to create metal components. This means that one guideline can be used for AM processes in any sector, from energy to coal and steel, from consumer goods to transport. Two RINA Business Units led the project to develop the guideline: the Industry New Manufacturing Technologies Unit and Certification Compliance & Process Improvement Unit. By working together, they combined technological know-how with RINA's consolidated certification approach.

RINA's new AM certification guideline highlights an important aspect of Industry 4.0. Manufacturing is continuously evolving and technological innovations seem to appear every other day. The main topics are on everyone's lips: Internet of Things, machine-to-machine, cloud computing, big data, augmented reality, data analytics, smart sensors, blockchain, robotics, man-machine interaction... However, all industries need reliable standards and guidelines developed by experts to ensure that these technologies fulfil their potential and develop into a stable, harmonious and transparent manufacturing ecosystem.

Innovation is fundamental for accelerating the process of modernisation that will eventually lead to the "smart factory" of the future. RINA is deeply involved in this innovation process, evaluating new technologies on the basis of solid experience gained through collaboration with important players in the coal, steel and other industries. The "Guideline for the certification of metallic parts made by additive manufacturing (AM)" is one small but important step along the way.

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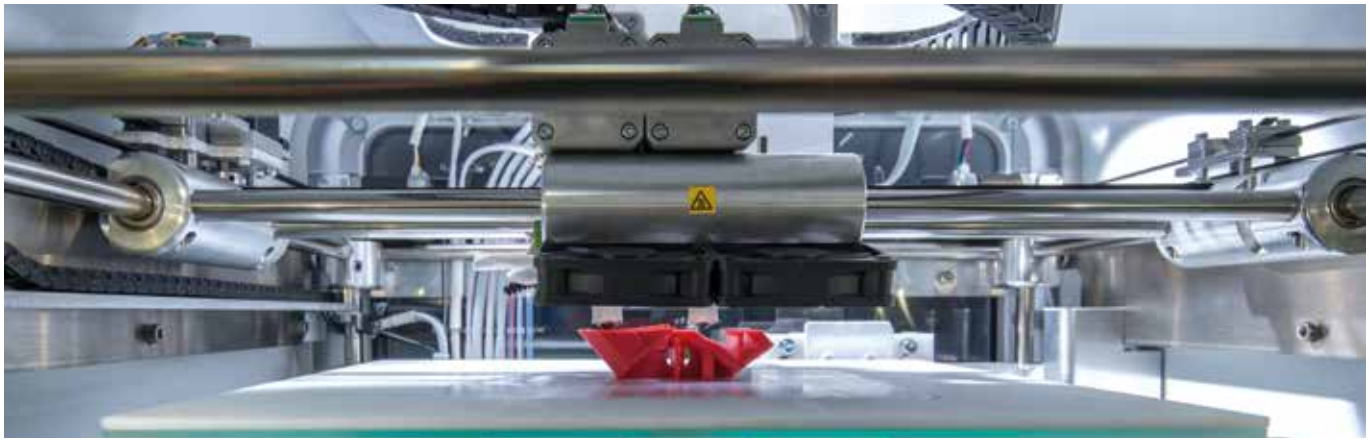

Boosting innovation with an advanced SEM

To keep up with the fast pace of innovation, three elements are essential: a deep technical understanding of materials and engineering, razor-sharp analytical capabilities and cutting-edge equipment. The first two come from long experience and multidisciplinary teams of experts, while the third is often a difficult decision. As a leading engineering consultancy business spanning a wide range of sectors, RINA is constantly faced with tough decisions about what equipment we need to upgrade in our laboratories and when to acquire it.

Our new Scanning Electron Microscope with Field Emission Gun (FEG-SEM) is a case in point. Although we already have five Scanning Electron Microscopes in our international laboratories, our new FEG-SEM provides even faster analysis and enhanced X-ray mapping capabilities. It also, crucially, adds new capabilities sought by our customers including phase identification, grain size determination and orientation measurements.

The SEM's advanced analytical capabilities will support our failure investigation, root-cause analysis, materials development and analysis, and asset life condition assessment services. It will serve our clients in sectors across energy, renewables, heavy industry, steel production, defence, marine, infrastructure and rail, as well as a large range of equipment or component manufacturers.

Customer demand is usually the main driving force behind our decisions to acquire new high-tech equipment. In the case of the FEG-SEM, developments in the field of materials have now made it essential to image and measure particular nanoparticles that control key properties such as strength and elasticity. With the help of the new machine, we have been able to measure nanometre-scale gamma prime precipitation within a nickel-based superalloy to determine the level of degradation within a gas turbine engine. For an aerospace client, we could identify trace elements on the fracture surface of a safety-critical component, enabling us to identify the cause of the failure and recommend corrective actions.

When considering what new equipment to invest in, efficiency is a key concern. With the new SEM, our clients experience even faster turnaround times of analytical results. As many of them are physically present to witness the analysis, this dramatically improves efficiency for their operation.

Innovation is not just about doing things faster and more accurately, but also about developing materials, components and systems that have never existed before. By enhancing our ability to carry out complex techniques, such as electron backscatter diffraction to reveal the detailed microstructure of a material, the SEM will help our clients develop and test brand new materials with the potential to give them a competitive edge in their field.

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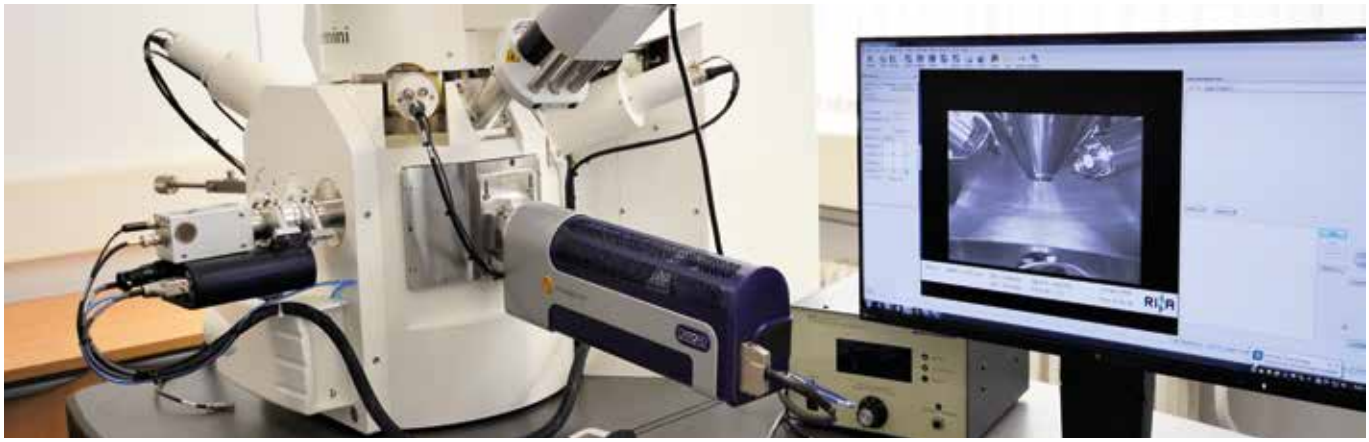

Staying tuned on technological trends

Technology Surveillance is a particularly critical task when dealing with advanced technologies, Key Enabling Technologies (KETs) and sensitive sectors such as biomedicals, pharmaceuticals, space or telecommunications. Typically, Technology Surveillance activities are aimed at an in-depth understanding of the competitive environments in which a company operates. This involves assessing the uniqueness of a proposition, identifying the value propositions and spotting any potential competition.

Competitor analysis tools can include reviewing competitors' scientific and technological publications, as well as their patenting efforts, patterns of cooperation and new launches of products and projects. This information can be used to gain useful insights and refine industrial strategies. The end goal is usually to maximise revenue or minimise risks. It could also be to anticipate future trends whose impacts might be relevant to the company's strategy of acquiring, securing and exploiting business opportunities.

We have deployed this tailored approach for clients in many sectors, including raw materials. What is new is our method for delivering the information in a more dynamic, time-sensitive way. This development was motivated by a request from a Latin American-based mining company that is a leader in its field and highly focused on innovation.

Typically, extractive industries are seldom perceived as innovative. The fact that they operate in dirty environments, with heavy machines to crush, haul and transport metal ores, may have influenced this perception. However, nothing could be further from the truth. Our detailed insights into technologies in the mining sector paint a clear picture of how constantly, heavily and ubiquitously the mining industry is innovating worldwide. Mining companies and suppliers of mining goods and equipment are investing a huge amount of effort in innovation every year.

Our Latin American client wanted this Technology Surveillance information delivered in a truly dynamic way, so that its executives and decision-makers could have access to the most up-to-date insights whenever they needed them. Therefore, instead of delivering periodic reports on paper or via static files transferred by email or a remote folder, we chose a cloud-based infrastructure. This works as a direct channel to connect our analysts to the customer, through five areas focused on the topics to be periodically updated. In this way, we provide our client with a direct and detailed overview of the products, processes, patents and publications of potential competitors, plus news and updates relevant to specific areas of innovation.

We are proud to offer such a high added-value service to help a leader in the mining industry take optimal decisions about its future strategic developments. By providing our service via a dynamic, cloud-based platform, we can best help the leaders of this company – and all other innovators who can benefit from Technology Surveillance – stay at the cutting edge of developments in their field.

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Showcasing RINA

If you want to keep up with the innovations that are changing the face of the industry, come and meet RINA at any of these key events in 2018:

EVENTS RINA IS INVOLVED IN

CONWEEB WORKSHOP: CONVERTING CONSTRUCTION WASTE INTO ENERGY EFFICIENT BUILDINGS
May 24, Brussels (Belgium)
www.conweeb.wordpress.com
RINA's role: project coordinator of VEEP project www.veep-project.eu

NACE, A EUROPEAN EVENT FOR THE CORROSION PREVENTION
May 27-29, Genoa (Italy)
www.naceitalia.it/GENOA2018/
RINA's role: exhibitor at booth no. 34

WWM'18 - 8TH INTERNATIONAL CONFERENCE ON MAGNETISM AND METALLURGY
June 12-14, Dresden (Germany)
www.imf.tu-freiberg.de/wmm2018
RINA's role: presenting three technical papers

OMAE 2018 - INTERNATIONAL CONFERENCE ON OCEAN, OFFSHORE & ARCTIC ENGINEERING
June 17-22, Madrid (Spain)
www.asme.org/events/omae
RINA's role: presenting a technical paper on subsea cables

FARNBOROUGH INTERNATIONAL AIRSHOW
July 16-22, Farnborough (UK)
www.farnboroughairshow.com
RINA's role: exhibitor at booth no. 1038

EVENTS POWERED BY RINA

For more information about these events and more, see **www.rina.org/en/media/events**

INDUSTRY NETWORKING EVENT FOR LOSS ADJUSTERS, INSURERS AND SOLICITORS
July 5, London (UK)
RINA's role: organiser and host, presenting our new Scanning Electron Microscope (SEM)

STEELMASTER ADVANCED TRAINING FOR THE STEEL INDUSTRY: WEEK 1
October 1-5, Genoa (Italy)
www.rina.org/en/steelmaster-week1
RINA's role: organiser and training provider

STEELMASTER ADVANCED TRAINING FOR THE STEEL INDUSTRY: WEEK 2
November 5-9, northern Italy
www.rina.org/en/steelmaster-week2
RINA's role: organiser and training provider

EEE CONFERENCE: ELECTRICAL AND ELECTRONIC EQUIPMENT & THE ENVIRONMENT
November 14-15, London (UK)
RINA's role: conference organiser, session chair and presenting two technical papers

MAM18 ADDITIVE MANUFACTURING ADVANCED TRAINING
December 4-6, Milan (Italy)
www.rina.org/en/mam-2018
RINA's role: organiser and training provider in collaboration with Politecnico di Milano

#DESIGN4ENTERPRISES – 3-YEAR PROGRAMME OF COURSES TO SUPPORT DESIGN-DRIVEN INNOVATION
RINA's role: training provider
- **Innovation Norway: June 7, Oslo (Norway)**
- **Cité du design: June 11, Paris (France)**
- **Athens University of Economics and Business (AUEB): June 21, Athens (Greece)**
- **European Institute of Innovation & Technology (EIT): July 3, Brussels (Belgium)**

Powered by RINA, Politecnico di Milano and Associazione Design Industriale (ADI). RINA was winner of the "Design for Enterprises" project in 2015.

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