

INNOVATION+ RINA

RINA MAGAZINE - INNOVATION EDITION



INSIGHTS
from industry experts

SUSTAINABLE
future technologies

ANALYSIS
for smart innovation

Welcome to the latest Innovation+, covering promising trends and groundbreaking ideas in industries worldwide. In this issue, our experts and interviewees explore different approaches to innovation, including technology transfer, cross-sector collaborations and how to gain a competitive edge in fast-changing markets. You can also read about innovative recycling techniques for high-grade aluminium and steel, developments in sustainable concrete production and heating systems, and software to support smart monitoring systems and manage workforce competence.

Many thanks to the European Space Agency, Tenaris and the Bio-based Industries Consortium for their valuable contributions.

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Supporting a culture of innovation

The world of work is changing. More and more companies are using new and innovative technologies to gain a competitive advantage and as a catalyst for business growth. Unlocking innovation is a key challenge for our industry customers and crucial to their continuing success.

Today, the concept of innovation is widely used in industry, research, economics, politics and other areas. But do we all agree on what it means?

The Oxford English Dictionary defines it as “making changes in something established, especially by introducing new methods, ideas, or products”. At RINA, we look at innovation as both a process and an outcome. It underpins the implementation of new ideas to support new products, processes and services that add value to an organisation.

Innovation can add significant value to existing problems of cost, efficiency, safety and operational capability. In order to meet the challenges of a changing work landscape, we also need to think more imaginatively and innovatively. As Henry Ford, founder of the Ford Motor Company, famously said: “If I had asked them what they had wanted, they would have said a faster horse.”

Within the Industry division at RINA, we are ideally placed to help our customers realise the benefits of innovative technologies and enhance their operational capabilities. In addition to our highly qualified and experienced teams in the Materials, Technology and Innovation (MTI) and Space and Defence Business Units, we are able to take advantage of our network of colleagues within RINA and across the world. Successful

innovation needs collaboration and multidisciplinary expertise.

We therefore work in partnership with other Business Units and industry stakeholders to solve shared challenges and achieve competitive advantage while driving down costs. With expertise and experience spanning many sectors, and a collaborative working approach, we address real market needs and demands to deliver measurable value to our customers.

Our MTI colleagues work closely with major players in the industry sector to enhance both products and manufacturing processes. Wherever materials and technology play a critical role, they can help.

In the Space and Defence sector, too, we are firmly focused on technical innovation. Innovation is essential to help governments improve defence and security capabilities to meet evolving threat landscapes, as well as respond to budget pressures and calls to “do more with less”.

In the end, innovation is about deriving value from ideas that meet market needs and demands. It applies to the full lifecycle of product development, from concept through implementation to evaluation. “Excellence behind Excellence” is RINA’s organisational principle, and behind that pursuit of excellence lies our strong culture of innovation.

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Mark Bairstow,
Senior Director of
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Innovation on the shoulders of giants

An artificial heart based on miniaturised satellite technologies. Advanced monitoring of solar plants to maximise efficiency. A lightweight drone with ultra-high resolution remote sensing capabilities. Precision farming. Virtual test-driving for cars. Screening for Alzheimer's. Insulating coating for glass. These are just a handful of hundreds of examples where European space technologies are benefiting our lives on Earth today.

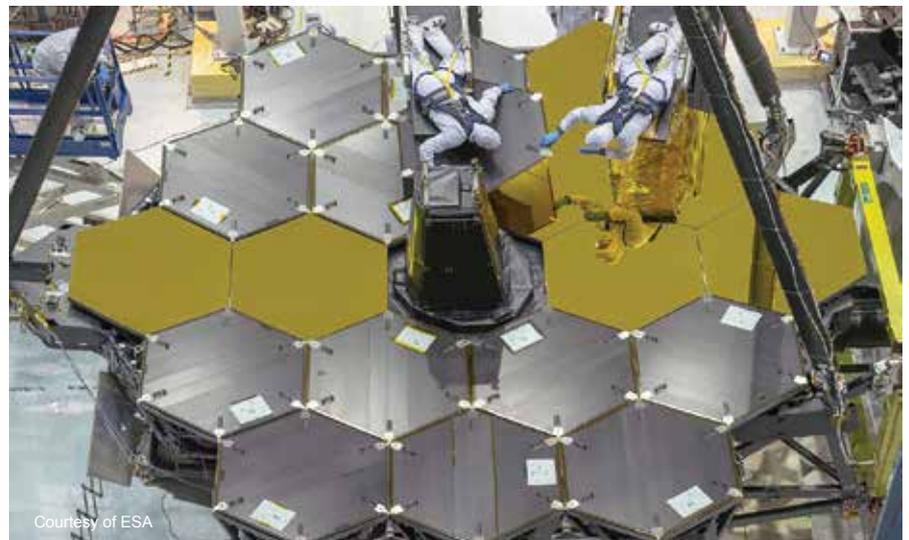
This is the main mission of the European Space Agency's Technology Transfer programme – to inspire and facilitate the use of space technology for non-space applications. We act like a dating agency for innovation, finding out what companies are lusting after and matching them with technologies from our portfolio.

Sometimes we approach companies directly, because it is easy for people to get stuck in day-to-day business and not look outside the window. But increasingly, Chief Innovation Officers who can't sleep at night because they are looking for a

solution are proactively coming to us to find the answer to their problems. Nevertheless, it can take several years and a lot of persistence to achieve a successful transfer of technology. Some people grumble, usually those who think businesses should continue to be run the old way. But then, whenever you move something on Earth, you get friction.

Technology transfer is not just about licenses and patents, but about connecting experts and sharing know-how. Ultimately, our aim is to strengthen the competitiveness and capabilities of European industry. That is why a big focus right now is on space entrepreneurship. We support good ideas whether they come from – big businesses or tiny start-ups based in someone's garage. Industry is waking up to the idea that innovation is not always about buying up other businesses or developing things secretly within the company. There is huge value in open collaboration with others. Just like crops need pollination, every company needs to be pollinated by fresh ideas and capabilities from outside.

Interview with
Frank Salzgeber,
Head of Technology
Transfer and
Business Incubation
Office, European
Space Agency



Courtesy of ESA

It is incredible how perceptions of entrepreneurship have changed. When I had my own IT start-up in Munich back in the early 2000s, people said, “Oh, he’s unemployed” – although we were 350 people. Now it’s cool to start a company. This is where the ESA’s 20 Business Incubation Centres, spread over 17 European countries, really come into play. The ESA Business Incubation Centre programme exemplifies the idea that when you stand on the shoulders of giants, you can see farther. The ESA is a giant in the space industry and we currently welcome around 160 new start-ups every year to use our shoulders as a launchpad for their game-changing ideas.

In this sense, we are less like a scary giant and more like a kindly uncle with a bit of cash in our pockets and the right address book. We don’t want anything from the start-ups in return for our support, so we can be neutral and give honest advice. After their two-year incubation phase, as they start to accelerate and internationalise, we continue to help them because we consider them part of the family. Innovation is only innovation when it is successful in the market, and the last mile is the hardest. So we support our start-ups for as long as they need us, like the uncle who helps his niece learn to ride a bike, then stands back as she cycles off alone. Although we do hope she stays cycling around in Europe.

When I say “we”, I don’t mean we achieve everything centrally. Our partners hold over 300 outreach events a year all over Europe, and the 15 “technology brokers” in the ESA Technology Transfer Network have a lot of independence. RINA has been a member of the network since its establishment in 1992 and has helped to support successful transfers of space technologies in areas as diverse as structural health monitoring and big data analysis software. The local knowledge and communication skills of our brokers are essential, because different nationalities – and even different industries – think differently about innovation. This diversity helps to maximise the potential of technology transfer.



From the point of view of standards and certification, perhaps we also need to think differently. Innovators need a playground to try out new ideas and develop them quickly, free from overly burdensome regulations. Sometimes we need to stick a round peg in a square hole to see what happens.

What I would really love to see is a standard for implementing innovation, one that allows us to fast-track qualification processes and allows exceptions to 100 percent compliance. Innovation in the rulebooks to fire innovation in real life. That would go a long way towards supporting our goals to successfully transfer space technologies and know-how to Earth and raise the competitiveness of European industry.

“Technology transfer is about connecting experts and sharing know-how.”

BIOGRAPHY

Frank M. Salzgeber is Head of the Technology Transfer and Business Incubation Office at the European Space Agency (ESA). Prior to this, he was Head of Commercial Development in the European Astronaut Department of the ESA’s Directorate of Human Spaceflight Microgravity and Exploration. Before joining the ESA, Mr Salzgeber was COO and CFO at an IT start-up that merged with CANCOM in 2003. He also spent seven years at Apple Inc. as an account manager and sales manager.

Mr Salzgeber is a member of several advisory boards in the fields of venture capital funds, international cooperation and start-up companies. He is also on the Board of Directors of the European Business Network (EBN) and a board member of the EBAN (European Business Angel Network) Space. He holds a degree in Industrial Engineering and lives with his family in the Netherlands and Bavaria.

Genuinely passionate about the importance of human space flight and the European Space Programme, Frank’s believes that “a society that stops exploring stops progressing”.



Keeping the ball in the air

Interview with
Philippe Darcis,
Pipeline Technology
Senior Director at
Tenaris



Driven by market volatility, advances in technology and the need to continuously optimise return on investment in changing contexts, our customers in the oil and gas industry want pipelines at the cutting edge of performance. And they want them fast. These trends in demand – high-tech solutions to new challenges, flexibility and speed – dramatically affect how we approach innovation at Tenaris.

The speed of change is unprecedented. Known as Tenaris since 2001, my company has operated globally in the steel industry and pipe business for over 100 years. We used to have three or four years to develop a new product. Now, we simply don't have that luxury any more. So from the point of view of innovation generally, including both products and processes, we need to have the flexibility and expertise to innovate quickly and efficiently while remaining versatile. Looking at innovation in products specifically, here we also see fast and fundamental changes. Market demand for reliable solutions in harsher environments, as well as high-tech services, translates into an increase in technical complexity.

This all means that to stay at the leading edge of innovation, we need to have a clear vision of how the markets and technologies will evolve. In the oil and gas industry there is continuity in technical plans. Understanding past evolutions allows us to see more clearly into the future. Close relationships with our customers, and the ability to really listen to their needs and where their business is going, are also key. To give an example from the offshore industry, we are seeing how the volatility of the markets is driving more brownfield development, rather than greenfield development, along with optimisation of existing production infrastructure. Anticipating changing investment trends in turn helps us to shape our own strategic innovation plans.

Just as markets naturally diversify and adapt to new conditions, so does Tenaris. In addition to producing ever more sophisticated seamless and welded steel tubular products, we have launched a full range of accessories and customised services including pipe ends services, technical consulting and pipe management. Covering the entire product lifecycle, these services are designed to

help our customers optimise their operations, improve safety and environmental impact, and enhance product reliability and efficiency. So our innovation doesn't only relate to our products, but also to how we can better serve our customers.

This evolution, or expansion, in the company's focus – from products to products and services – is an example of our broad approach to innovation at Tenaris. And essential to that broad approach is diversity. I said previously that we work hard to anticipate market and technological trends in order to

centres employ over 200 scientists and engineers from a diverse range of backgrounds, pushing boundaries in areas from advanced metallurgy and premium connectors to innovative processes. Secondly, we collaborate with universities on fundamental research topics with potential longer-term rewards.

Thirdly, we are supported by consulting engineering companies including RINA, with whom we have a strong relationship dating back more than 50 years. RINA brings not only cutting-edge equipment and

enjoyable aspect of my work. Leading innovation is like being a juggler with multiple balls. What is important is not to control all the balls in the air all of the time or to be afraid to throw balls to others. What is important is to avoid any balls falling onto the ground. So the trick is to have skilled and trusted people working closely with you and to be able to pass them the ball.

“This evolution, or expansion, in the company's focus – from products to products and services – is an example of our broad approach to innovation at Tenaris.”



get the right systems in place for quick and efficient innovation. Even more important, in my view, is to have the right people in place. My experience working in fields of innovation in the US, France, Mexico and Italy has convinced me that, whatever the country and whatever the industry, a company's key assets are people with the skills and courage to innovate.

In Tenaris, we are lucky to have three sources of such expertise with a focus on innovation. Firstly, the core of our innovation takes place in our Technological Departments and in our R&D centres in Argentina, Italy, Japan and Mexico. Together, Tenaris R&D

facilities for characterisation, testing and development, but also different perspectives and specialist expertise that help to enhance our innovation activities. We have collaborated in areas including product development, structural integrity and process optimisation, with RINA's support and flexibility complementing the work of our in-house R&D teams.

Strong and fast innovation is not possible without this diverse range of people. The personal relationships with my team at Tenaris, my co-workers, our customers, our suppliers and our partners such as RINA are really important for me and the most

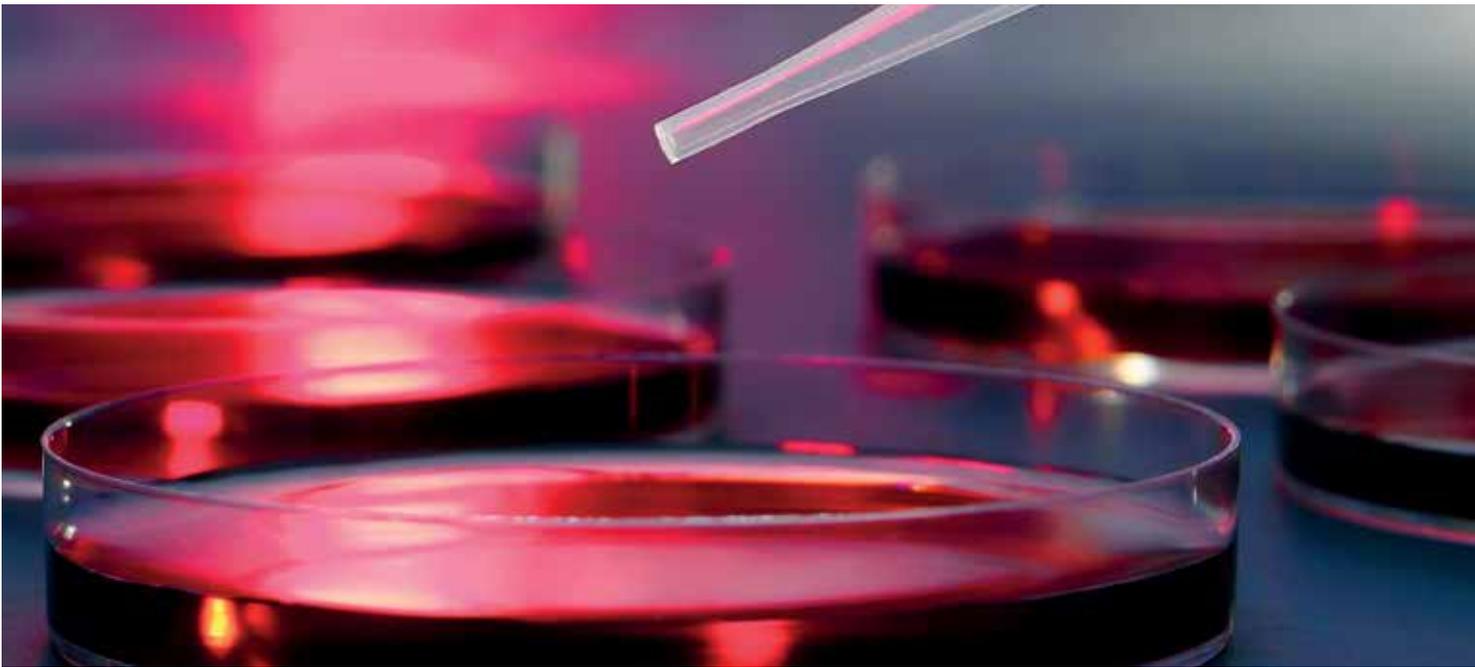
BIOGRAPHY

Philippe Darcis is the Senior Director for Pipeline Technologies at Tenaris, a leading supplier of tubes and related services for the energy industry. In this role, he leads the company's development of new oil and gas pipeline technologies, as well as technical sales.

He is an accomplished and results-focused Executive Director with a career spanning more than 15 years in various fields (university, government, industry) and in different countries (France, US, Mexico, Italy). Prior to joining Tenaris as Research & Development Department Manager in 2007, he was a guest researcher at the National Institute of Standards and Technology in the US, where he focused on improving the safety and aspects of infrastructures, including pipelines. He has a PhD from Blaise Pascal University in France.

 www.tenaris.com

Biotech innovation needs collaboration



Interview with
Nelo Emerencia,
 Director Programming
 at the Bio-based
 Industries Consortium



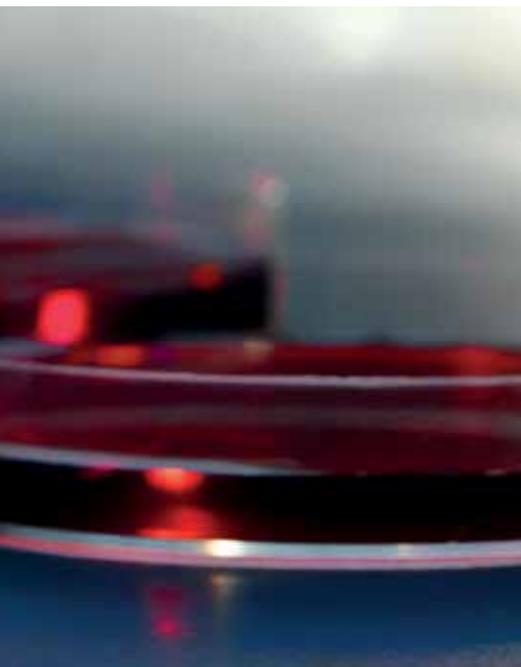
Some issues are too big to tackle alone, sustainability among them. At the Bio-based Industries Consortium (BIC), we believe that working collectively allows us to overcome common challenges and benefit from win-win opportunities in the new bioeconomy. Only through collaborative innovation will we boost European bio-based industries and drive sustainable development.

BIC represents the private sector in the Bio-based Industries Joint Undertaking (BBI JU), a €3.7 billion public-private partnership under the EU Horizon 2020 project. We seek to drive innovation and market demand for bio-based products as a key element of a decentralised and sustainable economy in Europe. The beauty of our industry-led Consortium is the active involvement of representatives from diverse sectors and standpoints, from industry associations to private companies and

civil society organisations. We work together to achieve the full potential of opportunities for bio-based industries, ones that will benefit not just companies and countries but the planet.

An inclusive and collaborative approach underlies our engagement with the four primary sources of feedstocks for bio-based products: forestry, marine, biowaste and agriculture. Take agriculture. The potential to source feedstocks from farming and related sectors, such as food processing and beverages, is both huge and hugely underexploited. The under-utilisation of this resource dates back to controversies over “food for fuel” when governments first started to implement regulations to push the use of biofuels. Potential food sources like maize and soya were burnt, damaging the image of the bioindustry and driving away biotech companies. But what about all the residual streams – the waste – coming from farming

and food processing? Innovative ways to increase the efficiency of agricultural value chains offer a win-win opportunity: we use renewable raw materials to replace fossil feedstock, reduce landfill, valorise residual streams and return nutrients to the soil. In practice, there are two ways to achieve this. The first is to treat farmers and food companies simply as suppliers of feedstock. The second is to invite all



stakeholders to be strategic partners, providing not just feedstock but expertise to co-design the value chain, develop innovative technologies and maximise the benefits for all.

This is what we aim to do, not just for agriculture but for the forestry, fishing and aquaculture industries ("blue biotech") and for biowaste from towns and cities. Is this an innovative approach? Surprisingly, yes. For decades, it was rare for people in the chemicals business, for example, to meet counterparts in the agricultural, marine or technology sectors. But the opportunities and challenges of the bioeconomy require cross-sector collaboration. There are compelling business reasons to join a platform that offers the opportunity to exchange ideas and innovate on projects with people from other industries and backgrounds. There are compelling business reasons to pursue the bioeconomy,

too. Consumers are becoming more concerned about the environmental impacts of human behaviour, from the "plastic soup" in the sea to climate change. At the company level, influential brands want to – and be seen to – lower their environmental footprints by using bio-based materials. Construction and automotive companies are increasingly using bio-based materials, not just for sustainability or reputational reasons but because they are strong and light.

There is a geographical element to the spread of innovative bio-based technologies. At the moment, bio-based innovation is mostly clustered around northwest and southwest Europe. Strategic outreach to other parts of the continent, namely the Balkan and Baltic states, and countries in Central Europe, will help to galvanise more widespread adoption. Secondly, decentralisation is essential because biomass and "residual streams" cannot easily be transported over long distances. Bio-based production units must be smaller, more mobile and more modular to suit national and regional needs.

"Consumers are becoming more concerned about the environmental impacts of human behaviour, from the 'plastic soup' in the sea to climate change."

At the same time as we look to decentralise operations for bio-based industries, we seek the opposite for legislation. Standards and policies should encourage the development of new, safe and sustainable products, not hinder their entry onto the market. By working together within the Consortium and with our partners, we can identify which policies impede the development of bio-based industries in Europe and which new policies could facilitate it. Co-designing rules and

standards applicable to bio-based products across Europe will help us transition collectively to a more sustainable future.

I talk a lot about collaboration, communication, listening to all stakeholders and using their expertise. RINA plays a big part in facilitating this inclusive approach by conducting extensive annual surveys of members and analysing the data in the context of technical developments and market threats and trends. RINA experts are a constant source of actionable information for our annual work plan, as well as valuable ad-hoc advice as we seek, collectively, to shape the future of European bio-innovation for the better.

BIOGRAPHY

After a career in the multinational chemicals industry, Nelo Emerencia became Director Programming at the Bio-based Industries Consortium in April 2015. In addition, within the framework of the EU Thematic Smart Specialisation platforms for interregional innovation projects, he coordinates the Bio-Economy partnership. Nelo studied Chemical Engineering at Delft University of Technology in the Netherlands before returning to Aruba, his native island, where he worked at the Esso refinery and progressed to Marketing Manager. In 1985, Nelo transitioned to the chemicals business in Rotterdam and later Brussels, holding positions in economics and planning, marketing and public affairs. Following a secondment to PlasticsEurope in Brussels as Communications and Public Affairs Director, he returned to ExxonMobil as Public Affairs Manager for the Netherlands. Between 2006 and 2014, he worked at the Dutch Chemical Industry Association in the positions of Education & Innovation Manager and Secretary of the Dutch Chemistry Board.

Smart systems for training

How do you deliver training to employees more productively, efficiently and cost-effectively, with better results and less time spent away?

The answer involves innovative systems and multidisciplinary expertise. Powered by advances in technology, today's dynamic training market increasingly focuses on systems that combine real-world blended, synthetic, classroom and online learning.

To take an example, training specialists and media developers from RINA's Training and Learning Solutions (TLS) and Digital departments joined forces this year to provide tailored training solutions for a major national air force. The aim was to develop more skilled, motivated leaders and technical specialists in order to improve operational outputs. Topics included aircraft maintenance, visual recognition, structural integrity and fuel tank safety, as well as operational topics for staff officers and engineering forward commanders.

The training should:

- be based upon robust and auditable analysis;
- be aimed at both junior and senior technical and leadership personnel;
- consider blended learning styles;
- be easily stored, managed and accessible.

The TLS-Digital team put their training analysis and media production capabilities to work. Using RINA's Training Capability Model, our TLS specialists systematically analysed existing training systems and examined future role requirements. In parallel, RINA's Digital team undertook a programme of training modernisation while also developing alternatives for

future training delivery.

Employees will be glad to know that the days of enduring endless hours of classroom-based training are nearly in the past. For example, using open-architecture Articulate Storyline software, existing courses can be repackaged into interactive eLearning courses that run on any computer, tablet or iOS device. As we all learn in different ways, this alternative

approach creates an enhanced learning environment that enables trainees to learn at their own pace, however and wherever they wish.

planning. A central component is the assessment and recording of employee competence. This gives managers real-time visibility of individual, team and department competence levels, allowing them to take more evidence-based decisions, set more precise targets and manage risk more effectively.

For example, if an aircraft technician's accreditations have expired or



will expire soon, supervisors are automatically alerted. This helps avoid the possibility of breaking regulations and makes contingency planning easier.

By harnessing the multidisciplinary expertise of TLS and Digital teams in this way, RINA will continue to explore and develop innovative training solutions tailored to specific client needs.

How do we measure whether this approach is truly effective in raising the skills of the workforce? How does a company, or a military force for that matter, know which of their many employees are qualified for which jobs? This is where RINA's Competentis® Competence Management System comes into play.

Competentis® is an online, multi-tenanted system that supports risk management, decision-making and

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How bowtie analysis can lower liability

Industry 4.0, unmanned vehicles, the Internet of Things, 5G, advanced robotics, machine learning... The list of new technologies with the potential to improve our lives is long. But the list of new risks and potential areas of liability is even longer.

Customers demand speed, advanced technology and the highest possible levels of accuracy and quality. New technologies and products can have faults, however, and the limits to manufacturers' liability are not clear.

Article 4 of EC Directive 85/374, which covers liability for defective products in the EU, dates from 1985 and merely says: "The injured person shall be required to prove the damage, the defect and the causal relationship between defect and damage." Today, the determination of responsibility and the pursuit of compensation are often resolved through costly and unpredictable legal disputes. But lawyers and engineers don't always understand each other. Lawyers want facts that are concrete, objective and precise, whereas engineers' facts are based on models

verified with observations and tests. Insurance products are available to cover losses arising out of negligent acts, errors and omissions in a company's products or services. However, liability policies are limited in their coverage and can be expensive, depending on the effectiveness of risk management procedures in place.

A bowtie analysis can help untangle these issues and save manufacturers money. So-called because it is shaped like a man's bowtie, the model helps to identify possible hazards and related risk scenarios for a particular product, as well as determine mitigation actions. In this way, the company's management can better understand and control risks that might arise from the use or misuse of a product, then transfer any residual risks to a liability insurance product at a reasonable cost.

In a bowtie model, the risk picture revolves around the hazard (something with the potential to cause damage or cost) and the top event (the occurrence of a hazard). The risk elements taken into account are the same as for other risk assessment methodologies but the

emphasis is on the causal relationship between threats, the consequences of a top event and controls to mitigate the hazards.

Bowtie analysis also explores escalation factors, i.e. reasons why a control may be less effective than it should. Last but not least, it makes it possible to visually demonstrate the link between controls and the management system in order to identify critical tasks (procedures, checks) and the link between controls and competences (and consequently training needs).

RINA has successfully implemented the bowtie approach to risk analysis in various industrial sectors, from aerospace to leisure. It forms part of an effective Safety and Security Management System, helping to strengthen understanding of the critical roles and responsibilities of a company's management and supporting both companies and brokers in defining an optimal risk insurance policy for products.

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Doing business in a connected world

Markets may be volatile, but there is no denying that opportunities to do business internationally are growing. New regions are opening up, helped by technologies that facilitate information-sharing and communication. It is getting easier and more valuable to connect with others across the globe.

If multinational companies want to remain ahead, they should ask themselves: Are we getting the best value out of our international connections? Are we sharing our expertise effectively worldwide? How well are we leveraging our networks to deliver global services at a local level?

At RINA, we believe we do these things well. By combining specialist expertise with an international network of 170 offices in 65 countries, we deliver real benefits to our clients in whichever region they wish to do business.

Our technical expertise is backed by extensive laboratory facilities in Italy and the UK, where we can analyse our clients' problems, develop innovative technologies to solve them and investigate the solutions in practice. Transparent communication allows clients in India or Saudi Arabia, for example, to benefit from these cutting-edge R&D facilities as if they were next door.

We have invested heavily in our laboratory facilities because we understand that precise data and clear analysis are essential to making the right business decisions at the right time. Working across project lifecycles, our Innovation and Competence Centres interact at different stages to add value and help our clients meet their development and delivery goals. Many aspects of business are strongly

affected by local markets and conditions. This is where our clients see the value of our international offices, engineers and consultants who truly understand the local markets in which they operate. Our Skills Hub database enables RINA employees to quickly connect with another colleague in the right place and with the right skills and experience for a particular project.

Business and innovation are not just about objective technical performance. Companies often face similar challenges but with different cultural or economic drivers. Our international presence enables us to deliver solutions that fit these different scenarios. That includes factors that often cause multinational companies major headaches, like local registrations, accreditations and agents.

Despite our solid international presence, we continue to invest in knowledge transfer with local partners. This is supported by a trend among many countries to insist that foreign skills providers must involve a quota of local nationals in each project or service. Leveraging local expertise has always been a strength at RINA, because every day and in every project we see the value of our multicultural employee base. Our 3,700 professionals come from dozens of different countries, each bringing their distinct culture, ethos and local knowledge to the table.

Connecting experts from all corners of the earth, transparently and efficiently, are – at RINA at least – the key to successful innovation and smart business worldwide.

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Chris Bull,
Director of Industry
International
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Studying recycling in nuclear fusion

Nuclear fusion technology promises an inexhaustible supply of energy that is clean, safe and environmentally friendly. The technological challenges are great, however. Among them is how to recycle and dispose of plant components after use. Several options are under consideration to recover valuable elements, separate radioactive elements and re-use materials. Melting techniques are a promising option. Steel components are melted at high temperatures, allowing them to be compacted for easier handling and disposal. Undesired elements can be removed or extra elements added to produce new components.

The most well-researched melting techniques derive from mature processes in industrial sectors such as steel, foundry, glass and ceramic. Can these technologies be transferred to the treatment and recycling of nuclear waste? In theory, yes. In practice, radioactive waste from fusion power plants is expected to have very different characteristics. A thorough re-design of technological solutions and operating conditions will be needed to make these options effective.

With strong and wide-ranging expertise in this area, RINA has been involved in two studies of melting technologies for treating components of fusion power plants after service. Performed within the framework of the EUROfusion Consortium, the studies focus on dismantled components made from AISI 316 and Eurofer steel, the grades envisaged for the first fusion power plants. The aim is to identify the appropriate conditions for removing elements such as carbon, manganese and tungsten using techniques adapted from steelmaking operations.

The feasibility analysis is promising. It shows that for each steel grade, an

optimum set of recycling conditions can be drawn up according to its anticipated re-use, and the characteristics of products and by-products can be precisely defined. Other innovative technologies investigated as part of the research project range from existing specialised techniques, such as the skull crucible method, to technologies that are still at conceptual and testing stage, such as magnetic levitation.

Why are these studies being done so early when nuclear fusion power plants are still a long way off? For two reasons. Firstly, the results help us select and design technological solutions for recycling and re-fabrication. Secondly, identifying achievable volumes and compositions of products from future recycling processes allows us to better design the materials for the fusion plants. The results suggest that to minimise radioactive waste, it is desirable to revise the specifications for the steel grades to be used in fusion

plants, as well as the selection of raw materials and fabrication cycles. The aim is to achieve a full "performance and recycling material design".

The results were presented at the 30th Symposium on Fusion Technology in September 2018 and will be published in the scientific journal Fusion Engineering and Design. Look out for the papers "Feasibility studies of DEMO potential waste recycling by proven existing industrial-scale processes" and "Innovative and emerging melting technologies for fusion power plants wastes recycling".

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RINA researchers study new melting technologies for fusion power plants

Boosting sustainability in leather and textiles

There is growing demand around the world not just for more sustainable products, but for more sustainable manufacturing processes and machines. This is especially true for the textile and leather sectors, which are not generally seen as environmentally friendly. Investing in innovative manufacturing solutions will give companies in these sectors a competitive advantage, allowing them to meet demand for greener products while reducing their costs and use of energy, water and chemicals.

But how do companies that develop innovative technologies for the textile and leather industries demonstrate their energy efficiency and sustainability? There are no fixed global standards for the environmental performance of their machines. "Labels" used by some manufacturers to claim sustainability may be purely marketing tricks – especially if they are not transparent, backed up by measurable data or verified by an independent third party.

This is the challenge behind the "Sustainable Technologies" project led by ACIMIT, the Association of Italian Textile Machinery Manufacturers, and ASSOMAC, the Association of Italian Manufacturers of Footwear, Leather Goods and Tanning Technologies. To demonstrate their investments in creating new and greener manufacturing technologies, companies can apply for the project's Green Label. This voluntary standard demonstrates the environmental performance of the machinery through a carbon footprint assessment carried out by RINA.

Amilcare Baccini, Director of ASSOMAC, explains that "the fashion industry relies on the increased environmental awareness of the final consumer to promote their products.

Innovative technical solutions, for processes even more in line with the requirements of sustainability and resources saving, together with a strong complementarity with digital



technologies (Industry 4.0) and the calculation of the environmental footprint, have in fact become an essential element of international competitiveness."

Federico Pellegatta, Director of ACIMIT, affirms that "many companies consider the sustainability of products and processes a decisive competitive factor. The Label is a business card that our Members use to make known the company's commitment."

Since June 2011, more than 1,300 Green Labels have been awarded. Growing demand for the label demonstrates the commitment of companies involved in the project. Mr Pellegatta adds: "The feedback that comes from the market is certainly positive. The need for sustainability that starts from the production process is now common to the textile industries of different countries, not just the most industrialised ones."

The creation of the Green Label in Italy is perhaps natural, given Italy's leading position in the fashion, shoe and leatherware sectors, as well as in engineering and equipment manufacturing.

Although the Green Label is focused on Italian textile and leather machinery and related sectors, RINA can perform similar certified carbon footprint assessments for associations of machinery manufacturers in all countries and industries. This type of independent voluntary certification is a powerful and transparent way to demonstrate investment in R&D focused on quality and sustainability. It addresses not just demand from environmentally aware customers, but increasingly strict government regulations worldwide.

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Recycling aluminium for high-tech products

Research in materials science and engineering, driven by critical needs in manufacturing technologies, has shifted towards the study and application of innovative processes. Key among these are powder-based processes. Taking advantage of additive manufacturing techniques, for example powder metallurgy, supports the production of components for high-tech industrial sectors such as aerospace and automotive. The main goal in this context is to lighten the components without reducing their mechanical performance.

The price of manufactured products is linked to two main parameters: manufacturing/processing techniques and raw materials. It is important to remember that natural resources are not inexhaustible. In response to increasing demand for aluminium in many sectors, global and regional policies are promoting aluminium recycling. This provides many environmental, economic and social benefits. It saves energy, time, money and precious natural resources. It generates jobs and helps to pay for community services that make life better for millions of people.

will enable organic material, including food waste and other residues, to be converted to energy sources for the process.

The resulting powders will then be analysed and tested against those typically used in additive manufacturing and steel processing. A comparison will be drawn up between the performance of the new powders and those currently available on the market and produced from pure aluminium.

The expected result at the end of this research project is a new aluminium



For this reason, new aluminium powders are being developed for additive manufacturing processes. In parallel, other areas of manufacturing such as steel processing are seeking quality and process improvements, for example by using aluminium powders as alternative killing agents in stainless steel production or for the development of refractories. The starting point of these metallic powders is generally a high-purity metal or alloy. This is then melted and atomised within enclosures consisting of gas or plasma atomisers to obtain the desired product.

RINA's ambition is to explore alternative sources to produce aluminium powder for use in additive manufacturing and other industrial technologies, as well as steel processing. The end product should be suitable for use in high-tech sectors, given that demand for aluminium in these fields is growing by an average of 5–7 percent annually.

In the course of this research, carried out in RINA laboratories, RINA will reuse aluminium from urban mining and especially from packaging waste and scrap. A special melting process

alloy extracted from scrap. It will be able to be used for raw material powders in conventional industrial fields as well as for high-tech, high-value products produced through additive manufacturing.

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A smooth path to successful innovation

The word “innovation” means many things to many people. Its definition changes according to whether you are looking at it from a technical, economic or social point of view. In most cases, however, innovation can be broadly described as a path leading from the initial identification of business opportunities all the way to introducing the final concept, product or service to the market.

The path of innovation is never an easy one and needs effective management in order to achieve successful results. But managing innovation is a complex process, involving several actors and resources that must be properly integrated to achieve the intended business goals. In fact, the process is so complex that ISO set up a Technical Committee (TC 279) to define a set of international standards on innovation management.

RINA, which has two delegates in TC 279, has been actively contributing to the ISO’s standardisation work with its experience and competence in Total Innovation Management. RINA Total Innovation Management supports

companies at all levels in bringing innovation to successful fruition. Its key features are:

- Innovation Leadership
- Strategic Planning
- Innovation Operations
- Impact Assessment & Improvement.

An essential tool across all four elements of the Total Innovation Management framework is Strategic Intelligence. This provides company leaders and upper management with recommendations to help them take decisions that impact the organisation’s vision, mission and innovation activities.

The four-step approach to Strategic Intelligence involves:

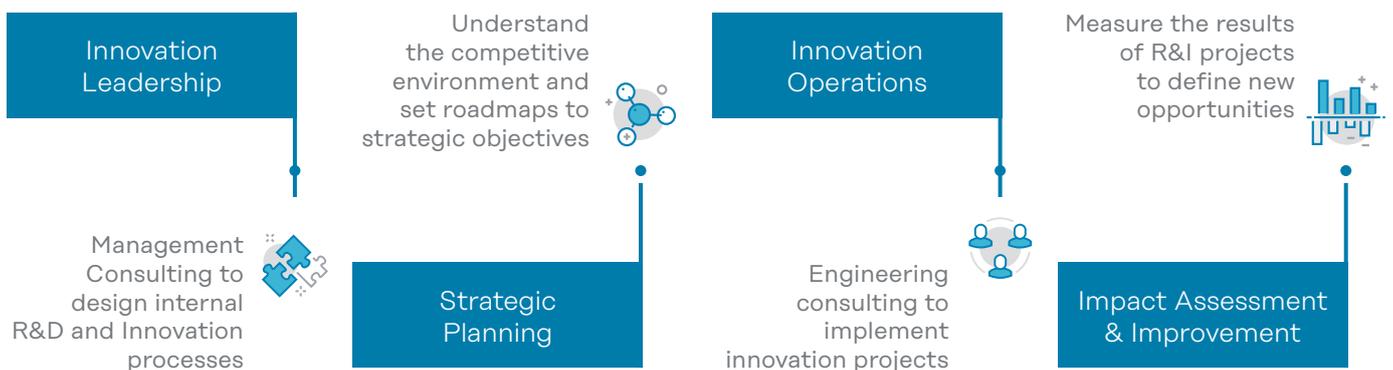
1. Framing. This “problem statement” step defines the context, scope and objectives of the intelligence project.
2. Gathering and analysis. This involves building the dataset and applying analytical tools to turn simple data into actionable data.
3. Interpretation. Actionable data

are interpreted according to the (company-specific) internal context and (market-specific) external context. This step generates the actual intelligence.

4. Recommendation. This involves transforming intelligence into effective communication material.

The first ISO standards on innovation management, ISO 56003: Innovation management – Tools and methods for innovation partnership – Guidance and ISO/TR 56004: Innovation Management Assessment – Guidance, were published in February 2019. RINA looks forward to helping more clients smoothen their path to successful innovation through Total Innovation Management.

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Pioneering AC pickling for steel



Those outside of metal manufacturing industries may not know how important “pickling” is to the process. Pickling basically means treating the surface of metals, such as stainless or carbon steel strips, to remove impurities including rust, scale and contaminants. It works by removing the oxides covering the metal surface, in effect cleaning it by exposing the bare metal. In industrial manufacturing processes, pickling comes right after annealing (heat treatment) and provides a transition between the hot and cold manufacturing cycles.

Over the last 15 to 20 years of R&D into pickling, there have been significant improvements in process control, efficiency and reducing environmental impacts. However, the complexity of both pickling lines and auxiliary plants has increased, driving up investment costs. Despite a widespread desire among manufacturers to reduce both the complexity and costs of pickling, it was generally agreed that pickling processes could not be improved any further. That is, until an innovative AC pickling technology was developed and

patented by RINA’s Centro Sviluppo Materiali (CSM) innovation centre. This dramatically modifies the concept behind electrolytic pickling treatments by applying alternating current (AC) instead of conventional direct current (DC). In contrast to the conventional process, AC pickling involves a continuously changing polarity. This produces a transient polarisation regime, which greatly increases the kinetics of pickling.

For stainless steel, AC pickling contributes to a dramatic improvement in line productivity of up to 50 percent. It also reduces the use of chemicals and eliminates the presence of Chromium(VI), making AC pickling a more environmentally friendly process. AC pickling has also proven its ability to maximise line productivity for carbon steel strips, especially grades for which pickling is more challenging and which, at the moment, must be processed with lower productivity.

Starting from electrochemistry studies and experiments at RINA labs, the new technology and process

were first validated at the pilot plant level and modelled using 3D COMSOL Multiphysics® software. AC pickling was then successfully transferred to an industrial-scale application at Marcegaglia steelworks in Italy. Since September 2014, more than 700 kilotonnes of steel strips have been successfully treated with AC pickling, confirming the viability of this breakthrough process and technology.

The licence to implement the AC pickling process and technology was recently granted to one of the world’s most advanced steelmakers, who selected it for an annealing and pickling line for stainless steel strips. RINA experts provided the technical specifications and are cooperating in the design of the plant modifications. Given the proven advantages of AC pickling for stainless and carbon steel, we expect other manufacturers to begin implementing the new process in the coming months and years.

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Connecting clean energy to the grid

Faults in electrical grids are inevitable. High-fault currents are not only detrimental to the electrical equipment, they can also cause serious fires and explosions. Grid operators employ fast-acting protection systems to eliminate or minimise the risks to equipment and personnel.

There is a growing trend towards distributed generation, especially synchronous machine-based systems such as Combined Heat and Power. This, coupled with recent improvements in network interconnectivity, has led to rising distribution network fault levels. The fault levels are getting close to the rated capability of existing equipment and this poses several challenges to both distribution network operators and independent power producers.

Network operators do not authorise connections to independent generation without proven means to protect the distribution network from excessive fault currents. So independent power producers are required to make significant investments in these protective measures, which can postpone their connection and defer their potential income from the sale of electricity to the grid.

RINA has teamed up with GridON, a provider of fault current limiting solutions, and Western Power Distribution (WPD), a UK electricity distributor, to further develop GridON's innovative fault limiting concept and demonstrate it in a live primary distribution network in the UK. The £2m Network Innovation Allowance project, funded by the UK's national electricity and gas regulator Ofgem, kick-started in September 2018 with a completion date of November 2020.

The project aims to upscale a newly



conceptualised solid-state Fault Current Limiting Interrupter (FCLi) designed to support the cost-effective connection of distributed generation. The project runs from prototype level to a commercial-scale device that will be trialled at the site of one of WPD's generation customers. The 3-phase FCLi will be designed for 11 kV connection in series to a 5 MW generator.

GridON, the manufacturer, will be responsible for the FCLi design, build, high power lab testing, and installation and commissioning at the demo site. RINA will be responsible for project management, technical consultancy, FCLi design review, demonstration site design and data monitoring. WPD will define specifications, approve the design, deliver the site works and coordinate the overall project.

An important characteristic of this FCLi is that it has near instantaneous (before first peak) fault limiting capability to protect the network operator's system. Other FCLs with such a fast response, such as resistive superconductive FCL, have so far

not been commercialised due to the high maintenance requirements and frequent failure of auxiliary systems.

It is expected that once the performance is proven in a live network, this FCLi will facilitate a quicker and safer connection of environmentally friendly distributed generators to the grid.

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The future of concrete is green

Fourteen international partners, four years and a budget of around €7.6 million: ECO-Binder is a project co-funded by the European Commission Horizon 2020 research and innovation programme under Grant Agreement number 637138. Its aim is to develop prefabricated building envelope components, such as foundations, roofs, walls, doors and windows, that are greener, more cost-efficient and have better insulating properties.

Concrete is the most widely used manmade material on Earth. Every year, we use around 10 billion square metres to build our offices, schools, bridges and more. But despite its benefits, it is also responsible for around 5 percent of worldwide greenhouse gas emissions. Finding more sustainable and lower-energy solutions involving concrete is an essential part of efforts to tackle climate change.

RINA is proud to be the technical coordinator of the ECO-Binder project, in which we have collaborated with other European partners to develop innovative precast concrete elements. These are manufactured with a new and more environmentally friendly Belite-Ye'elimite-Ferrite (BYF) class of

low-carbon binders, which are able to fully replace Ordinary Portland Cement (OPC). The new binders have a lower calcium content, lower clinker burning temperature and lower grinding energy requirements. They are combined with a novel finishing layer with improved insulation and multifunctional surface properties like thermal reflection, antibacterial, anti-stain and self-cleaning. The results are dramatic:

- 30% lower carbon dioxide emissions
- 20% improved insulation properties
- Lower costs compared to the current OPC-based solution

Thanks to faster maturation rates of the BYF cements, the new solution has reduced the average manufacturing time of a test wall panel from 16 hours to 10 hours. ECO-Binder solutions have been produced under challenging conditions, with temperatures ranging from -5°C to 47°C , and installed in five demo sites in different geographical and climatic areas. The solution has consistently demonstrated a minimum 5 percent reduction in energy consumption over the lifecycle of a building.

RINA experts were responsible for the overall project implementation, as well as testing the new cements from the various producers. A major challenge was replicating the results obtained in laboratory conditions in a real demo site, in order to demonstrate the suitability of the materials to be used in a real environment and to monitor their performance over time.

The technical coordination of large collaborative projects requires specific coordination skills and technical knowledge, together with a strong sensibility towards intellectual property rights. It also needs close collaboration with partners to overcome obstacles and pave the way for the long-term industrialisation and marketability of the project results. RINA's deep expertise in materials and technologies innovation, along with more than 30 years of experience in technical coordination, has helped to shape the ECO-Binder project and the future of concrete: greener, more cost-effective and with better insulation properties.

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Smart monitoring with RINACube



Investment in datacentres is set to change, according to analysts. They predict that most sectors will invest more in innovation and upgrades relating to “edge” infrastructures rather than core facilities. Much of the expenditure will focus on automating links between core and edge facilities to reduce costs and improve efficiency.

For a datacentre, operational efficiency primarily means business continuity. The power supply, for example, must be continuously monitored to guarantee uninterrupted operation. A condition-based monitoring system can help to guarantee business continuity. It involves installing sensors that continuously detect aspects such as noise, vibration and the temperature of power supply devices. By collecting these data and the time series, it is possible to evaluate the residual lifetime of the facility and the probability of a fault. These systems can also allow manual input of data from inspections.

This is the first step in a more comprehensive predictive maintenance system. This involves configuring an algorithm for a single component that

warns the plant operator when the component is approaching a potential failure.

Estimates suggest that by 2025, a fifth of global energy consumption will be related to datacentres. As a result, another increasingly important aspect of operational efficiency is energy efficiency.

The question is: how do we gather all these data from different sources, analyse them in real time and provide a clear output customised to the operator’s needs? RINA’s answer is RINACube, the platform where our monitoring systems are hosted. RINACube includes specialist software that can assess the energy efficiency of an asset such as a datacentre and support operational decisions to improve it. It can compare the asset’s performance with benchmarking data or with limits defined by the owner or manufacturer. Deviations that exceed a certain threshold trigger an alert, allowing timely intervention.

RINACube monitoring systems can be highly customised to the needs

of operators, both in terms of input and output. The flexibility means the systems can be transferred to potentially any asset that requires monitoring. They can be used for a single ship or entire fleet, specific buildings or an extended area of real estate, a particular energy plant or a distribution network. The output is also highly customisable in terms of how the information is aggregated, compared and visualised, and the alerts that can be activated.

Given the growth in automation in datacentres and other sectors, we expect the RINACube platform to strongly facilitate real-time monitoring for our clients in all industries worldwide.

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Sustainability: from cars to heating

What do vehicles and heating systems have in common? More than you might think.

Today, the automotive sector is responsible for around 12 percent of total EU emissions of carbon dioxide. This sounds like a lot, but since monitoring started in 2010, average carbon emissions per kilometre have actually decreased by 16 percent. This is thanks to massive investments in R&D around low-carbon technologies, boosted by the evolving market and global calls for a transition to a low-carbon future as recommended by the Paris Agreement. Vehicles will be connected, autonomous and nearly zero-emissions, supported by policies and regulations increasingly aligned to these environmental goals.

Although behind the automotive sector in terms of both technologies and stakeholder awareness, the domestic heating sector is aiming for a similar transformation. Heating is set to benefit from innovative sustainable solutions that will increase the efficiency of heat pumps, upgrade electricity networks and improve systems in major factories. The target is to reduce carbon emissions and contribute to the achievement of the UN Sustainable Development Goals.

So what can we learn by looking at the technical, market and policy aspects of the automotive scenario? RINA was selected by Energy System Catapult to find out. Taking lessons learned from the automotive industry, the aim of this innovative sustainability project was to contribute to supporting plans and investments for the decarbonisation of the heating and cooling sector.

Engaging with industry experts, we have studied the conditions that favoured the change in the

automotive paradigm, including the way stakeholders, governments, policymakers and manufacturers, as well as vehicle users, have reacted. We have also looked at patent applications, which clearly demonstrate that whenever a new policy was introduced, activity around patents increased as innovative solutions were developed across the industry.

The study has identified several key

A turning point in the automotive industry was the new stringent emissions standards that forced carmakers to increase investment in technologies. Now the change is being driven by our growing awareness of the need for a sustainable development approach to safeguard the future.

By studying sectors that are already advanced in terms of transitioning to a low-carbon future, we can



success factors that accelerated the transition process:

- Technical achievements supported by new technologies and R&D;
- Policies and proactive relationships between policymakers and representatives of associations;
- Market opportunities such as national incentives, which can make low-carbon systems more competitive and appealing than traditional technologies;
- Competition among manufacturers;
- Investments in innovative and sustainable solutions.

help companies in other sectors to transition more quickly and efficiently. This study demonstrates the value of a multidisciplinary, cross-industry approach to innovation in sustainability.

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Investing in Industry 4.0 for growth

With the so-called fourth industrial revolution comes the concept of a "smart factory", where manufacturing processes are boosted by digital technologies including automation, the Internet of Things, cloud computing, big data and machine learning.

Italy is the second largest manufacturing country in the EU, known for its broad scope of products, flexibility and innovation. But after the 2009 financial crisis, the Italian manufacturing base was exhausted. Machines were old. There was limited cashflow for investment. To encourage an upgrade in manufacturing assets, the Italian government introduced a "hyper-amortisation" measure in the 2017 and 2018 budgets. This tax measure basically offers a 150 percent increase in the value of investments in new tangible devices and technologies, purchased or leased, that enable the Industry 4.0 transformation. Companies can also benefit from tax relief for investments in intangible capital goods such as software and IT systems, with an additional 40 percent increase in value.

Assets that fall under the hyper-amortisation measure are capital goods controlled by computerised systems or managed by appropriate sensors and drivers, as well as intangible assets such as software, systems and system integration platforms and applications. Investment in these assets allows better interaction between personnel, processes and machinery, speeds up decision-making, improves productivity and quality and satisfies demand in a more targeted and cost-effective way.

In terms of success so far, this measure gets full marks: the Italian Confederation of Enterprises, Confindustria, has recorded sustained growth in all main sectors of the

economy and the Ministry of Economic Development has recorded strong growth in the turnover of asset-supplying companies.



To take advantage of the tax benefits, a formal attestation of conformity is required stating that the asset has certain specific technical characteristics and is interconnected

with internal or external digital systems. In Italy, this is the first time that fiscal benefits depend upon strict technical examinations.

RINA is one of the certification bodies accredited to issue the required attestation of conformity. The verification process spans a preliminary document analysis to an in-field verification of conformity and is carried out by a multidisciplinary team from our Certification and Industry Business Units. Over the last two years, we have performed such verifications for hundreds of companies. The process has been refined through specific monitoring tools, experimentation and sharing best practices.

Along with certification, we are often asked to support companies with digital consulting and specific training modules. New smart and attested assets may be the building blocks of the digital transformation, but consulting and training are essential to exploit their full potential. And as a true partner to companies, we don't just talk about digital transformation, we do it ourselves. Our RINACube cloud-based "platform of platforms" offers a space where key enabling technologies such as digital twins and blockchains can be tested risk-free by customers before integration into their own processes.

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Showcasing RINA

If you want to keep up with the innovations that are changing the face of industry, come and meet RINA at any of these key events in 2019:

EVENTS RINA IS INVOLVED IN

INDIA STEEL

January 22-24, Mumbai, (India)

www.indiastelexpo.in

RINA's role: exhibitor at booth no. 48

IDEX 2019

February 17-21, Abu Dhabi (UAE)

www.idexuae.ae

RINA's role: present at exhibition and conference

NACE INTERNATIONAL - CORROSION 2019

Conference and Expo

March 24-28, Nashville, TN (US)

www.nacecorrosion.org

RINA's role: exhibitor at booth and presenting technical papers

SPE INTERNATIONAL PETROLEUM TECHNOLOGY CONFERENCE (IPTC) 2019

March 26-28, Beijing (China)

www.iptcnet.org

RINA's role: presenting two technical papers in cooperation with a major client

EPERC 2019 CONFERENCE PRESSURE EQUIPMENT INNOVATION AND SAFETY, organised by INAIL

April 1-3, Rome (Italy)

www.eperc-aisbl.eu

RINA's role: part of the organising committee

MADE IN STEEL 2019 CONFERENCE AND EXHIBITION

May 14-16, Milan (Italy)

www.madeinsteel.it

RINA's role: exhibitor at booth no. 7, pavillion 24

SAM 13

May 20-21, Pisa (Italy)

www.irt-m2p.eu

RINA's role: RINA's role: presenting technical papers and speaker at DissI2M workshop

DSEI 2019

September 10-13, London (UK)

www.dsei.co.uk

RINA's role: exhibitor at stand S7 303

35TH INTERNATIONAL CAE CONFERENCE

October, Vicenza (Italy)

RINA's role: presenting technical papers

EVENTS POWERED BY RINA

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

SPINNAKER NAVAL NETWORKING EVENT

February 21, Portsmouth (UK)

RINA's role: organiser and presenter

EUROSTEELMASTER ADVANCED TRAINING FOR THE STEEL INDUSTRY

April 1-5, Northern Italy (Italy)

RINA's role: organiser and training provider

STEELMASTER ADVANCED TRAINING FOR THE STEEL INDUSTRY: WEEK 1

October 14-18, Rome (Italy)

RINA's role: organiser and training provider

STEELMASTER ADVANCED TRAINING FOR THE STEEL INDUSTRY: WEEK 2

November 11-16, Taranto (Italy)

RINA's role: organiser and training provider

ELECTRICAL AND ELECTRONIC EQUIPMENT AND THE ENVIRONMENT CONFERENCE

November 13-14, London (UK)

RINA's role: organiser and presenting technical papers

MAM19 ADDITIVE MANUFACTURING ADVANCED TRAINING

December (Italy)

RINA's role: organiser and training provider in collaboration with Politecnico di Milano

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