



#131

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THE *NEW* INDUSTRIAL REVOLUTION



16

#131



46

ISO focus

November-December 2018



10



22



4



28



38-39

Raising the bar on quality infrastructure

Sustainable tourism

Singapore's Smart Industry Readiness Index

ISO standards in support of legislation



40

2 A new revolution in the making
Comment by Christoph Winterhalter.

4 New (e-)takeoff for aviation industry
Why modern-day Icaruses can afford to think big.

10 From high-tech gadgets to the smart enterprise
State-of-the-art solutions keep business competitive.

16 The new frontier for artificial intelligence
Pushing the boundaries of uncharted technologies.

22 Connecting with robot co-workers
The extraordinary interaction of humans and machines.

28 Hyundai Motor gears up for change
World's car giant in the smart lane.

34 The road to industrial smartness
Why Dutch industries are fit for the future.

40 Standards leaders meet to build a better world
Highlights from the General Assembly in Geneva.

46 Riding the waves of change in the shipping industry
Sail the turning tides of technology.

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A NEW REVOLUTION in the making

Industry 4.0 represents the so-called Fourth Industrial Revolution, encompassing many societal, work-related, industry-specific and technological changes. It is the digital transformation of industrial markets with smart manufacturing currently at the forefront.

The rapidly increasing digitalization of industry and society is changing production methods and how we work in general. It represents the extensive connection between all areas of industry and society. Industry 4.0 (a term coined in Germany), or the Fourth Industrial Revolution, brings cutting-edge information technologies to all aspects of production, allowing us to form intelligent value networks. New business models and technologies like artificial intelligence and additive manufacturing are driving this process – changing current business models, shifting market structures and redistributing global market shares.

Industry 4.0 is opening the door to innovative and economic strength. It allows products to be tailored precisely to customers' needs – at low cost, high quality, and with a high level of efficiency. One example of this is DESMA Schuhmaschinen GmbH, a medium-sized company headquartered in Germany, which is using Industry 4.0 methodology to produce individualized footwear in lot size 1 at mass production cost based on digital models. Those who attended the ISO Week in Berlin in September 2017 might remember the presentation of their first demonstrator.

The key raw material of this digital revolution is data. The efficient utilization of data is an essential enabler

for future business. Global data traffic is exploding. One important reason for this is the increasing networking of devices, machines and humans via the Internet. In 2015, over 20 billion devices and machines were connected and this number is expected to have increased to half a trillion by 2030. The wide use of new technologies requires an intelligent integration of systems across all domains and hierarchies, which can only be achieved if relevant technologies, interfaces and formats have been clearly and reliably laid down in standards. Thus, digitalization and standardization must go hand in hand.

The consolidation of new concepts by means of standardization at an early stage of development is absolutely essential if they are to be rapidly implemented in industrial practice. In addition, a consistent approach and concerted efforts are required on the part of different organizations and associations. Overall, a need for coordination at various levels becomes a key element for success.

In Germany, with the Standardization Council Industry 4.0, we have set up a platform to coordinate the standardization activities in the field of Industry 4.0. In particular, the Standardization Council identifies concrete standardization needs, orchestrates their implementation and promotes fundamental concepts. It bundles the



Christoph Winterhalter, Chairman of the Executive Board of DIN.

The Fourth Industrial
Revolution has
the potential to shape
a global economy.

stakeholders and represents their interests in forums and consortia.

But Industry 4.0 is not just a national affair. Quite the contrary, it has enormous international significance and therefore requires an international approach. National standardization activities need to be harmonized with those at the international level. Thus, worldwide cooperation is absolutely essential for opening up the way towards global standards and ensuring all stakeholders speak the same language. The key role of standardization in this area is reflected in these increasingly international activities.

Intensive work is currently being carried out by ISO and its sister organization, the International Electrotechnical Commission (IEC). ISO set up the Smart Manufacturing Coordinating Committee (SMCC) which began work in 2017 as a forum for sharing information and mapping smart manufacturing standards. Its aim is to ensure the overarching coordination between relevant technical committees and to serve as the focal point for interfacing with smart manufacturing bodies from IEC and the International Telecommunication Union (ITU) to facilitate a joint international approach.

The IEC also recently founded the System Committee Smart Manufacturing (IEC/SyC SM) to provide coordination and advice for the harmonization and advancement of these activities within the IEC and other SDOs. A good example of overarching cooperation between ISO and the IEC is Joint Working Group 21, founded by technical committees ISO/TC 184 and IEC/TC 65. More than 70 experts from 13 countries are working together with a view to harmonizing existing reference models and monitoring the development of an underlying architecture for smart manufacturing.

Digital transformation is a task for the whole of society and a global development. The Fourth Industrial Revolution has the potential to shape a global economy with more efficient and sustainable production. If we are to make full use of this potential, we will need to cooperate across borders. We will have to strengthen international cooperation in the field, for example in areas such as standardization, access to test beds, or support for small and medium-sized enterprises. It is my conviction that standardization for the digitalization of industry can only be successful if it is cross-sectoral, forward-looking and if it involves all stakeholders and standards organizations, be they consensus-based like ISO and the IEC or from relevant consortia. With the spirit of our Berlin Declaration “Open Minded, Open for Change”, we are on the path to achieving these goals. ■

New (e-)takeoff for aviation industry



by Ann Brady

New technologies, from robotics to machine learning, are ushering in a period of rapid change and development. While the aviation industry is working to reap the benefits of this industrial automation, standards, especially those of ISO/TC 184/SC 4, will play a key role in ensuring a smooth flight path – but only if they can keep up.

Ever since Icarus boldly strapped on his wooden-framed wings made of feathers and wax and took to the skies, human beings have been defying gravity, designing and creating all kinds of contraptions and devices to get themselves airborne. Hubris, along with solar power, did it in for Icarus, but these days, the likes of Elon Musk, founder and chief designer of SpaceX and creator of Tesla, and Jeff Bezos, founder of Amazon.com and Blue Origin, are blazing new trails in the skies, driven by their vision and a sense of adventure, and propelled by the new technologies of the Fourth Industrial Revolution.

These modern-day Icaruses can afford to think big, and their successes, trailblazing endeavours and projections are splashed across the media. Of course, the aerospace and aviation industry has been pushing boundaries for years. From the first commercial air flight in 1914, demand for air travel has grown exponentially. As a result, the

industry has had to seek new ways to design safer, faster, lighter, more fuel-efficient aircraft. And in the ever more environmentally aware 21st century, the industry also has to take action to reduce aircraft emissions and achieve a more sustainable carbon footprint – big challenges indeed in an era that has been described as “generation EasyJet”.

Fast and flexible

Finding solutions to these challenges calls for cost-effective, fast and flexible new production processes. Technologies such as advanced robotics, artificial intelligence, machine learning, cloud computing and the Internet of Things are playing a huge role in such processes and are quietly transforming our lives, particularly in the aviation industry. Every time we step on a plane and buckle up, we are handing ourselves over to some degree of automation.

For instance (nervous flyers should look away now), we never think about the thousands of holes that are holding the different parts of the plane together and how those holes were drilled, a time-consuming task that also requires a lot of precision. Ben Morgan, Head of the Integrated Manufacturing Group at the Advanced Manufacturing Research Centre at Sheffield University, points out in an article on automated manufacturing in *The Engineer*, this is a task better suited to robots than people. “Automated systems can achieve greater precision, and do not get bored or tired; drills capable of handling aerospace materials and layers of different materials are bulky, heavy and difficult even for skilled staff to use,” he says. Good news for air travellers.

And when you consider that a Boeing 747, for example, consists of six million parts, which must all be assembled, it becomes clear that automated manufacturing has a key role to play

in building new aircraft. However, therein lies the challenge for the aviation industry – not only in staying abreast of the rapid development of new technologies but also ensuring standardization in the field of automation systems and their integration for design, sourcing, manufacturing, production and delivery, support, maintenance and disposal of products and their associated services.

One person with a unique perspective on both these challenges is Kenny Swope, Senior Manager, Business Capability Integration, at Boeing, and Chair of technical committee ISO/TC 184, *Automation systems and integration*, subcommittee SC 4, *Industrial data*. For a company like Boeing, which is a manufacturer of highly complex systems at scale, Swope says standards are critical to its overall success in the industry and are woven through the company’s “product, the supply chain and the service offerings in a myriad of ways”.



Key role for standards

He cites three standards as playing a key role. According to Swope, one of the most successful standards in the adoption of a digital product design is ISO 10303, *Industrial automation systems and integration – Product data representation and exchange*, often referred to as STEP. ISO 10303 comes under ISO/TC 184/SC 4 on industrial data. STEP has evolved into the most commonly used standard for exchanging product design data between computer-aided design (CAD) systems, both inside companies and across the global supply chain.

He says: “As the heart of the product design and deliverable from engineering to manufacturing, the three-dimensional representation of the product design coupled with the engineering requirements and manufacturing information form the core of the digital twin.” This collection of data for a detailed virtual representation has clear benefits. At Boeing, Swope says, “the product design is distributed to both internal and external stakeholders at the component and assembly level and this standard is critical to that network”.

Disseminating complex data on product design for general instruction, training and documentation is another big challenge. Here, Swope highlights ISO 14306, *Industrial automation systems and integration – JT file format specification for 3D visualization*, which is also managed by ISO/TC 184/SC 4. He says the standard is invaluable in providing what he describes as a “lightweight version” of a complex data structure such as the visualization of the product for manufacturing, service and support, which “is useful in engineering documents, online service manuals and manufacturing stations”.

The third standard, ISO 32000, *Document management – Portable document format*, “is a strong partner to both ISO 10303 and ISO 14306”, says Swope. This standard, commonly known as the PDF standard, is, he adds, vital to the seamless operation of the digital future as it provides a universally accepted conveyance vehicle for the product design and its associated information.

Finally, ISO 8000, *Data quality*, and ISO 22745, *Industrial automation systems and integration – Open technical dictionaries and their application to master data*, are significant enablers to smart manufacturing. As ISO 9000 is to manufacturing quality, ISO 8000 is to data. Smart manufacturing requires data free of defect and openly shareable data definitions of commonly used parts. ISO 22745 provides a multi-industry solution to sharing definitions of these common parts for use across the supply chain.



The aerospace and aviation industry has been pushing boundaries for years.



Automated manufacturing
has a key role to play in
building new aircraft.

Automation and efficiency

Annalise Suzuki, Director of Technology and Engagement, at Elysium Inc., a software company that describes itself as a multi-CAD data exchange optimization platform, also extols the benefits of standards and the critical role they play as the trend for industrial automation grows. She says: “Organizations pursuing automation for efficiency gains must find a balance between adopting new technology and leveraging stability from standards where they can.”

Like Swope, Suzuki believes that leveraging standards allows organizations to quickly agree on the means and methodology to collaborate, without overcomplicating processes. She says: “It allows doers to take action without the need to solve ‘how’ first.” While standards allow collaboration among people today, she says they will be “a key enabler to drive automation potential for machine-to-machine communication, which will be the basis for achieving the Fourth Industrial Revolution”. Standards clearly go a long way to helping industry realize the full potential of automation, enabling people and technology to work hand in hand. But what about safety? Unlike our old friend Icarus, who turned a deaf ear to his father’s warning about flying too close to the sun, the aviation industry rightly puts safety concerns to the fore. But does smart manufacturing, and industrial automation in particular, carry the seeds of potential lapses in safety, especially when it comes to data security?

Bridging the safety gap

Christoph Preusse, an expert and designee from ISO/TC 199, *Safety of machinery*, and Chair of the Smart Manufacturing Coordinating Committee (SMCC), acknowledges the threat to safety from IT-system malfunctions. However, he points out that a lot of effort has been made by ISO/TC 184 (together with the International Electrotechnical Commission’s IEC/TC 65) as well as in ISO/TC 199 to improve security and the interaction between security and safety (for example, future technical report ISO/TR 22100-4). As a result, Preusse says, “industrial automation and its control systems are actually on the way to improving the safety of machinery”.

As mentioned earlier, one of the striking characteristics of the Fourth Industrial Revolution is the speed at which new technologies are being developed. Many young people growing up now, for example, have never used



a land line. While industry adoption is something that each company has within its control, Swope says that gaps are often found that need to be addressed and resolved. “These resolutions simply take too long in today’s rapid-paced business environment. In addition, new technologies and methods of manufacturing are emerging that are seeing significant industry excitement. Additive manufacturing, blockchain, and advanced robotics are recent examples. While value generation is occurring right now as an emerging space, the real value will come when these and other technologies are standardized and replicated at a massive scale.”

Open for opportunities

The biggest challenge, therefore, in many respects, is how ISO and other standards organizations can keep up and ensure their standards remain relevant. As Swope puts it: “There is speed to adoption and speed of development.” He says consensus can be time-consuming and the more stakeholders have to agree, the more difficult consensus becomes and the longer it takes to achieve.

However, along with the biggest challenge, Swope also sees a great opportunity – the rate of standards development. He says: “I see opportunity for ISO and other standards bodies to digitally transform themselves and move to that agile future state. There are encouraging pilots and early work occurring in this area.” For Swope, ISO/TC 184/SC 4 is contributing to that future state “by adopting and promoting as many advancements as possible with these pilots, working with stakeholders in industry and across ISO”. Smart moves. ■



From high-tech gadgets to the smart enterprise

Technological change is taking place at a dizzying rate, transforming our lives in all manner of ways that are not always obvious. How can we ensure efficient management of these automated systems so disruption is positive and does not become a bewildering maelstrom beyond our control?

We have all read stories of robots taking over our jobs – from Flippy, the hamburger-flipping robot (aka an “AI-driven kitchen assistant”) at a restaurant in California, to Pepper, a humanoid robot from SoftBank Robotics, that can recognize human emotions and has been employed in stores around the world. But smart manufacturing is actually much more pervasive and already making a huge difference to all our lives, more quietly and, as in Flippy’s case, more efficiently.

As more and more of us gain access to the Internet, smart manufacturing will become an indispensable element in our daily routines. A survey from the Pew Research Center indicates that there has been a noticeable rise recently in the percentage of people in emerging and developing countries who use the Internet. It goes on to say that while people in advanced economies still use the Internet more and own more high-tech gadgets, the rest of the emerging world is catching up – fast.

Patrick Lamboley is Chair of technical committee ISO/TC 184, *Automation systems and integration*, and Senior Director of Standardization at Schneider Electric. Schneider Electric is a European multinational corporation that specializes in energy management and automation solutions, spanning hardware, software and services. In the UK, for example, the company works with airports, providing them with state-of-the-art solutions to keep them competitive in a fast-moving business environment. Behind-the-scenes services include helping them implement the latest security measures using technology to keep baggage-handling systems working efficiently.

Here, Lamboley explains how standards can help address the biggest issues in smart manufacturing and why the relationship between human beings and machines has never been so important.

ISOfocus: What do you think are the greatest challenges for smart manufacturing?

Patrick Lamboley: I believe that managing digitization is the great challenge. As in the first industrial revolution, when national economies and the organization of the global economy changed, we are undergoing the same transformation or revolution. And this revolution is not a long-term vision; it's a reality, taking place now. Today, the world's biggest and most profitable companies no longer simply focus on what they produce; the focus is shifting to software companies, or the IT players dealing with data. This data is definitively an important point of attention of smart manufacturing and, of course, the big issue is how to ensure cyber security and data privacy for users and organizations alike with respect to their data, their knowledge.

Another big challenge is understanding and changing the relationship between these new technologies, such as artificial intelligence (through computers, apps, analytics, etc.), and the place of the human being in smart manufacturing, in order to achieve successful outcomes from this collaboration and define the role of humans in this new high-tech world.

How can ISO standards help overcome these challenges?

ISO committees have been strongly involved in automation and manufacturing for a very long time. An important element regarding ISO standards is



Photo: Patrick Lamboley
Patrick Lamboley, Chair of ISO/TC 184 and Senior Director of Standardization at Schneider Electric.



Photo: Patrick Lamboley

ISO committees have been strongly involved in automation and manufacturing for a very long time.

that they don't concentrate solely on technologies or one specific aspect, but at the level of the complete system, on the integration of subsystems and components. This is why our knowledge is so relevant to addressing the standardization of smart manufacturing.

One example of this desire to address the complete system is the creation of the Smart Manufacturing Coordinating Committee (SMCC), which comprises representatives of the relevant technical committees. As its name suggests, the SMCC is concerned with all the areas in ISO that fall within the scope of smart manufacturing, and establishes or reinforces relationships and concrete cooperation between them. And with the participation of joint technical committee ISO/IEC JTC 1 – the standards development environment where experts from ISO and the International Electrotechnical Commission (IEC) come together to develop worldwide information and communication technology (ICT) standards for business and consumer applications – the SMCC is also able to incorporate the IT world and associated topics.

In what ways can ISO's recent efforts in automatization bring added value?

As I mentioned already, the SMCC creates good emulation between stakeholders and new ideas and values in the respective committees. What's more, smart manufacturing was a major topic at the annual meeting of ISO/TC 184, called the Super Meeting, in Beijing in May 2018. A full day was devoted to smart manufacturing as a means of initiating exchanges between the experts involved in this field, which was also a great opportunity to get fresh perspectives and generate initiatives. The event drew participants from industry and R&D institutions, such as AVIC, SAC, WIZ, JLS Innovations, Beihang University, Siemens, Boeing and many more.

We named this day the "cavalcade day" and it consisted of two parts. The first part was dedicated to the presentation of local views and the implementation of smart manufacturing, along with the activities of ISO/TC 184 and its associated subcommittees. The second part, which took place during a "world café" session, was an interactive debate between experts on how the technical committee and its subcommittees respond to smart manufacturing and how we can make progress on what has now become one of the world's hottest topics.



The goal is to define the common rules needed to build reference models for a smart manufacturing system.

We concluded the day with two demonstrations that were directly linked to the implementation of ISO/TC 184 standards for smart manufacturing and gave a review of the feedback, ideas and ways to improve our activities in the different working groups.

What standards are making the most impact on smart manufacturing and why?

There are many standards within the scope of smart manufacturing that help with the definition of all associated components, such as the life cycle of technical installations, reference model, digital twin, data quality, and so on. ISO/TC 184 and its associated subcommittees are leading or are strongly involved in some of them. ISO/IEC Joint Working Group 21 was set up with the aim of harmonizing existing reference models and overseeing the development of an underlying architecture with regard to smart manufacturing models, with a special focus on aspects such as life cycles and the technical and/or organizational hierarchies relating to assets.

The goal is to define the common rules needed to build reference models for a smart manufacturing system. This begins with the merging, comparison and analysis of existing models, and with the active participation of countries that have defined their own reference models (e.g. China, France, Germany, Japan, Sweden, the UK and the United States, among others), to deliver a standardized metamodel that includes existing standards and/or specificities coming from the countries involved.

The second key topic for me is the "digital twin". It started in ISO/TC 184's subcommittee SC 4 (industrial data) with ISO 15926. The purpose of ISO 15926 is to provide a common language for computer systems, thereby integrating the information produced by them. Originally designed for the process industries working on large projects that involve many stakeholders, and plant operations and maintenance that last decades, the technology can also be used by anyone wanting to set up a proper vocabulary of reference data to provide a shared understanding of a specific domain. Only in this way can true integrations emerge, bringing added value to industries that are, to a large extent, knowledge-based. ■





The new frontier *for artificial intelligence*

by Robert Bartram

No longer just a fictional theme for far-fetched science fiction movies, artificial intelligence is now very much a day-to-day part of our reality. In factories, in intelligent transportation, even in the medical field, artificial intelligence (AI) is just about everywhere. But what exactly is artificial intelligence? As AI becomes more ubiquitous, why is there a need for International Standards? And what are some of the topics surrounding its standardization?



People tend to think of AI as autonomous robots or a computer capable of beating a chess master.

A recent report by the McKinsey Global Institute¹⁾ suggests that investment in artificial intelligence (AI) is growing fast. McKinsey estimates that digital leaders such as Google spent between “USD 20 billion to USD 30 billion on AI in 2016, with 90% of this allocated to R&D and deployment, and 10% to AI acquisitions”. According to the International Data Corporation²⁾ (IDC), by 2019, 40% of digital transformation initiatives will deploy some sort of variation of AI and by 2021, 75% of enterprise applications will use AI, with expenditure growing to an estimated USD 52.2 billion.

From perception to reality

But what exactly is AI? According to Wael William Diab, Chair of the new technical committee ISO/IEC JTC 1, *Information technology*, subcommittee SC 42, *Artificial intelligence*, the field of AI includes a collection of technologies. The newly formed committee has started with some foundational standards that include AI concepts and terminology (ISO/IEC 22989). Diab stresses that the interest in AI is quite broad, bringing together a very wide range of diverse stakeholders such as data scientists, digital practitioners, and regulatory bodies. He also points out that there’s something of a gap between what AI actually is today and what it is often perceived to be. “People tend to think of AI as autonomous robots or a computer capable of beating a chess master. To me, AI is more of a collection of technologies that are enabling, effectively, a form of intelligence in machines.”

He also explains that AI is often seen as a group of fully autonomous systems – robots that move – but, in reality, much of AI goes into semi-autonomous systems. In many AI systems, a good deal of data will have been prepared before being fed into an engine that has some form of machine learning, which will then, in turn, produce a series of insights. These technologies can include, but are by no means limited to, machine learning, big data and analytics.

Umbrella of technologies

Currently a Senior Director of Huawei Technologies, Diab is Chair of the ISO/IEC subcommittee for good reason. Armed with several degrees in electrical engineering,

1) McKinsey Global Institute, *Artificial Intelligence: The Next Digital Frontier?*

2) IDC, *US Government Cognitive and Artificial Intelligence Forecast 2018-2021*

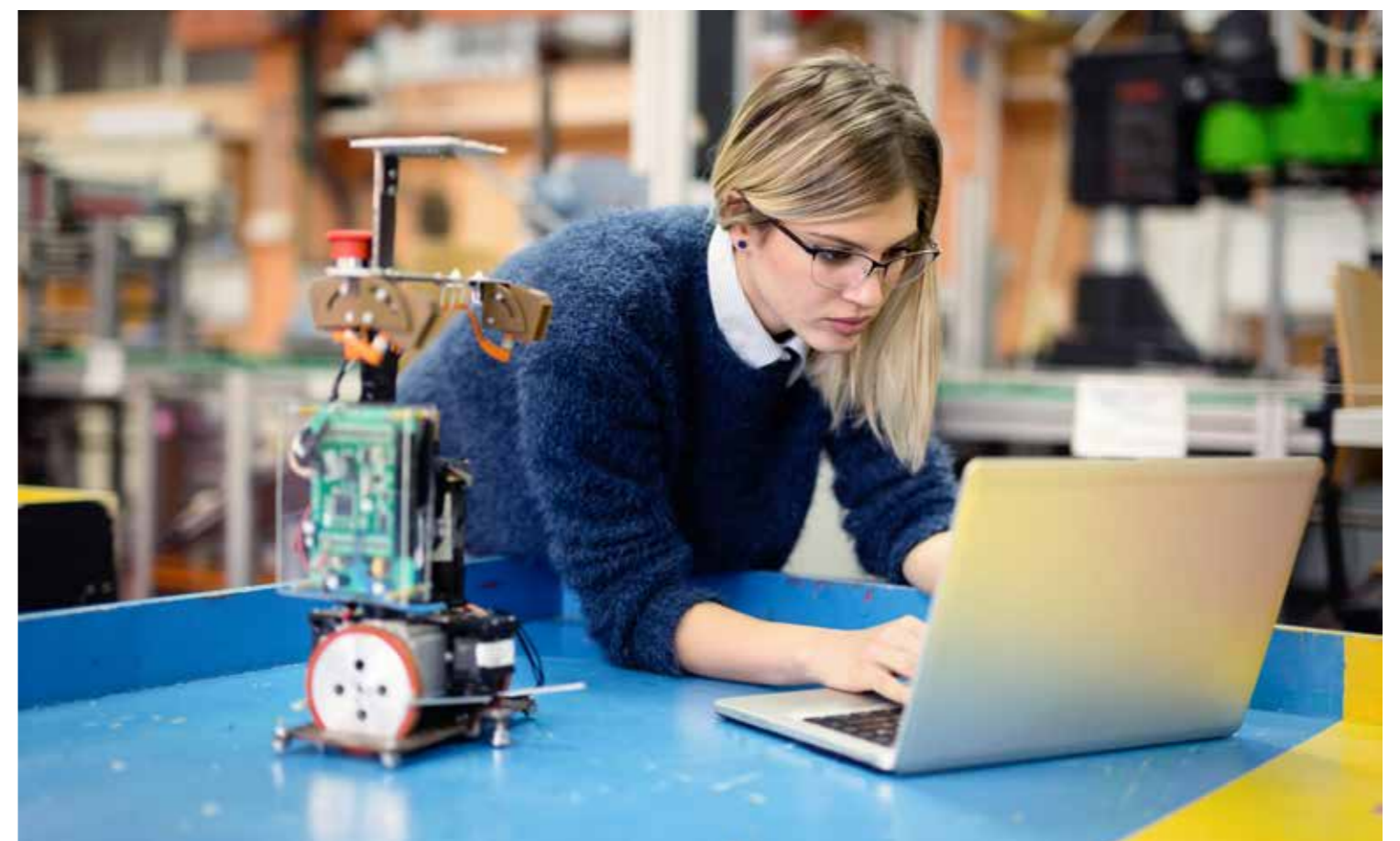
economics and business administration from both Stanford and Wharton, his professional life has focused closely on business and technology strategy. Moreover, he has also worked for multinational conglomerates Cisco and Broadcom as well as been a consultant specializing in Internet of Things (IoT) technologies, most recently as the Secretary of the Steering Committee of the Industrial Internet Consortium. He has also filed over 850 patents, of which close to 400 have been issued, with the rest under examination. That’s more patents than those filed by Tesla – and not one of his applications has been rejected. Diab’s true specialism lies in the breadth of his expertise – his range stretches from the early incubation of ideas to strategically driving the industry forward. It’s also why he’s so keen on standardization, as he sees it as the perfect vehicle for the healthy expansion of the industry as a whole. He argues that we need standards for AI for several reasons. First, there’s the degree of sophistication of IT in today’s society. After all, an average smartphone now has more power than all of the Apollo missions combined. Second, IT is moving deeper and deeper into every sector. After a slow start in the 1970s and 80s, people no longer need IT systems merely for

greater efficiency and it is now needed to reveal operational and strategic insights. Finally, there is the sheer pervasiveness of IT in our lives. Every sector relies on it, from finance to manufacturing to healthcare to transportation to robotics and so on.

Part of the solution

This is where International Standards come into play. Subcommittee SC 42, which is under joint technical committee JTC 1 of ISO and the International Electrotechnical Commission (IEC), is the only body looking at the entire AI ecosystem. Diab is clear that he and his committee are starting with the recognition that many aspects of AI technology standardization need to be considered to achieve wide adoption. “We know that users care deeply and want to understand how AI decisions are made, thus the inclusion of aspects like system transparency are key,” he says, “so comprehensive standardization is a necessary part of the technology adoption.”

The AI ecosystem has been divided into a number of key areas spanning technical, societal and ethical considerations. These include the following broad categories.



Foundational standards

With so many varying stakeholders, a basic starting point has been the committee's work on "foundational standards". This looks at aspects of AI that necessitate a common vocabulary, as well as agreed taxonomies and definitions. Eventually, these standards will mean that a practitioner can talk the same language as a regulator and both can talk the same language as a technical expert.

Computational methods and techniques

At the heart of AI is an assessment of the computational approaches and characteristics of artificial intelligence systems. This involves a study of different technologies (e.g. ML algorithms, reasoning, etc.) used by the AI systems, including their properties and characteristics as well as the study of existing specialized AI systems to understand and identify their underlying computational approaches, architectures, and characteristics. The study group will report on what is happening in the field and then suggest areas in which standardization is required.

Trustworthiness

One of the most challenging topics for the industry is that of "trustworthiness", the third area of focus. This goes straight to the heart of many of the concerns around AI.

The study group is considering everything from security and privacy to robustness of the system, to transparency and bias. Already with AI, there are systems that are either making decisions or informing individuals about decisions that need to be made, so a recognized and agreed form of transparency is vital to ascertain that there is no undesirable bias. It is highly likely that this study group will set out a whole series of recommendations for standardization projects. Such work will provide a necessary tool and proactively address concerns in this area. "By being proactive in recognizing that these issues exist and standards can help mitigate them, that's a huge departure from how transformative technologies were done in the past, which were more of an afterthought," Diab says firmly.

Use cases and applications

The fourth area of focus is to identify "application domains", the contexts in which AI is being used, and collect "representative use cases". Autonomous driving and transportation, for instance, is one such category. Another example is the use of AI in the manufacturing industry to increase efficiency. The group's reports will lead to the commencement of a series of projects that could include everything from a comprehensive repository of use cases, to best practices for certain application domains.

Societal concerns

Another area of focus is what Diab terms "societal concerns". Broad technologies like IoT and AI have the ability to influence how we exist for generations to come, so their adoption creates impacts that go much further than the technology itself. One of these is economic considerations, such as AI's impact on the labour force (which naturally goes beyond the remit of the committee). But others certainly do fall into its purview: issues such as algorithmic bias, eavesdropping, and safety directives in industrial AI are all central to what the committee must look at. How, for instance, should an algorithm be safely trained – and then, when necessary, re-trained – to function properly? How do we prevent an AI system from correlating the "wrong" information, or basing decisions on inappropriately biased factors such as age, gender or ethnicity? How do we make sure that a robot working in tandem with a human operator doesn't endanger its human colleague?

SC 42 is looking at these aspects of societal concern and ethical considerations throughout its work, and collaborating with the broader committees underneath its parent organizations, ISO and IEC, on items that may not be under the "IT preview" but impacted by it.

Big data

A few years ago, JTC 1 established a programme of work on "big data" through its working group WG 9. Currently, the big data programme has two foundational projects for overview and vocabulary and a big data reference architecture (BDRA), which have received tremendous interest from the industry. From a data science perspective, expert participation, use cases and applications, future anticipated work on analytics, and the role of systems integration, the big data work programme shares a lot of commonalities with the initial work programme for SC 42. From an industry practice point of view, it's hard to imagine applications where one technology is present without the other. For this and many other reasons, the big data programme has been transferred to SC 42. The committee will focus on how to structure the work at its next meeting. It is also anticipated that new work products for big data will be developed.

Exponential growth

The field of AI is evolving very quickly and expanding so much that the application of the standards being developed by SC 42 will continue to grow along with the work programme of the committee. Diab foresees many more standards taking shape, especially in areas that have broad appeal, applicability and market adoption.

And it's also because of these standards that Diab is certain AI adoption will not only be successful, but is one of those major technology inflection points that will change how we live, work and play. ■



How do we make sure that a robot working in tandem with a human operator doesn't endanger its human colleague?

CONNECTING WITH ROBOT CO-WORKERS



by Barnaby Lewis

After little more than a decade of social networks, many of us would find it difficult to imagine life without them. From keeping up to date, to finding a new job, they've transformed our lives. So it shouldn't come as a surprise that now the robots want to get in on the action.

Admittedly, it may be still a stretch to talk about what robots "want", but as manufacturing equipment becomes more intelligent, there are a number of parallels that can be drawn with the ways that humans digitally connect to each other through social networks. The comparison at least gives us a context to imagine the dimensions of this massive technological shift.

In reality, industrial robots have been in the workplace for decades in the form of powerful automated arms performing heavy-duty tasks that are considered too dull, dirty and dangerous for humans. Among a whole host of benefits, they minimize the risk of human error induced by unfulfilling, boring and repetitive tasks. More recently, however, technological advances have begun to allow for greater diversity of robotic systems in the workplace. Next-generation "collaborative robots" have the ability to work side by side with workers, creating the potential for a wider range of applications.

Next-generation
“collaborative robots”
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By building on a solid platform of International Standards, connected robot systems have the power to transform the way we make things, the way we work, and even what children will study in future. ISO standards are fundamental in connecting robot systems to each other, linking the stages of manufacture from initial design to quality control and shipping, to the people who buy the end products.

Boilers, beef, then bytes

The core concepts of connected manufacture are outlined in what some may know as “Industry 4.0”. Originally spelt “Industrie 4.0” since the idea was “Made in Germany”, it is now part of a wider vision known as the “Fourth Industrial Revolution” (4IR) – “fourth” because, like the revolutions that came before it, it’s an industry-wide game changer.

Similar to steam power, which gave rise to the first industrial revolution (1IR), connecting intelligent machinery is an enabler that isn’t product- or process-specific. In common with the factory lines that ushered in 2IR, which began in meat-packing warehouses before spreading to automobiles, then everywhere else, it is endlessly adaptable. And in the same way that digital automatization (3IR) has reduced product costs and eliminated the most dangerous and tedious jobs, 4IR has the potential to improve not only the quality, safety and variety of products we buy, but the conditions we work in and the wages that are paid.

Whereas the first three revolutions impacted physical processes and transformed manual work, the Fourth Industrial Revolution heralds the possibility to impact work where thought, or judgement, is required. The potential is immense, with greater numbers now working in industry than at any time in history. This is partly due to the mechanization ushered in with 1IR and 2IR, which have enabled an ongoing move toward cities, consumerism and industrial work, including manufacture. As technology is now poised to bring sweeping changes to the industrial sector, and the seven hundred million people ¹⁾ that it employs, readiness is key.

¹⁾ International Labour Organization, *World Employment and Social Outlook: Trends 2018*



Don’t be scared... be prepared

Helping business, governments and individuals make the most of standardized technology has been central to ISO’s mission since the very beginning. ISO created technical committee ISO/TC 299, *Robotics*, in 2015 to meet the growing need for robotics in all areas, from manufacturing to personal care. I asked Staffan Elfving, Chair of ISO/TC 299, to explain some of the challenges that ISO standards will address. It seems that the wide applicability and versatility of robotics are both its strength and a headache: “Robotics products are becoming more and more multidisciplinary, requiring advanced solutions from hardware and software, to mechanics, computers and sensing,” says Elfving. “At the same time, both our customers and our own teams are increasingly global. As complexity increases, we need to ensure that we maintain a tight focus in our development work.”

One way to deal with the speed and complexity of this fast-changing industry is to make sure that everyone is speaking the same language. Of course, that applies to robots as they interconnect, but is equally important to humans, which is where ISO/TC 299’s working group WG 1 on vocabulary and characteristics comes in. Elfving remarks that “the creation of new ‘ease of use’ standards is key for success in product development. It enables us to keep up with the rapid market changes, as well as capture new-technology opportunities in robotics”.

ISO/TC 299 brings together standardizers and industry to work for common goals: promoting collaboration with consensus agreements, applying non-competitive best practice, reducing costs and increasing value for suppliers, end users and customers. Elfving concludes: “What’s good for the industry is also good for all participants in the complete value chain.”

New roles for
robots mean
new roles and
futures for
people.



The digital twin

With almost unlimited potential applications, an understanding of the bigger picture is essential, which is where the initial comparison with social media helps. One of the key features of 4IR manufacturing is in its similarity to our creation of online versions of ourselves on social networks. In human life, this allows us to experiment with identity, purpose and relationships. But for inanimate objects, simulation using a virtual twin allows us to improve responsiveness, autonomy and efficiency.

The creation of digital twins means that for every object that exists in a factory, there is a virtual counterpart. This counterpart represents the ideal version of the real-life thing, allowing robotization of processes where judgement of conformity, assessment of quality, or customization is required. It's even possible to imagine certain commercial transactions, purchasing decisions and optimization of resources independently. Not only can ISO standards define many of the ways by which machines can connect with each other, and authorize the exchange of information, they also standardize the physical parts of robot systems, the shape and size of moving parts that grasp and manipulate objects. International Standards are the key to interchangeability, modularity and flexibility at the heart of the intelligent manufacturing revolution.

Safer systems

If intelligent, connected automatization has the potential to increase speed and efficiency, how can it also contribute to improving workplace safety? According to Roberta Nelson Shea, Convenor of ISO/TC 299's working group WG 3 on industrial

Designing safety
into the robots
themselves
is the next
building block.

safety and Global Technical Compliance Officer at Universal Robots A/S, "only a completed application can be described as safe". This means looking at the whole applied robot system, rather than just an individual part of it. Designing safety into the robots themselves, whilst looking at how they interact as part of a system (in particular where they interact with humans), is the next building block. "These two distinct aspects of addressing safety are covered by ISO 10218-1 and 10218-2 respectively, both of which are currently under revision," Shea adds.

As an engineer who has spent more than four decades in industrial safety and automation, Shea brings valuable hands-on expertise to her ISO job. She remains down-to-earth when asked to speculate on how robots will impact not only our jobs, but also our private lives. "When it comes to job security, there are understandable concerns that some jobs will be replaced, but the net-effect will be positive due to productivity increases and new more interesting jobs," she says. Elfving agrees that we can only benefit from this technology: "There will be a shift that requires new skills, but that's an opportunity, much more than a threat." And as Shea points out, "with 4IR and improved robot designs, the robots are so much easier to operate that they become tools that can be used by a wide range of operators, ideally with no special training or skills. Robots will be increasingly intuitive and easy to use by everyone".

Robot job exchange

So, it seems likely that many of us in the future, even those who don't work in manufacturing, will be sharing our workplace with robots. Will that also lead to scenarios where we fully coexist with robots, even outside of work? Shea tells me that there's a balance to be struck, and certain areas where it makes less sense to apply robots to our everyday tasks. "I, personally, am not interested in filling my life with tiny robots to do tasks that could be achieved with simple tools." Does that make Shea a closet Luddite? "I wouldn't say so as I am a geeky, nerdy type of person: I recently contemplated buying a small grill-cleaner robot! It's more that I believe the real contribution of the technology lies elsewhere and not lost in my kitchen gadget drawer."

I ask her in what specific ways robotization can contribute to well-being. "The obvious example is in industrial settings where we can reduce the

need for humans to do dirty, dangerous or highly repetitive work." Shea is right to say that the degree of employee engagement and pride in managing robot systems almost certainly outweighs a manual task like loading parts. Looking wider, it seems that there are other possibilities, Shea continues: "wearable robotics could assist with specific tasks that still require judgement, augmenting human strength and precision".

So, tasks where great strength or finesse is needed, heavy lifting or surgery, for example, are a natural fit where human capacities can be boosted, reducing accident rates. The possibility to apply this same technology to people with reduced mobility presents an exciting development in maximizing participation and minimizing physical limitation. "Think about wheelchair users being able to walk with 'wearable robots' – WOW!" Shea concludes.

Beyond bots

The Fourth Industrial Revolution relies on more than just robots, with most commentators in agreement that there are, in fact, nine pillars of technological advancement²⁾ that are essential to driving change. From cloud computing to additive manufacturing, to handling big data and security, ISO remains tightly focused on developing user-friendly standards in almost every area that underpins and enables this new form of industry. Thanks to ISO's technical committees, fuelled by the tireless contribution of experts like Shea and Elfving, we can move beyond the big ideas to concrete benefits for industry and consumers.

While it may be a long time before we are interacting with robot systems that are sufficiently intelligent and autonomous that we would "friend" them on our own social networks, most people in manufacturing have a good reason to be excited about their robot co-workers. New roles for robots mean new roles and futures for people – as 4IR brings advantages beyond safety, and beyond reduced product costs.

Most importantly, it will allow us to identify and maximize the unique value that humans can add to manufacturing. That means more interesting and better jobs, and that's a reason to give robots at work a solid thumbs-up. ■

2) LCR4.0, "The Nine Pillars of Industry 4.0", 19 January 2017



Photo : Hyundai

Hyundai Motor **gears up for change**

Shifting from a traditional automotive manufacturing process to advanced automated and digitalized intelligence manufacturing will lay the ground for how automotive companies compete in the future. We ask Hyundai how it all connects.



Dr-Ing. InSung Chang, Executive Director, Manufacturing Engineering Research & Development Center, at Hyundai Motor Company.

Standards are needed to achieve both efficient data connectivity and effective information flow.

separate islands of efficiency. The overarching concept of smart manufacturing in the auto industry is to interconnect each individual stage of production to achieve plant-wide efficiency. *ISOfocus* caught up with Dr-Ing. InSung Chang, Executive Director, Manufacturing Engineering Research & Development Center, at Hyundai Motor Company, to find out how smart technology is driving the auto industry.

***ISOfocus*: Why is smart manufacturing a key focus for the auto manufacturers sector in general, and at Hyundai Motor, in particular?**

Dr-Ing. InSung Chang: Historically, automotive manufacturers – or OEMs, as they are known to industry – have been defined by automated assembly and inspection to increase productivity and quality. This enabled large volumes of standardized vehicles to be manufactured.

Now, however, the make-to-custom car model is on the rise, bringing obvious challenges with regard to how we control quality, cost and deadlines. As mass production turns into mass customization, or “personalized” production, the complexity in production plants has significantly increased. Unless we manage to solve this complexity, we won’t be able to provide high-quality products at acceptable prices, and we cannot expect sustainable growth either.

That’s why the Hyundai Motor Company is putting the focus on smart manufacturing systems. Built on the concepts of smart products and smart factories, these form a production environment in which production and logistics systems organize themselves without human intervention. This is known as a “smart ecosystem” and has been a source of great satisfaction to Hyundai Motor and our customers.



Final quality inspection in a Hyundai car manufacturing plant.

In the last century, the car culture has conquered the entire world, shaping not only the global economy but how millions of people live. Yet, for all its staying power, the automotive industry is facing transformative change on multiple fronts with autonomous vehicles, hyper-connected smart cars and electric mobility, to name a few. But even the best transitional strategies can fail if the businesses themselves don’t follow, and the companies that stand the distance will be those that digitalize not just their products and services but how their businesses operate.

To capture the trend, automotive manufacturers cannot simply turn to their traditional toolbox. They need to take key strategic decisions about how they build cars in the future. A case in point is the Hyundai Motor Company, which, with a global value of USD 13.2 billion, consistently ranks among the world’s top-valued brands. Under its brand direction “Modern Premium”, Hyundai Motor is working incredibly hard to realize its vision for future mobility. And this includes plans to implement smart manufacturing solutions in order to improve production processes.

Currently, a standard car manufacturing plant uses multiple systems, including information technology, intelligent motors, sensors, computerized controls and production management software, that coexist as



Photo: Hyundai

Hyundai smart tag.



Photo: Hyundai

Final assembly line.

Could you tell us a little more about Hyundai’s “smart manufacturing solutions”. How is Hyundai’s “smart tag” being used in the production process?

Hyundai Motor defines the smart factory as an environment in which automation becomes more human-centric and massive quantities of information on the physical layer collect into the cyber layer in a digital form. This digitalized information is linked to other related information and will finally be fed back to the automation level. To embed the elements of automation, digitalization, connection and intelligence in the smart factory, we make the best of Hyundai’s manufacturing technologies and cutting-edge ICT, such as smart sensors, the Internet of Things, big data, artificial intelligence, and others. A year ago, Hyundai introduced its “smart tag” technology, a wireless production control system to be implemented in all our factories. Developed by Hyundai’s production technology development centre, the smart tag boasts a real-time locating system – including high-capacity memory, wireless chip and location tracking sensor units – that provides positioning information to secure information connectivity. This real-time data collection is expected to enable immediate response to even a small error. Smart tag is a core technology of connectivity, which is fundamental to the smart factory concept.

What about standards? We obviously need them to really have the connectivity goals of a digitally connected enterprise or a smart manufacturing ecosystem. How can standards keep up with the pace of innovation?

The core of smart manufacturing consists of connectivity and convergence. Standards are needed to achieve both efficient data connectivity and effective information flow by making it easy to connect devices and services from various suppliers at low cost. What’s more, solutions and standards must always be taken into consideration together. In an era of convergence, both solutions and standards must be flexible. We hope that ISO standards will serve as a platform for building this smart manufacturing ecosystem. It is up to each company to adopt the standards and, ultimately, to adapt them accordingly in order to compete.

With increased complexity in activities and communications, how are ISO standards making smart manufacturing “smarter”?

There are a lot of human errors involved in analysing complex data. In this era of complexity, it is therefore important to standardize data types and data



Photo: Hyundai

Hyundai’s Manufacturing Engineering R&D Center drives the future of automotive manufacturing.

connections so that complex situations can be automatically judged and executed, utilizing information and communication technology.

In my view, complexity can be handled in the smartest way when automatically gathered and standardized information is linked with other related information. Therefore, I believe that ISO standards are essential for the creation of a smart manufacturing ecosystem, because they are developed in a way that promotes the participation of various companies and organizations involved in smart manufacturing.

In an era of rapid convergence, what advice would you give other companies looking to embrace “smart manufacturing” solutions and standards?

We should approach smart manufacturing from the perspective of customers and corporate sustainable growth rather than by focusing on the smart manufacturing technology itself. Otherwise, it will only cause additional cost to the enterprise.

I believe each company should develop tailor-made solutions that are affordable and suit its needs. Standards allow a more dynamic and competitive marketplace, without hampering the opportunity to differentiate. They reduce the risk of error between enterprises developing solutions and those implementing them, accelerating adoption of new manufactured products and manufacturing methods. This will ensure that both solution-providing companies and auto makers embracing smart manufacturing systems enjoy long-term competitiveness in the global automotive industry. ■



THE ROAD TO industrial smartness

The world is on the brink of a Fourth Industrial Revolution, driven by giant leaps in technology that promise to radically alter the face of industry in years to come. With a powerful manufacturing base and world-class ICT infrastructure, the Netherlands is poised to play a leading role in smart industry, says Rik van Terwisga, CEO of NEN, ISO's member for the country.

NEN is
contributing
to the further
development of
smart industry.

by Rik van Terwisga

Just look at the disruptive impact of the Internet of Things, cyber security, blockchain and robotics on existing business processes and business models. The Fourth Industrial Revolution is unfolding before our eyes. It has its roots in digitalization, a new technological phenomenon that enables us to build a new virtual world from which we can steer the physical world. Smart industry, as it has become known, is defined as the broad digitalization and interconnection of equipment, resources and organizations, leading to new ways of production, new business models and, even, completely new sectors. Take a smart robot, for example. Its value is greatest if it can work together with other machines on a production line. This interoperability within the factory, between companies and with customers is the reason why many businesses are setting their sights on smart industry. Such developments are opening up all manner of opportunities to manufacture products faster, more cheaply and to a higher quality, while being able to align them more closely with clients' needs, as they can increasingly be made up on a custom basis.

State of play

How flexible are we to adapt to the change? Dutch industry benefits from an excellent knowledge position in state-of-the-art technology and data processing. Many technology companies based in the Netherlands are among the best in the world. Big names like Booking.com, TomTom, Adyen, NXP, Philips and ASML already have a considerable track record in incorporating smart technologies into their business. And did you know that Wifi and Bluetooth are Dutch inventions?

The Netherlands is a densely populated country with a highly educated, internationally oriented workforce and a strong tradition for collaboration in networks and clusters, in which industries work with knowledge institutions and government. It also has one of the most sophisticated infrastructures in the world, especially in terms of information and communication technology (ICT), with a 98% Internet penetration in Dutch households. All these ingredients make the Netherlands potentially very well equipped to play a leading role in the development of smart industry.

However, perhaps counterintuitively, smart industry surveys have shown that a significant number of Dutch entrepreneurs are still relatively uninformed about the upcoming digital revolution and its implications for business. Published by the World Economic Forum (WEF) and INSEAD business school, The Global Information Technology Report 2014 reveals that, while the Netherlands is doing very well in ICT, its adoption of new technology can be improved. It also notes that ICT is being used more by companies in their contacts with consumers than for business-to-business transactions.

To boost efforts in this area in a concerted manner, the Smart Industry Action Agenda was launched in 2014. Driven by a broad coalition of companies, knowledge institutions, trade associations and government, it proposes a variety of initiatives for exchanging knowledge, accelerating development in the country's 30 field labs – which are something akin to practice environments for testing out smart industry solutions – and generally creating a stronger institutional foundation.

Smart connections

Smart industry calls for cooperation between customers and suppliers within a connected network of organizations. It also requires cooperation in a technological sense between the equipment of different manufacturers, also called "interoperability". This allows parties within the supply chain to collaborate more efficiently and effectively.

The Smart Industry Standardization Agenda

ACTION LINE 1: ENHANCING EXISTING KNOWLEDGE

1. Include standardization in existing instruments used to disseminate knowledge related to smart industry.
2. Monitor and report on smart industry standardization within Dutch industry.

ACTION LINE 2: ACCELERATING DEVELOPMENTS

CUSTOMIZATION AND FLEXIBLE MANUFACTURING

3. Develop and use standard formats for exchanging digital models and produce a case study.
4. Develop and use standards for controlling a flexible manufacturing environment.
5. Develop a new reference architecture for the information infrastructure in the factory.

SMART COLLECTION, PROCESSING AND SHARING OF DATA

6. Stimulate the development and standardization of new smart-data-sharing concepts for different field labs.
7. Develop security standards and promote their application for data sharing within smart industry.
8. Ensure alignment with European and international developments in the area of "Smart Industry Data Spaces", "Digital platforms for manufacturing" and the "Industrial Internet of Things".

ROBOTIZATION

9. Set up a platform and a Dutch standards committee in the manufacturing sectors with a subcommittee for robotization and support the participation of companies, start-ups, and educational and knowledge institutions.

ACTION LINE 3: CREATING A STRONGER FOUNDATION

10. Encourage competence development in the area of smart industry standards.
11. Ensure standardization is a prominent theme in new field labs.
12. Set up a Smart Industry Standardization Platform.



Rik van Terwisga, CEO of NEN.

To achieve this level of interoperability, you need standards with a broader scope than a single supplier or a single product; that means clear and generally accepted agreements in the form of International Standards. If we really want to be innovative and enable smart industry to succeed, standardization within the entire supply chain becomes essential for value creation.

Standardization makes markets bigger, promotes innovation, provides access to new media, ensures that processes and systems work together in a flexible and efficient way and stimulates the exchange of information and knowledge inside and outside the supply chain. In some areas, standards are already available, while in others they have yet to be developed. Some of this development work is taking place in the Netherlands, but in many cases it is being carried out on an international level.

So what makes standardization so crucial for smart industry? Simply put: without standardization, there would be no smart industry. Hence, one of the activities of the Action Agenda was to create a Smart Industry Standardization Agenda. NEN is one of the initiators and co-authors of this Agenda, which outlines 12 concrete actions to bring smart industry standards to the attention of the Dutch business community.

The Dutch approach

As part of the Smart Industry Standardization Agenda, NEN has created the Smart Industry Standardization Platform, designed to promote the development of standards in that field. The platform's main purpose is to:

- *Coordinate standardization activities on smart industry*

Standardization is complex, taking place via formal standards organizations (be they international like ISO, or European like CEN/CENELEC) as well as in fora and consortia, so it's important we coordinate the Dutch involvement in these standards organizations for the effective allocation of resources by stakeholders.

- *Identify standardization needs in smart industry field labs*

While field labs in the Netherlands can benefit from the knowledge incorporated in existing standards, they can also identify shortcomings in these standards as well as pinpoint needs for new work items.

- *Disseminate information on smart industry standardization*

The aim is to convince companies and other stakeholders that participation in standards development holds immense benefits for them, not least as a valuable source of information on state-of-the-art technology concepts.

Last but not least, the Smart Industry Standardization Agenda is involved in various educational activities. Last year, for example, NEN gave a lecture on the use of standards in smart industry as part of a course run by the Faculty of Business Administration at the Erasmus University Rotterdam.

Standards at NEN

At NEN, we support the development of standards, but we also make them easily available 24/7 for our standards users worldwide through our online environment NEN Connect. We are constantly developing this environment to ensure it remains easy to access and use. But we also recognize, as a standards organization in an increasingly "smart" world, that we have to match this development and make standards content available in formats that can feed directly into this digital stream of information by being both machine-readable and interpretable where necessary. This is a major challenge, which NEN is working on with our national and international customers and partners.

If smart industry is to be a success in the Netherlands, it is important that all existing standards are used in a targeted way (and adapted as required) and new standards are developed where necessary. By actively taking part in the Smart Industry Standardization Platform and by developing new formats to make standards available for industry, NEN is contributing to the further development of smart industry in the Netherlands and in the world. ■



RAISING THE BAR ON QUALITY INFRASTRUCTURE

ISO Secretary-General Sergio Mujica visited the Uzbek capital of Tashkent earlier this year for the 53rd meeting of the Eurasian Interstate Council for Standardization, Metrology and Certification (EASC), an association that strengthens mutual cooperation in the field of interstate standardization.

The event was chaired by Abdukhamid Karimov, General Director of UZSTANDART, ISO's member for the country, and drew members from Belarus, Kazakhstan, Kyrgyzstan, Moldova, Poland, Russia, Tajikistan, Turkey and Ukraine as well as representatives from international and regional organizations. Discussions focused on a wide range of topics related to national quality infrastructure as well as future cooperation strategies between ISO and EASC.

Sergio Mujica stayed in Tashkent for meetings with the UZSTANDART team. He welcomed Uzbekistan's readiness to have more Uzbek experts participate in ISO standards development work, praising the country's efforts to bring the skills of Uzbek specialists up to speed. Mr Mujica said the ISO Central Secretariat looked forward to helping UZSTANDART take this agenda forward.



ISO STANDARDS IN SUPPORT OF LEGISLATION

The US Food and Drug Administration (FDA), the government department that regulates the medical devices sector, announced its intention to use ISO 13485 as the basis for its quality system legislation. ISO 13485, *Medical devices – Quality management systems – Requirements for regulatory purposes*, is the

International Standard for quality management systems for the medical devices sector. The standard, which is now in its third edition, received strong support from the FDA, in line with its drive for global convergence of medical device regulatory processes.

ISO/TC 210, the technical committee responsible for the quality management of medical devices under the stewardship of ANSI, ISO's member for the United States, warmly welcomes the FDA's planned adoption. Wil Vargas of the Association for the Advancement of Medical Instrumentation (AAMI), and Secretary of ISO/TC 210, said "this announcement will take global harmonization of regulatory requirements in the medical devices sector to a next level". The committee Chair, Peter Linders, added that "this bold step by the FDA seems logical, considering the role of ISO 13485 as the foundation for the Medical Devices Single Audit Program (MDSAP), currently operated by Australia, Brazil, Canada, Japan and the USA".

SUSTAINABLE TOURISM

Tourism is a booming industry. According to the United Nations World Tourism Organization (UNWTO), the number of travellers is expected to rise to 1.8 billion by 2030. While this places pressure on our planet, global tourism also holds huge potential for sustainable development, bringing significant economic benefits to local communities.

On 27 September, World Tourism Day 2018 put the focus on "Tourism and the Digital Transformation", highlighting how a digitally advanced tourism sector can support development objectives through the empowerment of local community and efficient resource management.

ISO has many International Standards for innovation and technology that support



the tourism industry in its efforts towards sustainable development. These include ISO/TS 13811, a technical specification that helps organizations reduce the negative impacts of tourism accommodation on the natural environment, and the recently published ISO 20611, which lays down good practices for sustainability in adventure tourism.

ISO/TC 228, *Tourism and related services*, the ISO technical committee that published the documents, is currently working on two additional standards – ISO 21401 on sustainably managed tourist accommodations and ISO 21416 for sustainable practices in recreational diving – that will contribute directly to sustainable tourism.

Learn more about standards for tourism:



SERVICE MANAGEMENT GETS AN UPGRADE

Improving customer service, productivity and efficiency are just some of the many benefits of a service management system (SMS). An SMS helps organizations manage the service life-cycle from planning to delivery, offering better value to customers and those delivering the service.

ISO has updated two standards in its service management series, with new features, topics and tips from the top. Published in conjunction with the International Electrotechnical Commission (IEC), ISO/IEC 20000-1 specifies the basic requirements for service providers to plan, maintain and improve an SMS, while ISO/IEC 20000-10 lays down the core concepts and terminology for the ISO/IEC 20000 series.

Developed by joint technical committee ISO/IEC JTC 1, *Information technology*, subcommittee SC40, *IT Service Management and IT Governance*, the revised versions take into account changes in market trends and incorporate updated terminology as well as the latest requirements in service planning.

Jan Begg, Chair of the technical subcommittee in charge of the revisions, said "the ISO/IEC 20000 series is the only one available to measure conformance, support certification and provide assurance to customers that their services are being effectively managed". Once the preserve of IT services, it is increasingly being applied to other services to improve business processes and decision making.



SINGAPORE'S SMART INDUSTRY READINESS INDEX

The Singapore Smart Industry Readiness Index ("the Index") is a world-first "Industry 4.0" tool developed by the Singapore government to enable transformation of industrial sectors at the enterprise and national levels. Created in partnership with global inspection, certification and training provider TÜV SÜD, and validated by an advisory panel of industry and academic experts, the Index is designed to help companies of all sizes and sectors in a systematic and comprehensive way.

At the enterprise level, the Index sets out a four-step approach to help manufacturers *learn* about "Industry 4.0" concepts, *evaluate* the current state of their facilities, *architect* a transformation roadmap, and *deliver* sustained value for their business. At the national level, it has the potential to serve as a metric for maturity benchmarking within and across industries, enabling government bodies to better design sector-specific policy interventions to accelerate transformation in industrial sectors.

To help companies prepare for this latest industrial revolution using standards, Enterprise Singapore, ISO's member for the country, has been engaging key industry stakeholders to map national and international standards to the various dimensions of the Index. The mapping covers areas such as smart manufacturing, robotics and automation. The first version of the mapping was launched in October 2018 and will be reviewed regularly to maintain its relevancy to the industry.

For more information:





Standards leaders *meet to build a better world*



“Advancing the global agenda” was the theme of this year’s ISO Week, which looked at how the power of international standards can be harnessed to address many of the world’s greatest challenges like climate change, pollution and poverty.

Throw away old beliefs and paradigms to find solutions that nobody else could have found, challenged Bertrand Piccard, the leading figure behind Solar Impulse, the first airplane to fly around the world without fuel. Piccard was addressing more than 500 delegates from over 150 countries representing standardization and other international organizations at the 41st ISO General Assembly, held in Geneva, Switzerland, from 24-28 September 2018. “You have to be interested in what other people are doing, even if it’s not what you think, to create other ways of thinking,” he said in his inspirational speech about how organizations can innovate and make positive change. Change that will help us all build a better, more sustainable world, the key theme of this year’s event, which brought together some of the world’s leading thinkers to discuss the powerful role that standards play in doing just that. Opening the event, ISO Secretary-General Sergio Mujica highlighted that international standards provide a platform for innovation, from which new technologies and solutions can be born. “They are also key tools for addressing all of the challenges outlined in the United Nations Development Agenda 2030 and its 17 Sustainable Development Goals (UN SDGs),” he said. “ISO has been involved with the SDGs even before they were created, and this year’s General Assembly is the perfect starting point for developing a roadmap for policy makers, businesses and organizations for how international standards can help us achieve a more sustainable future.”



Bertrand Piccard, the leading figure behind Solar Impulse, addressed more than 500 delegates at the 41st ISO General Assembly.

Change will help us all build a better, more sustainable world.



Sergio Mujica, ISO Secretary-General.

To this end, ISO held an interactive session jointly with the United Nations, represented by the United Nations Economic Commission for Europe (UNECE), to discuss how regulators, businesses and standardizers can work together to further contribute to the UN SDGs. ISO also launched a dedicated page on its Web site (www.iso.org/sdgs) with a mapping tool that highlights more than 600 standards that contribute directly to achieving the Goals. The new tool is intended to serve as a reference for organizations looking to play their part.

Standards supporting international trade

The relevance of ISO international standards in facilitating international trade was also a key pillar of the week-long event. Deputy Director-General of the World Trade Organization, Alan Wolff, said that given the current turbulence in international trade relations, fostering the trade and standards linkage is more important than ever.

“The headlines are all about tariffs and trade war,” he said. “But the reality is that most trade that has been flowing will continue to flow, and the rules of the multilateral trading system are in large part responsible for the continuity. This is particularly true with respect to product standards.”

While standards don’t always make the headlines, he continued, they are essential. “Without international standards, there would be far less international trade, far less global prosperity, far fewer markets for exporters and far less variety for consumers. Most goods and many services traded are affected in one way or another by standards. Indeed, it is often when standards *fail* that we notice them. A failure to meet standards can stop trade in a product or service altogether.”

As an example, Wolff cited recent announcements of prototype driverless cars fitted with beds. “But before any of us lie down in a car,” he said, “we had best think about whether the standards for intelligent highways and different brands of autonomous vehicles will operate under the same international standards and communicate perfectly with each other. [...] Compatibility, through international standards, will be necessary for a restful automobile trip, if it is not to be a final journey.”

In response to the current climate related to international trade relations, ISO urged its members to advocate that a strong multilateral trading system is indispensable for economic and social development, and that international standards are key to supporting these goals.



Alan Wolff, Deputy Director-General of the World Trade Organization.



Chaesub Lee, Director of the ITU Telecommunication Standardization Bureau; James Shannon, IEC President; John Walter, ISO President.

International standards
are key to supporting
economic and social
development.

Building bridges

This year’s annual event also comes at a time when “the world needs more ISO”, said ISO President John Walter. “We don’t build walls, we build bridges. We don’t develop enemies, we develop trusted colleagues. We don’t promote division and isolation from the rest of the world, we create partnerships. And ISO members have a unique opportunity and obligation to show to the rest of the world that we can only address and resolve the challenges that we face by working together – for the benefit of all.”

ISO’s partnerships with other organizations were also celebrated as ISO and its fellow members of the World Standards Cooperation – the International Technical Commission (IEC) and the International Telecommunication Union (ITU) – signed a new joint statement sealing their intent to work even more closely together in the future.

“There is a crisis of multilateralism in the world, and we must recognize that we play a role in diffusing that crisis,” said IEC President James Shannon.



Christine Loew, Director of the UN Women Liaison Office, Geneva.

“We believe that the best way to resolve world issues is to bring together experts to find solutions, and that international standards have played a crucial role in lifting people out of poverty. It is extremely important that we tell our story and the role we have played in advancing economies around the world.”

Reducing inequalities

Another highlight of the week was the meeting of ISO’s Committee on developing country matters (DEVCO), which unveiled plans to reduce inequalities in the developing world, including those related to gender. “When [women’s] lives are improved, the benefits reverberate across society,” said guest speaker Christine Loew, Director of the UN Women Liaison Office, Geneva, at the DEVCO meeting. “Women and girls bear the greatest burden of energy poverty,” she added, “gathering fuel for an average of 18 hours per week, with a knock-on effect of lower school attendance than their male counterparts.”

However, with women generally doing the majority of the cooking, in conditions that are detrimental to their health, thousands die prematurely from respiratory illness, she reminded us. While praising standards for cleaner-burning stoves, and pointing to ISO’s positive gender representation in some areas, Loew underlined that more could be done to involve female experts in the standards development process.

Loew’s comments echoed the views of ISO’s Secretary-General, Sergio Mujica, an International Gender Champion who has placed diversity and capacity building at the heart of ISO’s work. His strong

International standards have played a crucial role in lifting people out of poverty.

belief in the role of standards in building a fairer society was clear, and was echoed throughout other events during the ISO Week 2018. Speaking on the United Nations Sustainable Development Goals, Sergio Mujica (@isosecgen) assured that, together, “we can contribute to making the 2030 Agenda a reality, so no one is left behind”.

Other notable speakers during the week included Jean-Pierre Reymond, Ambassador of the Permanent Mission of Switzerland to the United Nations Office, and Filippo Veglio from the World Business Council for Sustainable Development (WBCSD) on how standards contribute to addressing sustainability. The event was an opportunity to give thanks to Piet-Hein Daverveldt, ISO Vice-President (technical management), for his

tireless efforts and dedication as he steps down from his role. ISO President John Walter commended Piet-Hein for his excellent consensus-building skills, his focus on continual improvement, both strong ISO values, and the collegial atmosphere he brought to the job. The General Assembly also reappointed Dr Bronwyn Evans as Vice-President (finance) and elected Edward Njoroge (Kenya) as its next ISO President, who will serve as President-elect in 2019.

Participants at the ISO Week also took part in interactive workshops and discussions on a variety of aspects supporting world sustainability, covering topics such as international trade and the role of standards, technology standards and innovation, and engaging policy makers and government. ■



Piet-Hein Daverveldt, ISO Vice-President (technical management), and John Walter, ISO President.

Edward Njoroge (Kenya), new ISO President-elect.



Riding the waves of change

IN THE SHIPPING INDUSTRY

by Clare Naden

When we think of ships, words like pirates, cruises or sailors may come to mind, yet shipping is implicit in virtually every area of our lives. Something like 80% of global trade is carried out by marine transportation, and that trade has increased more than twice over the last 30 years. With it come issues related to safety, environment, security, climate change, energy, trade and more. Standards are not only providing solutions to almost every one of those challenges, they have even played a huge part in transforming this transformational industry.

Take the humble container ship. It encompasses the concept of intermodal transportation (or container ships), itself a business that took off and changed the world thanks to standardization. Today, the largest container ships are about 400 m long and can now store a whopping 18 000 containers.

To give an idea of how enormous that is – if all of those containers were filled with bananas, the ship would be carrying more than 745 million bananas. That’s just one ship.¹⁾ What’s more, the total capacity of international merchant ships is expected to more than double by 2050.²⁾

But it’s not just banana-carrying ships that roam our seas. Or container ships in general, for that matter. There are tankers, fishing vessels, bulk carriers, high-speed craft... the list goes on. Not to mention passenger ships.

Cruising to safety

Another area of marine transport that has exploded in recent years is leisure craft and cruise ships. Some 27 million holidaymakers are expected to take a cruising holiday this year alone, testament to an industry that is bursting with more and more ships going to more and more destinations. The largest cruise ships are like small cities, measuring over 350 m long and capable of carrying nearly 9 000 passengers and crew.³⁾

Unsurprisingly, safety is paramount – for every kind of ship. Every vessel has numerous processes and systems in place to ensure things go smoothly. An example is “man overboard” detection systems. Standards work to ensure they are effective, i.e. detecting the person in time, and in the right place, so that something can be done to save them.

1) Ocean Insights, “8 facts about the shipping industry”

2) World Economic Outlook Database, October 2016

3) Business Insider, “The world’s largest cruise ship has robot bartenders and a nine-story zip-line – here’s a look inside”, 20 July 2018

Robin Townsend, Chair of the ISO technical subcommittee that develops standards for maritime safety, says International Standards are a boon for the industry as they ensure harmonization and international best practice for everyone in the supply chain. “With everyone working from the same set of requirements, manufacturers can more easily evaluate safety, effectiveness and performance of the systems, providing a strong foundation on which new technologies can be developed.”

But while there have been major steps forward in improving safety in the industry, it is an ever-changing beast and requires constant vigilance. The seas are an extremely hostile environment, reminds Jing Wang, Secretary of ISO’s technical committee for ships and marine technology (ISO/TC 8). The risk profiles of shipping are constantly changing, as ships continue to get larger and to go further from traditional shipping lanes. Large passenger ship safety in polar regions, for example, is an ongoing concern.

She also reminds us that major incidents can be easily skewed. In the case of the Costa Concordia, for example, the disaster could have been prevented had systems been readily available at the right time, she points out, just as a slightly different wind and wave condition might have resulted in thousands more lives lost.

“The message is that we can never let our guard down in the marine industry, whatever type of ship it is. The industry is increasingly improving in this manner and ISO is taking its part in ensuring that standards are provided before they are needed rather than after.”

Riding the environmental wave

Aside from the obvious safety aspects, the industry is also taking steps to reduce its environmental impact. The emissions from ships, says Carolyn Junemann, Secretary of the ISO technical subcommittee that develops standards for marine environment protection, pose a significant threat to human health.



“The emissions from ships engaged in international trade in the seas surrounding Europe are estimated to amount to 1.6 million tonnes of sulfur dioxide and 3 million tonnes of nitrogen oxide per year. And they have been steadily increasing over the past 30 years.”⁴⁾

Carbon dioxide (CO₂), one of the main greenhouse gases responsible for climate change, is in the same boat. In 2012, for example, CO₂ emissions from ships made up around 3% of global man-made emissions, and these are expected to double or even triple by 2050 if nothing is done.⁵⁾

The good news is that the International Maritime Organization (IMO), which sets mandatory international regulation for the maritime industry, has set targets to reduce CO₂ emissions by 50% by 2050⁶⁾, and there are many new technologies in development. These include liquefied natural gas, hydrogen fuel cells, battery electric systems, biofuels and more, all areas where standards are playing a major role to facilitate their development. For example, ISO/TC 8 has developed standards for measuring energy usage and efficiency, as well as standards to help ship operators select hull paints that help to reduce hull drag, which can itself reduce energy efficiency.

Sailing into the future

Smart technology is also transforming the industry, helping to cut energy costs, mitigate environmental impact and improve efficiencies. According to Markus Lorenz, partner and Managing Director at The Boston Consulting Group, intelligent machines are the next big thing, with smart technologies at the heart of the Fourth Industrial Revolution. The shipping industry is not excluded, and such technologies can help to mitigate some of the environmental damage currently taking place. In a TED Talk about Industry 4.0, he gives the example of motors on cranes that lift containers off and on ships, fitted with sensors and connected to a software model.

“The motors can sense the real weight in real time of the container as we lift it,” he explains. “When

4) AirClim, “Air pollution from ships”

5) Ibid.

6) IMO, Marine Environment Protection Committee (MEPC), 72nd session, 9-13 April 2018



Presenting the LDE Award to ISO/TC 8, Ships and marine technology, (from left): ISO Secretary-General **Sergio Mujica**; ISO President **John Walter**; ISO/TC 8 Chair **Yanqing Li**; ISO/TC 8 Secretary **Jing Wang**; and **Piet-Hein Daverveldt**, ISO Vice-President (technical management).

sensing the weight, it sends that data to a software model, which then builds a 3D model of the ship – the digital twin of that ship – and it will tell the motor exactly where to place the next container in order to optimize the weight balancing of the ship. With optimized weight balancing, that ship can save up to USD 1000 a day on fuel – that’s a 5% to 8% gain in fuel efficiency. And just by optimizing the shuffling of the container.”⁷⁾

Aware of this potential, a working group within ISO/TC 8 was set up more than two years ago. As Chair Yanqing Li points out: “Smart technology will not only improve the operational efficiency of equipment, but its wide application will promote the further integration of upstream and downstream industries in shipping. International Standards are important catalysts for this revolution.”

Other areas targeted for future standardization by ISO/TC 8 include better safety, security and environmental protection as well as maritime education and training. And, of course, technology. With standardization for smart shipping featuring high on the ISO agenda, who knows where this new wave could lead us. To a brighter, cleaner future, we hope. ■

7) YouTube, TED Institute, “Markus Lorenz: Industry 4.0: how intelligent machines will transform everything we know”, published 4 September 2015

Excellence in shipping standards

Among ISO’s oldest and most established technical committees is ISO/TC 8, *Ships and marine technology*. Over the last 70 years, it has developed more than 300 International Standards covering ship safety, intelligent navigation and environmental protection.

These not only support international regulation – they help to create it. Mandatory international regulations, which are developed by the International Maritime Organization, are done so with the valuable input of ISO/TC 8, and the committee’s standards serve as key tools to help meet those requirements.

ISO/TC 8’s achievements have been recognized through the Lawrence D. Eicher Award for excellence and superior performance in standards development, presented on 27 September 2018 at the 41st ISO General Assembly, held in Geneva, Switzerland.

Announcing the award winner, ISO President John Walter pointed out that ISO/TC 8 also works closely with 25 other relevant international organizations.

“ISO/TC 8 also does an excellent job at creating and maintaining strong links with industry to ensure that their standards meet market needs,” he said.

Smart technology
will improve the
operational efficiency
of equipment.

