



DHL

Delivered.

THE GLOBAL LOGISTICS MAGAZINE

ISSUE 01/2017

BUSINESS

THE NEW SILK ROAD

Why China is building a new version of the ancient trading route

SOLUTIONS

THE CONNECTED WORLD

Insights into globalization from the new DHL Global Connectedness Index

VIEWPOINTS

ARE YOU READY FOR INDUSTRY 4.0?

The digital age demands new job skills

FOCUS

FAST TRACK TO THE FUTURE

Engineering and Manufacturing embraces the digital revolution





DEAR READER,

How equipped are you for Industry 4.0? As digitalization is rapidly changing the way business runs, there is the promise of big opportunity. Our **focus on Engineering & Manufacturing** shows that the coming together of the digital and physical worlds also brings an equal measure of challenge, as some companies still struggle to decide where they should direct focus and money in order to thrive amid digital disruption.

One company starting to bridge the physical and digital worlds is **Satair Group**. While some of the 655,000 different part numbers in its inventory around the globe were produced in the 1970s, today several hundred of them are 3D printed, a number expected to rise to the thousands over the next few years. **Paul Kilmister, Global Head of Warehouse and Transportation, Satair Group**, gives us a fascinating insight into how his company supplies airlines across the globe with the components and tools needed to maintain their fleets.

The future of globalization has been much debated over the past year. **"How connected is the world"** presents insights from DHL's own Global Connectedness Index, while in **"Silk Road reloaded"** we explore China's new One Belt, One Road project, which aims to invest heavily in many countries along its ancient trade routes.

We aim to cover a wide array of global topics related to business, innovation, logistics and supply chains. If there is a topic you would particularly like to see in *Delivered.*, please contact me at bill.meahl@dhl.com

Enjoy your read!

Bill Meahl
Chief Commercial Officer, DHL

Cover photo: Frank Schultze/agentur.zs



08 FOCUS FROM BOLTS TO BYTES

04 NEWS

FOCUS: E&M

- 08 From bolts to bytes**
Engineering and Manufacturing meets the digital age
- 14 Machines that will change the world**
Engineering and manufacturing companies of all sizes are set to benefit from cheaper, smarter and more adaptable robots
- 17 Keeping the world moving**
Satair Group provides the spares for global airlines to maintain their fleets with state-of-the-art supply chain technology

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BUSINESS

- 19 Powering the tech revolution**
New lithium-oxygen batteries could help power the tech revolution
- 20 Silk Road reloaded**
China's plan for a modern version of the ancient trade route aims to boost the region's economy
- 22 A new kind of supply chain intelligence**
Big data is set to create smarter supply chains, bringing new levels of efficiency
- 25 India's GST – a game changer?**
India's new Goods and Services Tax (GST) will replace all indirect taxes levied by central government and the states

- 26 How connected is the world?**
The newly released DHL Global Connectedness Index 2016 shows the latest state of globalization

SOLUTIONS

- 30 Delft Hyperloop**
How passengers will be able to travel from Amsterdam to Paris with a revolutionary new transportation system
- 32 Skills for Industry 4.0**
What skills will people need for the fourth industrial revolution?

VIEWPOINTS

- 34 Delivered. talks to...**
Futurist Glen Hiemstra, who helps organizations understand the challenges and opportunities ahead
- 36 From risk to resilience**
An essay by Dr. Joseph Fiksel
- 38 What's the story, Mr. Houter?**
A team from Delft University has built a groundbreaking prototype for Elon Musk's SpaceX Hyperloop Pod Competition

Contributors
Pritam Banerjee,
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www.delivered.dhl.com

NEWS

A VIRTUAL MATCH

DHL has launched a virtual delivery marketplace called CILLOX to help companies control their shipment processes as simply as possible. Using CILLOX, companies can match their loads with transport providers' capacity to find the right carrier. Based on shipment details and last-booked rates, shippers get access to pricing information that permits a better comparison of quotes. They will also get an instant quote from DHL, which they can book immediately. All transport providers are verified by CILLOX for fast quotes and easy transport booking, while invoicing and payment is simple and safe. The CILLOX driver app allows drivers to receive jobs on their smartphones, and the in-app scanner allows them to easily scan and upload delivery documents, ensuring they get paid within a matter of days.



 www.cillox.com

ASIAN TIGER STILL ROARING

The Asian tiger continues to roar for DHL Express, which has responded to significant growth in the region by launching an €85 million (\$89 million) express hub within the free trade zone of the Airfreight Centre at Singapore's Changi Airport. The new facility is fitted with South Asia's first fully automated express parcel sorting and processing system, able to handle up to 24,000 shipments and documents per hour and more than 628 tons of cargo at peak processing times.



PLUG AND PLAY

A third of companies are operating more than 10 supply chains. That's the statistic revealed in a new white paper from DHL Supply Chain. Globalization and years of prolonged growth often mean companies have lost sight of their customers or have inefficient overlaps in their supply networks. The white paper proposes a plug-and-play approach that would allow companies to develop a core supply chain model, which would standardize and streamline 70 to 80 percent of operations and cut costs. Download the Plug-and-Play white paper at:

 www.dhl.com/plugandplay-growth

SHELL CAR YOU CAN BE SURE OF

Shell has unveiled a concept city car that could deliver real reductions in energy use. The three-seater would use about half the energy needed to build and run a typical small family car and some 69 percent less than a standard sports utility vehicle. Shell has brought vehicle, engine and lubricant designers together in a co-engineering collaboration to ensure all elements of the car are tailored to work optimally with each other. 3D printing, recycled materials and cutting-edge smart technology would be used to make the vehicle as environmentally friendly as possible.

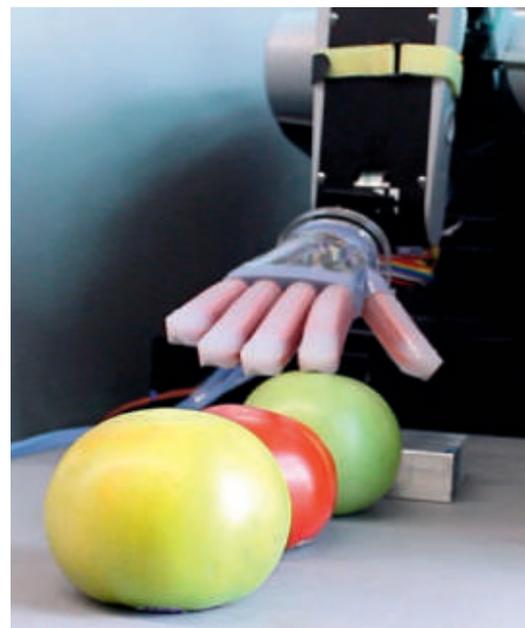


 bit.ly/shell-concept-car

95%

The amount of recycled waste plastic from the ocean that sportswear giant Adidas is using in the knitted upper portion of its new UltraBOOST running shoes.

 www.news.adidas.com



A SOFT TOUCH

Robotics engineers at New York State's Cornell University have developed a soft robot hand that can not only pick up fragile items but also sense the shape and texture of things it touches. The Gentle Bot – which uses light signals rather than conducted electricity to sense objects – has the potential to handle more delicate items than ever before and could lead to advances in other areas, such as prosthetics.

 bit.ly/cornell-robotic-hand



THE STORY

RICE AND EASY

DHL eCommerce has linked up with Thailand's Ministry of Commerce to help the country's rice farmers who often struggle with getting their product to consumers in a market that is often over supplied. DHL has offered its e-commerce expertise and services free for four months, giving farmers an easy and streamlined process to manage their online business and ship to customers overseas.



Thai farmers are empowered to create e-commerce sites to drive up sales

+



Order your Thai rice straight from the farmer

+



Free delivery for four months

=



Services will help farmer co-ops across the country

 www.thaitrade.com/rice



SHOP TILL THE BUS STOPS

No time to do the weekly shop? Well, a Dutch supermarket may have the solution – turning a city bus stop into a pop-up shop. Retail chain Jumbo transformed the bus shelter in Utrecht with barcoded products so time-pressed commuters can scan and order items using a smartphone app for home delivery later.

AYE, ROBOT

French startup Effidence won the €10,000 (roughly \$10,500) DHL Robotics Challenge at DHL's Innovation Day with its prototype self-driving delivery cart, which was put through its paces on an outdoor circuit, successfully navigating kerbs, slopes, rain puddles and pedestrians, before facing a vote by an expert jury and the audience.

 www.iffistore.effidence.com



LIVING RESPONSIBILITY

AIR PARCEL

A 22-year-old student has won the Fair and Responsible Challenge at DHL's annual Innovation Day, held to recognize forward-thinking pioneers in logistics. Anne Gross, a product design student at the Bauhaus University Weimar, clinched the €5,000 (\$5,266) prize for her simple yet ingenious concept "Air Parcel" – a reusable package that can be filled with air to cushion the contents. Users simply place the object to be shipped inside the package, seal it using the adhesive address label, and then inflate it by blowing into a special detachable tube. Apart from the prize money, Anne has also been given the chance to advance the idea further. "DHL's dedication to sustainable and environmentally friendly concepts motivated me to participate," said Anne. "Winning this challenge is a great honour for me and I'm looking forward to continuing to develop the concept with DHL." Anne's prototype was made of nylon coated with thermoplastic polyurethane using a Teflon-coated iron. She now hopes to experiment with recyclable plastics. "That would be an important step in the direction of sustainability," she said. The Fair and Responsible Challenge was set up to find original logistics ideas and solutions that would address and solve environmental and social challenges.





aisle help you with that

No more traipsing around the shop looking for that product you want to buy. At least not in the Ingolstadt branch of technology retailer Saturn Markt, which now has a friendly robot called Paul to guide you to your purchase. Built by developers from Fraunhofer Research Center and Phoenix Design, Paul will even chat to customers as he leads them through the store's aisles.

getting the full picture

As globalization means supply chains grow bigger, many multinational companies can no longer see the full extent of their network, and are unable to visualize their first-tier suppliers and, in turn, their suppliers... and on and on. To help avoid this pitfall, DHL has launched its Resilience360 Transparency Portal. Data collected through the online portal enables companies to get a full picture of their networks – and the service can be combined with the Resilience360 risk assessment solution to help them identify possible problems that could have an impact on their supply chain, whether from natural disasters, regulatory issues or political upheavals.

 bit.ly/r360-transparency

RESILIENCE360

carbon-neutral Costa Rica

We're used to whole buildings and even communities running entirely on renewable energy – but a whole country? That's exactly what the Central American nation of Costa Rica did for two months in a row last year. Admittedly it's a country of only 4.6 million people, but it has generated 100 percent of its power needs from renewable energy sources for some 300 days over the past two years. The nation's high rainfall – about 4,000 mm a year – means that about 80 percent of the country's power can be generated by hydroelectric plants. Costa Rica has set itself the very realistic goal of becoming completely carbon-neutral by 2085.



electric dreams

The EU is planning to lead the way with electric cars. A draft directive awaiting approval will require every new or refurbished home in Europe to have a charging point from 2019. The regulations will also propose that, by 2023, 10 percent of parking spaces in new buildings within the EU will need recharging facilities as well. The initiative is intended to mirror the electric car boom planned by Norway and the Netherlands, who both intend to phase out diesel engine vehicles by 2025.

MAY

09-11

The date of DHL's 2017 Global Technology Conference – this year in Amsterdam, Netherlands – with the theme "Shifting Gears". It's a chance to share, learn and network with your industry peers.

Find out more here:



bit.ly/global-tech-2017

**FROM BOLTS TO BYTES:
ENGINEERING AND
MANUFACTURING
MEETS THE DIGITAL AGE**





DRIVING CHANGE:

A Liebherr excavator loads iron ore onto a Caterpillar Inc. 793F autonomous haul truck.

At the turn of the 21st century, the world seemed to be dividing along technological lines. On the one side were bits: the fast, flexible elements of digital information, flashing at the speed of light across rapidly expanding communication networks and enabling thrilling new virtual worlds of communication, commerce and entertainment.

On the other side were atoms, the traditional building blocks of the old economies. Atoms were slow and difficult to handle, it required effort to shape them into useful products and machines, but the techniques required to do that work were mature and well understood. The main challenge, it seemed, was finding cheaper, easier ways to do that work.

Of course, the separation between the digital and physical economies was always a false one. The digital world is firmly rooted in the physical. Even the smartest smartphones and supercomputers rely on mining equipment to pull their constituent materials from the ground, machines to shape their components and ships, trucks and aircraft to reach customers.

And the companies that build those machines have used digital data for as long as it has been available: equipping their production lines with robots and automated machinery, designing and analyzing products using smart computer systems and scheduling production with sophisticated planning systems.

Today, however, the maturity and uptake of digital technologies in manufacturing is accelerating dramatically, precipitating a change significant enough to

earn its own title: the fourth industrial revolution, or Industry 4.0.

It's a revolution built not on one idea, but many. Consultancy McKinsey & Company highlights four major disruptions: a significant rise in data volumes, computational power and connectivity; the emergence of sophisticated data analytics capabilities; new forms of human-machine interaction and improvements in the way digital instructions are transferred to the physical world.

Internet of things

The connectivity part of Industry 4.0 has its own buzzphrase: The internet of things, or IoT. The term refers to the ability of once “dumb” devices, from light bulbs to machine tools, to communicate across digital networks, transmitting information on their own state, and reacting to instructions from computers and other connected devices.

For manufacturers, IoT technologies offer a host of potential benefits: monitoring the health of machines on the factory floor, tracking the location of products as they move through the supply chain, or delivering new insights into the reliability and performance of products once they are in customers' hands. Consultancy A.T. Kearney forecasts that by 2020 IoT devices will outnumber “traditional” connected devices by two to one, helping to improve global productivity by almost two trillion dollars.

**25
PERCENT**

The potential increase in manufacturing productivity in Germany due to automation

Data alone isn't enough to deliver better products or more reliable, efficient processes. Companies also need the ability to transform that data into useful information. That's where analytics come into play. A range of new techniques has evolved to take advantage of the ability of powerful computer systems to rapidly crunch huge quantities of data.

In manufacturing applications, from mining to semiconductors, companies are using advanced statistical methods and machine-learning algorithms to reveal hidden relationships between inputs, such as process temperatures, pressures and raw material composition, and outputs, like quality and yield. They are using these insights to fine-tune their processes, squeezing extra performance out of their operations.

Data analysis capabilities are also helping manufacturers extend their offerings through "servitization" – businesses built on the ongoing support of products once they are in customers' hands. Caterpillar, the world's largest maker of mining and construction equipment, has established a dedicated analytics and innovation unit, and invested in several technology startups. A key goal of its efforts is the development of predictive analytics that will help its customers squeeze more value out of their equipment, for example by detecting wear and damage in components, allowing machines to work for longer between maintenance overhauls while reducing the occurrence of breakdowns in the field.

Digital information is already making its way to the factory floor, on touchscreen machine control interfaces and tablet computers. The latest systems can fine-tune the information presented to staff based on its context. Diagnostic systems for maintenance technicians can provide step-by-step instructions for testing a faulty machine, for instance, and automatically recommend additional tests or mitigating actions based on the results.

U.S. aircraft maker Boeing has piloted the use of augmented reality glasses and voice commands to guide workers assembling complex wiring harnesses. The project, developed with software company Upskill (formerly

"Business customers want the same level of speed and flexibility as consumer supply chains."

Reg Kenney, President, DHL Engineering and Manufacturing

APX Labs), cut harness assembly time by 25 percent while reducing the errors. The company is now exploring opportunities to roll out similar technologies in other production areas.

Driverless trucks

Advanced digital technologies are also changing the way companies think about machines. In part, that's because machines are becoming more capable, allowing them to take on more work that once required human input. In the mining sector, Rio Tinto has introduced a fleet of 69 driverless trucks at three iron ore mines in Pilbara, Western Australia. The vehicles move millions of tons of ore every year, working 24 hours a day under the supervision of a team of controllers working more than 1,000 kilometers away in Perth. The company is also using driverless trains and automated drilling machines.

Fully automated "lights-out" factories are still rare, but they are becoming an ambition for a growing number of manufacturers. In Japan, robot maker FANUC already uses its own robots to build versions of themselves without direct human assistance. Camera maker Canon is investing more than \$100 million to fully automate its own Japanese factories by 2018, a move designed to cut production costs by up to 20 percent.

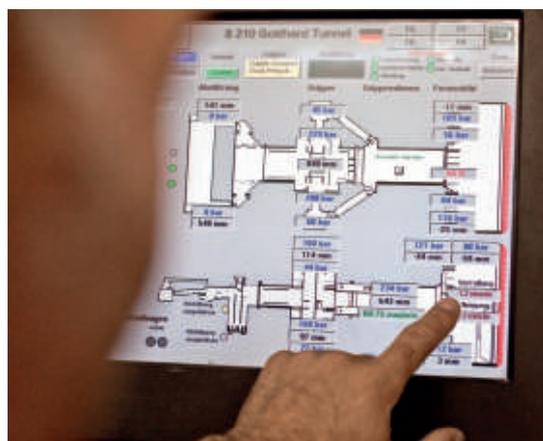
Machines are becoming more flexible, too, as companies such as Siemens seek to build a "digital factory" that can reconfigure itself rapidly to meet changes in customer demand. Robots and computer-controlled machine tools can be programmed to make different parts every cycle, for example, reducing batch sizes and easing the introduction of new product variants or improvements.

One of the most radical ways that the digital and physical worlds are merging is 3D printing – or additive layer manufacturing – a process that allows complex shapes to be produced by fusing materials, including liquid polymers and powdered metals, into precise shapes. Once reserved for prototype parts due to its high costs and relatively slow speed, the technology has advanced to the point where it is increasingly being used in serial production.

CFM LEAP aircraft engines, produced by a collaboration between GE and Snecma, will each use 19 3D-printed fuel nozzles. GE says the technology offers a host of advantages, including a 25-percent weight reduction, a reduction in components per nozzle from

\$15 BILLION

The revenues being targeted by GE's digital arm by 2020



ON THE PULSE:

Miner Vincento Marcese operates the tunnel-boring machine in the eastern tunnel of the Gotthard Base Tunnel near Faido in Switzerland.



EYES FRONT:

High-tech glasses using a head-up display, coupled with new software called Skylight, are being used in a number of E&M settings.

18 to one, and improved durability in service thanks to an intricate arrangement of cooling channels and reinforcements enabled by the manufacturing technique. By 2020, GE Aviation says it will have manufactured more than 100,000 parts using 3D printing techniques.

Elsewhere in the aerospace sector Airbus is also adopting additive layer manufacturing techniques in a number of areas, such as producing engine pylon components for the A320neo developmental aircraft.

Huge opportunity

Together, the widespread adoption of these trends is expected to deliver a significant boost to the manufacturing sector. BCG, a consultancy, expects Industry 4.0 to increase manufacturing sector revenues in Germany by €30 billion (\$32 billion) a year, for example, equivalent to 1 percent of the country's GDP. The same analysis suggests that manufacturing productivity, excluding the cost of raw materials, could rise by 15 to 25 percent. Industry 4.0 is also a huge opportunity for the engineering companies that make the components, software and machines these new approaches require. BCG suggests that German industry will need to invest around €250 billion (\$270 billion) over the next ten years to reap the promised benefits.

The potential of these new opportunities is so great that many of the world's biggest engineering companies have made digital and Industry 4.0 a central part of their business strategies. Engineering giant GE, for example, now describes itself as a "digital industrial company." The company has appointed a Chief Digital Officer in each of its businesses, while its IoT and ana-

lytics arm GE Digital achieved \$5 billion in revenues in 2015, and is targeting \$15 billion by 2020.

Similarly, alongside its traditional focus on electrification, Siemens has made automation and "digitalization" the central pillars of its strategy for the next five years. The German company is partnering with 3D-printing specialist Stratasys, for example, to develop software and hard tools that allow additive manufacturing to be more easily integrated into larger production systems.

The impact of digital technologies will inevitably touch companies' logistics processes, too. 3D printing and other flexible manufacturing techniques encourage companies to move towards the on-demand manufacture of products and components, and those objects need to reach their end customers as quickly as possible.

That has implications for network footprints, encouraging companies to move certain production applications closer to their customers, perhaps turning inventory-holding locations into production sites. It is also driving up demand for fast delivery services.

"Business-to-business customers increasingly want the same level of speed and flexibility they have become used to in consumer supply chains," says Reg Kenney, President, DHL Engineering and Manufacturing. "That's driving up the use of air freight and express services in engineering supply chains."

Challenges remain

Significant challenges remain, however. The very nature of digital disruption makes it hard for engineering and manufacturing companies to decide where to invest time, energy and money. To reap the full benefits of

**\$270
BILLION**

The amount German industry will need to invest over the next ten years to reap the benefits of digital trends

Industry 4.0 requires seamless data connections right across the manufacturing supply chain, but the digital revolution is happening so fast, efforts are being focused on small, isolated areas.

“When we talk to our engineering and manufacturing customers, many of them say they are still grappling with the implications of big data and digitization,” says Kenney. “Many companies are only making use of a small fraction of the data they hold now, and there are issues of data quality, and of finding enough people with the analytical skills needed to make these systems work.”

There are more pragmatic problems, too, such as deciding how ownership and access to data is shared across the supply chain. Should data on the performance of a production machine belong to the company that runs it, for example, or the OEM that built and maintains it? Making better use of data that spans complex supply chains is an area of particular interest for DHL, says Kenney, and the company is launching an Analytics Lab, based in Singapore, to explore opportunities to help customers make better decisions based on complex data analytics. ■ *Jonathan Ward*

See p. 32 for an article on the human skills needed for Industry 4.0

3 QUESTIONS FOR

Reg Kenney,
President, DHL
Engineering and
Manufacturing



1. What is the mood of the engineering and manufacturing sector today?

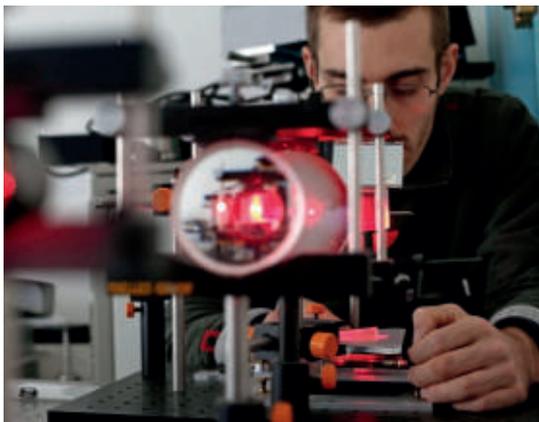
Our customers in many industry sectors are more optimistic than they have been for several years. There are strong indications that infrastructure spending is set to rise, especially in the U.S. That is likely to have a positive effect across the sector, driving up demand for construction equipment and for steel and other raw materials, which should boost commodity prices and encourage investment in other sectors, such as mining.

2. Will digital technologies have a role to play in meeting rising demand?

Absolutely – across the sector we are seeing a change in the approach that engineering companies are using to meet their customers’ needs. They aren’t just thinking about improving manufacturing efficiency, they are also looking for innovative ways to help their customers get more value out of their products, and that is driving interest in new technologies and new business models, with strong service offerings alongside their traditional product expertise.

3. What is the role for logistics companies such as DHL in the world of Industry 4.0?

A lot of Industry 4.0 is about using digital technologies to create highly responsive, tightly integrated and collaborative supply chains that give customers exactly what they want, when they want it. Supply chain and logistics processes are a critical element in that effort. We believe our breadth of service offerings and strong technology can really support our customers in those efforts.



HIGHLY FOCUSED:

Optinvent, leading producer of the disruptive ORA smart glasses. The company is one of only five companies in the world producing this kind of high-tech equipment.

PRINTED SEATS:

A view of Airgo’s 3D-printed prototype of its Orion long-haul aircraft seats at the manufacturing facility in Singapore.



THE MACHINES THAT WILL CHANGE THE WORLD

Engineering and manufacturing companies of all sizes are set to benefit from cheaper, smarter and more adaptable robots.

Around the world, robots are selling at record levels. According to industry body the International Federation of Robotics, industrial robot sales passed a quarter of a million units for the first time in 2015, following five years of growth at an average of 16 percent per year.

Almost two-thirds of the world's industrial robots are still found in just two industries – automotive manufacturing and electronics – but according to Tom Bonkenburg, Director of European Operations at independent supply chain engineering consultancy St. Onge Company, a surge in innovation in the sector is poised to dramatically increase their prospects for use elsewhere. That could transform the activities of engineering and manufacturing companies, where low production volumes and highly variable tasks have precluded automation in the past.

“Material handling and robotics has traditionally been a slow-moving sector,” he says. “The automotive industry buys so many robots that suppliers have been fighting each other over a few percentage points of price or reliability. They kept improving the gears and motors a bit, and bringing the price down, but the robot arms that make cars have been broadly the same since the 1980s and 1990s.

“Until recently, robots were blind, they were dumb and they didn't do anything but repeat the same motions over and over again. Now computer power is finally getting to the point where advanced algorithms, combined with low-cost sensors and better vision systems, mean we can apply robots to tasks that were too difficult to tackle before.”

Often, those tasks are things that are easy for humans, but frustratingly challenging for machines, like identifying an arbitrary object on a shelf or conveyor and picking it up. Such capabilities are coming, says Bonkenburg, citing research efforts like Amazon's “Picking challenge” competition, and Google's work

using groups of “cloud robots” that learn how to undertake different tasks before sharing their knowledge with each other.

New workers, new jobs

The ability to adapt to unpredictable working environments will open a host of new robotics applications, like picking and packing operations in distribution centers, says Bonkenburg. But for engineering and manufacturing companies, some of the most exciting developments have more to do with new ways robots can be integrated into the production environment.

“Traditionally, the cost of the robot has been only a small part of the cost of the entire project effort required to support it,” he notes. “You have needed skilled engineers to program the robots, elaborate cages and fences to protect workers, and accurate conveyors to deliver parts.”

“Now companies like Rethink Robotics in the U.S., or Universal Robots in Denmark have developed ‘co-bots’ that can operate safely near human workers without the need for protective cages,” says Bonkenburg. “These robots also take a lot less skill to program, offering iPad-style interfaces and the ability to manipulate the robot to teach it a new task.”

Those capabilities make it much easier to redeploy robots to new tasks, or switch them between tasks, says Bonkenburg – a boon for companies that tend to work with small batch sizes and a greater variety of products.

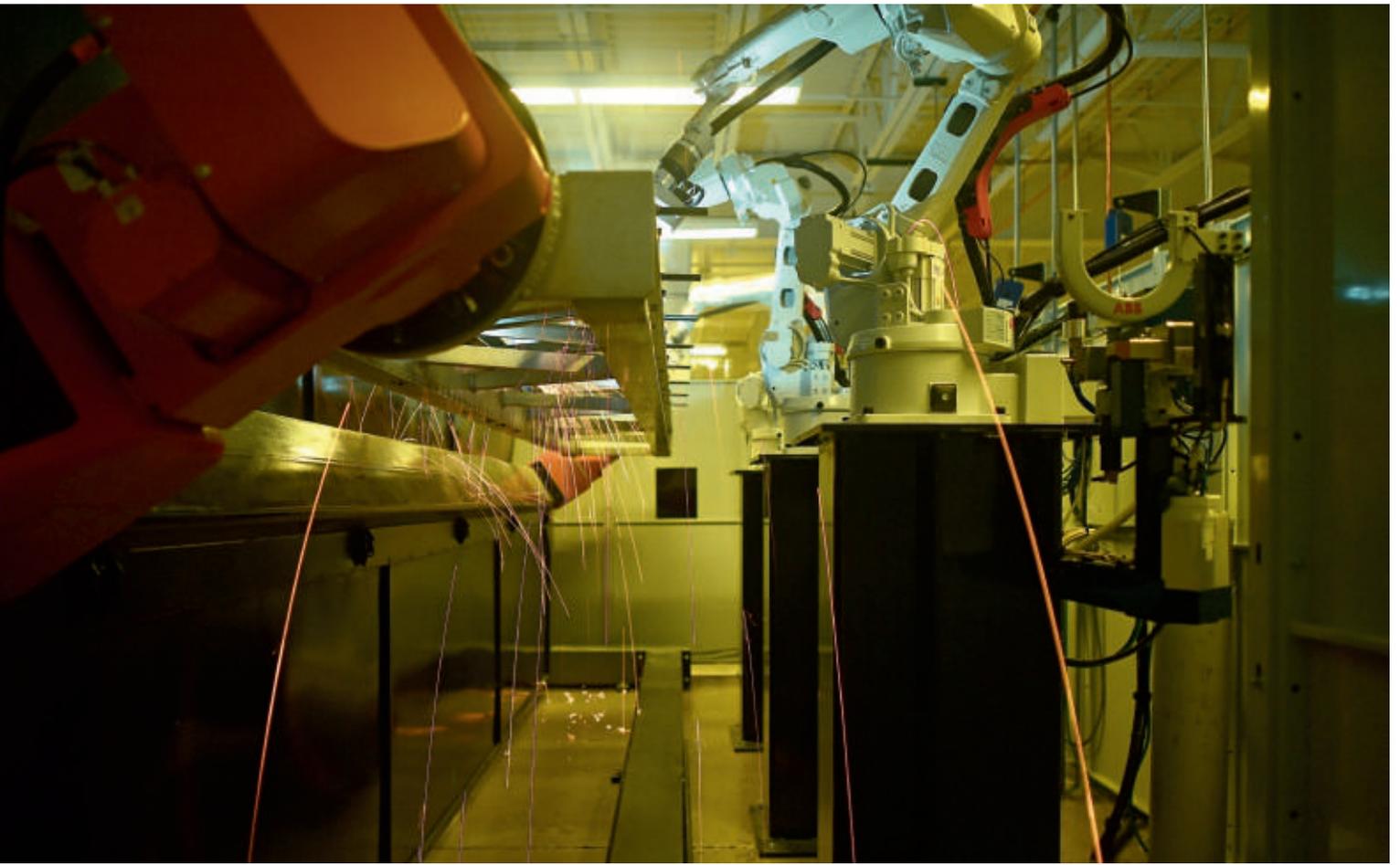
“A small collaborative robot can be powered from a conventional wall socket. It doesn't need to be bolted to the floor with its own dedicated power supply. You start to see a situation where instead of every robot application being an engineering project, the robot becomes a tool that a worker can use without special training,” he says.



TOM BONKENBURG

Tom Bonkenburg is a partner in St. Onge Company, an international supply chain engineering and consulting firm. For the past 18 years Tom has helped top companies design and implement innovative distribution and manufacturing centers. Many of his consulting efforts have focused on custom automation and robotics within the distribution and warehousing environment.





HIGH TECH:

The welding robot works on a truss inside the welding cell at Prescient, a Colorado-based company that developed a framing system for commercial construction projects.

“The price of collaborative robots is coming down to \$30,000 or \$40,000. It is now possible to buy one and try it in different parts of a facility. People are finding creative uses for these robots that were not originally expected. That’s something that is very different now from the way things were done in the past.”

The continually falling price of robots will reshape the economics of their use in other ways, says Bonkenburg. It may eventually become cost effective for companies to operate “swarms” of robots, with spare units held in reserve to meet periods of high demand, or replace units that fail. That’s especially useful in environments like distribution centers, he notes, where demand peaks are particularly high. It also reduces the need for skilled maintenance staff to keep the robots running. “If you have a fleet of robotic forklifts, and one breaks down, you can push it into a corner and wait for a service engineer, while your other machines carry on with their work.”

On the verge of a revolution

Companies need to proceed with caution, however. Bonkenburg warns there is still a way to go before commercially available robots live up to their emerging potential. “When we look at a lot of real-world applications, we find that the robots aren’t quite there

“I’ve seen much more progress in robotics in the past five years than in the previous ten.”

Tom Bonkenburg

yet,” he says. “The current generation of collaborative robots is still a little too expensive. They are not quite fast enough, not quite accurate enough and they don’t quite do enough.”

The direction of travel, however, is very much the right one. “Every year these robots are getting better and better. I’ve seen much more progress in robotics in the past five years than in the previous ten,” says Bonkenburg. “There are huge sums going into robotics research today, and that’s mainly because affordable computing power has risen to the point where problems that were once considered too hard are now becoming interesting.”

That high rate of progress means engineering and manufacturing companies need to keep a close watch on developments, he says. “Talk to the robotics industry, understand what their products can do and what they can’t. If you have applications that might be appropriate for robotics – maybe because they are repetitive, dangerous, or boring for people – but you rejected the approach before because it was too costly or complex, it might be time to look again.” ■ Jonathan Ward

PAUL KILMISTER:
Head of Global
Warehouse
and Transportation,
Satair Group.



KEEPING THE WORLD MOVING

Airlines around the world rely on Satair Group for the materials and tools they need to maintain their fleets. That calls for some specialized supply chain capabilities.

A commercial airliner is an unusual sort of asset. Costing anything from \$20 million to \$320 million, aircraft need to work hard to make money for their operators – an unscheduled grounding can cost an airline \$500,000 a day.

At the same time, aviation is a highly regulated and safety-critical industry, and aircraft must be carefully maintained throughout an operating life that may span four decades.

These conditions mean that access to the right spare parts in the right place at the right time is a vital part of the commercial aerospace business. Supplying those parts to many of the world's airlines is the responsibility of Satair Group. Satair Group has been a wholly owned subsidiary of Airbus since 2011, and the organization is now responsible for all the European aircraft maker's aftermarket sales and support operations. In addition, it supplies components for the other major aircraft makers – Boeing, Bombardier and Embraer.

“We have quite a diverse product portfolio,” says Paul Kilmister, Global Head of Warehouse and Transportation, Satair Group. “Our inventory includes around 655,000 different part numbers, which can be anything from a simple bolt or seal to complete flight control surfaces like rudders, flaps and slats, up to 12 meters in length.”

Demand patterns are as diverse as the products. An important part of Satair Group's remit is the complete support of all Airbus aircraft for as long as customers wish to keep operating them. “Some of the parts we have in stock were originally manufactured in the 1970s, and we haven't sold them yet,” says Kilmister. Whether parts are old or new, the company needs to offer the same level of service to its customers, he adds, noting that during 2016 one U.S.-based customer was operating both the newest A320 in the global fleet and the oldest.

In many cases, those service demands are exceptionally high. If a part is required for an aircraft on the ground awaiting repair, Satair Group aims to pick, pack and ship it, along with all the appropriate airworthiness documentation, within just four hours. Overall, it fulfils 90 percent of orders directly from its inventories, with the remaining parts sourced or manufactured to order. To keep transport times as low as possible, the company ships from a network of nine warehouses around the world.

Aviation is a round-the-clock business too, and Satair Group has to run its operations the same way. Its facilities

operate 24 hours a day, every day of the year, and the company works hard to prevent anything disrupting its operations.

“Some of our facilities include their own back-up power generation, so they can continue to run for several days in the event of a loss of power from the grid,” says Kilmister. “At some of them, we even have beds and food, so our teams can keep working in the event of severe weather disruption.”

Regulatory challenges

Even in good weather, maintaining consistent service across its global network is a key operating challenge, says Kilmister, since processes must be adjusted to meet local differences in regulations and customer requirements.

“The biggest regulatory challenge is customs and export legislation,” he notes. “We touch 130 different countries every year, so that's a lot of different rules we have to follow. In addition, some of our warehouses are bonded and others are not.” With a huge amount of inventory in its facilities, compliance with taxation rules is a high priority for the business.

Satair Group carefully analyzes the composition of the aircraft fleets in different regions and adjusts its local inventory policies accordingly. It's a process that needs to consider not just the overall types of aircraft in use, but also their age and specification.

“Airbus operates a policy of incremental engineering, continual minor adjustment to improve passenger comfort, fuel efficiency and the economics of the aircraft. Those changes mean we may have one part number with many variants, and each variant will only be suitable for certain configurations of aircraft,” explains Kilmister.

The company has a relatively small customer base, numbered in the hundreds. But those customers vary dramatically in size and sophistication. “We operate on an aerospace-specific EDI platform that fully automates the ordering process, allowing bigger customers to integrate their own ERP systems directly with ours,” says Kilmister. “For smaller customers, we also have a web portal and the capability to take orders by phone or email. There are even a few who still place orders by fax.”

Customers are similarly varied in their approach to logistics, with some preferring to make arrangements with their own logistics service providers, while others leave final delivery up to Satair Group through its customized logistics services. “When it comes to more complex deliv-

130

The number of countries where Satair Group has customers

eries, like those large flight control surfaces, customers are more likely to ask us for help, and that’s where our own strong relationships with specialist providers are important,” says Kilmister.

Today, some customers are choosing to outsource the responsibility for parts entirely to Satair Group, and to cater for this the company offers Integrated Material Services (IMS). With an IMS solution the customer has the option of outsourcing the purchasing and planning of its entire inventory to Satair Group, typically embedding its own staff at customer sites to coordinate the process. The solution is conceived as an innovative new managed supply chain service offering to the airline aftermarket.



ON THE CASE: Satair carries a large range of spares for a range of aircraft manufacturers.

Inside its facilities, Satair Group is continually looking for ways to improve the speed and efficiency of its operations. It is experimenting with automated materials-handling technologies for some categories of parts, for example, and Kilmister sees the increased use of robotics within its warehouses as “a big opportunity for the future.”

The company also has a strong focus on environmental performance. It is working with its logistics service providers to reduce the carbon emissions associated with the transportation of parts, and has set demanding targets for the reduction of packaging waste.

It is adopting reusable containers for interfacility transportation, and shredding inbound packaging to use as dunnage, for example. It has a target of zero cardboard, bubble wrap or dunnage waste across all its facilities by the end of next year, and a program to optimize the size of the packaging used to ship parts to end customers has reduced the quantity of material used by 40 percent on average, says Kilmister.

3D-printed parts

The way parts are manufactured is changing, too. At one end of the scale, Satair Group is increasingly stock-

ing reconditioned used parts to give customers a more cost effective and environmentally friendly alternative to buying new. At the other end, the company is closely involved with its parent company’s investments in additive layer manufacturing (ALM) – or 3D printing. Today, says Kilmister, it supplies a few hundred different 3D-printed parts, but that number is expected to rise to the thousands over the next few years.

ALM is growing in three main areas, he explains. The first is the tools used for aircraft maintenance, which present fewer regulatory challenges than components intended to be installed on an aircraft. The second area is low-volume parts required for aircraft that are out of production, where 3D printing is more cost effective than restarting production using traditional methods.

Finally, there are parts for newer aircraft designed specifically with 3D printing in mind. “It is those parts where ALM delivers the biggest benefits,” says Kilmister. “Giving our engineering teams far greater scope, without the limitations of traditional manufacturing processes, to be as creative as they can and to save as much weight as they can.”

Looking ahead, the success of the global aerospace industry is presenting Satair Group with new challenges. “There is a huge backlog of orders for new aircraft today, which will lead to a big increase in the flying fleet, and rapid growth in demand for spare parts over the coming years,” says Kilmister.

“We need to ensure we can meet that rising demand in a sustainable way, without sacrificing service levels or cost efficiency.” The organization is already working hard to ensure that happens. At least 50 percent of its warehouse network will need to be physically enlarged over the next three years, for example. “It is a lot of construction projects for a relatively small company,” says Kilmister.

Satair Group’s ability to meet its customers’ needs in the longer term requires it to think about the shape of its network, as well as its size. That’s happened already, as the organization expanded from its European roots to meet the needs of the fast-growing Asian aviation market. The next step, says Kilmister, will probably be Africa. “Even though we have very small business volumes outside South Africa today, there is enormous potential in the region,” he says.

Satair Group has plans to exploit that potential – currently at the feasibility stage – and see it not just as expansion opportunity but also a chance to “rewrite how spare parts distribution is done in future.” A new greenfield facility will be an opportunity to fully implement a wide range of new ideas, he says, from high levels of automation and sustainability to closer relationships with customers. ■ *Jonathan Ward*

POWERING THE TECH REVOLUTION

The next step change in battery power for the tech revolution could be just around the corner, thanks to a breakthrough in the design of new lithium-oxygen batteries.

The search for long-life batteries to run the new generation of powerful electric cars is going into overdrive. Tesla founder Elon Musk has opened the new \$5 billion “gigafactory” in Nevada to churn out cheap lithium-ion batteries for half a million electric cars a year. Tesla, Jaguar and GM are all launching electric cars with a more than 200-mile (302-kilometer) range.

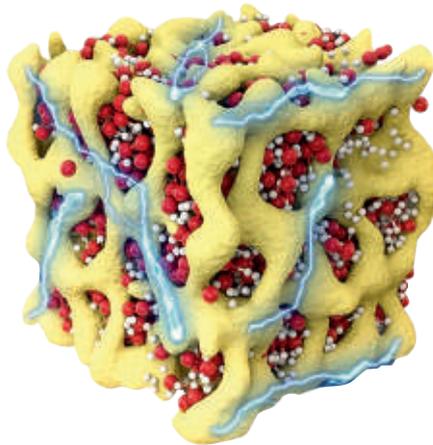
New research is providing incremental improvements to lithium-ion batteries, with U.S. startups such as Amprius, Enovix and Envia attracting tens of millions of dollars in funding for a silicon-anode battery.

There is a ceiling as to how much storage can be wrung out of conventional lithium-ion batteries, however.

Much scientific research is being carried out to find ways of perfecting alternatives, with the hot money on a variant of lithium-air technology.

Lithium-air (Li-air) batteries could offer between five and 15 times the energy per kilogram compared with lithium-ion batteries, providing a lightweight solution with the energy density of petrol. They would keep your mobile phone going for a week on one charge and allow a car to travel 400 miles (644 kilometers), outdoing the 300-mile (483-kilometer) drive per recharge from a lithium-ion battery. Li-air could also prove useful for storing solar energy. Supporters of this technology say it represents the greatest hope for significant increases in battery life.

Engineers have been working on the Li-air battery for 40 years, but the technology faces some huge obstacles. Last summer, however, researchers in the U.S. and China announced they may have found a way around the problems, heralding a new era in superefficient batteries.



SWITCHED ON:
The lithium-oxygen battery works more efficiently by embedding oxygen in a solid form.

Embedding oxygen

The new approach to Li-air was developed by Ju Li of Massachusetts Institute of Technology, along with researchers from Argonne National Laboratory and Peking University. They outlined the process in the journal *Nature Energy*.

Li-air batteries usually work by drawing in oxygen from the air to react with the battery’s lithium during the discharging cycle. This oxygen is then released again to the atmosphere during the reverse reaction when recharging the battery.

However, one of the shortcomings of lithium-air batteries is that the output voltage is more than 1.2 volts lower than the voltage used to charge them – a costly power loss every time it is charged. “You waste 30 percent of the electrical energy as heat in charging... It can actually burn if you charge it too fast,” Li explains.

The new battery works by embedding the oxygen in the cell but keeping it in solid form rather than changing between gas and solid. The oxygen is never in a gaseous state, so there is no need to use energy to shift it between solid and gas.

The result is faster charging and less heat wastage. This reduces the energy needed to power the battery to just 8 percent of the charge rather than 30 percent. Li says the batteries could also have a longer life than lithium-ion batteries as they are protected from overcharging by the natural process of the chemical reaction.

There have been dozens of research projects over the years on ways to improve on the basic Li-air design, but some battery specialists believe Ju Li’s solution holds the best hope for the future – and the team expects to be able to make a practical prototype within a year. ■ *David Benady*

**GLOSSY HIGHWAY:**

Pakistani and Chinese workers on an excavator as they leave the newly built tunnel after maintenance in northern Pakistan's Gojal Valley.

SILK ROAD RELOADED

Between 120 A.D. and the 1450s, the Silk Road was one of the most important trading routes in the world. Could China's plan for a modern version have the potential to boost its own economy while adding a new twist to global trade?

The humbly named Belt and Road Initiative (BRI) is anything but humble. Also called One Belt, One Road (OBOR), it is China's bold new vision for a network of routes featuring an overland trade route through central Asia to Europe, and a new version of the maritime Silk Road through Southeast Asia to the Middle East and Africa, together spanning more than 60 countries with a combined population of over 4 billion.

Launched in 2013 by President Xi Jinping, BRI envisions investments to the tune of several trillion dollars on new roads, railways, ports, airports, pipelines, refineries and power plants, together with supporting infrastructure. The intended result comprises new hubs of development, industry and urbanization in some of the least developed parts of the world, creating new markets for Chinese exports and jobs abroad for part of its workforce, while opening routes for the West to move expertise, products

and services east. According to Merics, the Mercator Institute for China Studies, China's aims encompass economic diversification, political stability and the development of a multipolar world order. From an economic perspective, China hopes the development of new trade routes, markets and energy sources will lead to economic growth and at the same time reduce dependencies. "Projects linked to OBOR are to once again fill the order books of Chinese state-owned enterprises, which are presently suffering from overcapacity. Furthermore, with the expansion of the Eurasian transport infrastructure, Beijing aims to lay the foundations for China-centered production networks, for instance with Chinese companies relocating production to Southeast Asia," it says.

Some countries are reportedly reluctant to get involved in the project and critics say it could become either a "bridge to nowhere" or risk exacerbating China's economic imbalances. However the BRI appears to have its fair share of supporters, and according to The Economist Intelligence Unit, 900 deals are already underway.

In addition to \$40 billion of seed funding from the Silk Road Infrastructure Fund, China is already leveraging other global public and private finance, such as the Asia Infrastructure Investment Bank with \$100 billion and the BRICS-backed New Development Bank (\$50-\$100 billion). Cost estimates for the full plan vary widely between \$4-\$8 trillion, however, once in place, the combined route "could be pumping out upwards of \$2.5 trillion of annual trade value by 2025," says the Hong Kong-based South China Morning Post. Some of the key projects underway or completed include a \$16.8

billion Moscow to Kazan high-speed railway, shortening the journey time from 12 hours to 3.5.

The Greek port of Piraeus was an early beneficiary after Chinese shipping giant COSCO bought a 67-percent stake. In 2015, its capacity rose to 3 million containers, from 685,000 in 2010, and by 2020 it is expected that its cargo-handling capacity will reach some 6.3 million TEU per year, which would make it the south gate of the China-Europe land-sea express.

Another key port investment is Gwadar in Pakistan, located some 400 kilometers from the Strait of Hormuz, giving China strategic access to the Indian Ocean through a 3,000-kilometer-long economic corridor that links Gwadar with Xinjiang, China's largest natural gas-producing region.

The Khorgos gateway, a dry port on the Chinese-Kazakh border, is seen as a key new cargo hub on the new Silk Road. Already handling 70,000 rail freight containers a year, it will be able to process more than 500,000 containers annually by 2020, on their way to or from China to Central Asia, Europe, Iran and Turkey.

The first freight train to travel the new Silk Road all the way to the United Kingdom arrived in London in January, having traveled 12,000 kilometers through eight countries on its 16-day journey. According to Kelvin Leung, CEO, DHL Global Forwarding, Asia Pacific, the revival of the China to Europe railroads brings real benefits. "We are already seeing the benefits of our multimodal services on the southern rail corridor from China to Turkey. With greater access to Chinese goods, Turkey is likely to further boost its trade balance with top European trading partners like Germany and France. In addition, in Kazakhstan, Azerbaijan and Georgia, which the railway crosses, governments are throwing their full support behind increased trade across their borders. Quite simply, there's a lot of opportunity."

Leung argues there is a need for both business and governments to play a key role in supporting BRI projects. "Running an intercontinental freight route is an ambitious undertaking. Multiple borders mean multiplied complexity. Currently, a large part of our work for our customers involves negotiating the various legal and regulatory nuances that apply to each country our shipments pass through. In order to boost the BRI, governments should focus on simplifying complexity and link crossborder infrastructure projects directly to the implementation of trade facilitation measures."

An enthusiastic promoter of the BRI is Jeff Astle, Executive Director, China-Britain Business Council. "BRI is a global game changer," he says, adding "We see it as a very big and ambitious plan for the next 15 to 20 years." In terms of opportunities, Astle says as projects develop, more and more international companies will be able to leverage their expertise.

"Whether they are energy or water specialists, or port or airport developers, through to banks, brokers and professional service providers, there will be a lot going on. Then manufacturers will move into these new nodal

cities that develop along the routes, which will then lead to tertiary business services, such as logistics, ICT, customer services and e-commerce."

Some nations will also be early to benefit, particularly those starting from a very low base of development Astle says, including China's close neighbors such as Vietnam, Myanmar, Laos and Kazakhstan.

"There will be an expansion in bilateral manufacturing and supply chains during the next five years, followed by market-making, building a marketplace over 10 to 15 years, creating places to export to, as China has done with its own urbanization program."

Astle acknowledges the recent new international mood. "Protectionism may be a problem, but I think China is big enough with its collective will and determination to see this through. This is a pragmatic and far-reaching global engagement, and whatever the challenges, there are enough opportunities to see it through. This is a long-term initiative that every international business should have on their agenda, especially in relation to China."

Bert Hofman, the World Bank's Country Director for China, Mongolia and Korea, even believes the BRI has the potential to be even bigger in influence. "The question is whether OBOR would need a more formal agreement at some point – covering trade, investment and business climate issues – to maximize its benefits," he writes on the World Bank's blog.

"For now, countries along the Belt and Road have highly diverse development conditions, and some have a challenging governance environment that has made investment in infrastructure hard." Hofman believes that using the initiative to help countries improve their investment climate, technical standards and customs and logistics procedures through a formal agreement could bring major benefits. If a more formal agreement were to ensue, it would be among the largest of its kind. ■ Keith Crane, Michelle Bach

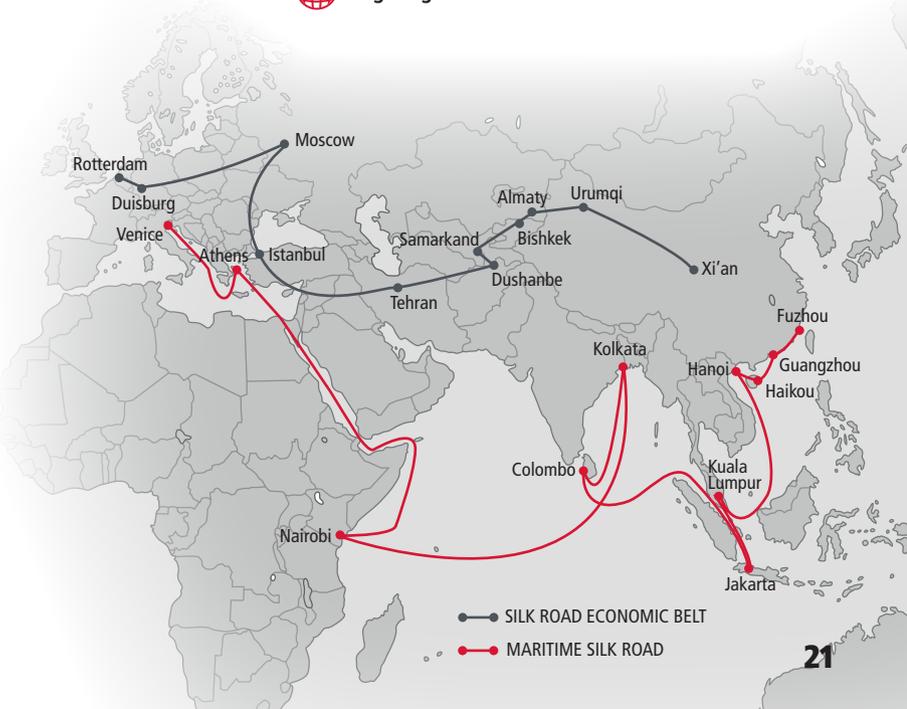
70

The number of countries potentially involved in the One Belt, One Road project

\$50 BILLION

The value of the Silk Road Fund, just one of many projects in the initiative

 english.gov.cn/beltandroad



A NEW KIND OF SUPPLY CHAIN INTELLIGENCE

The supply chain is already one of the most data-rich environments in business. Now, thanks to advanced analytics and machine-learning technologies, companies are using that data to transform their flexibility and responsiveness.

Data flows across the supply chain from an increasingly diverse range of sources. The internet of things has allowed companies to augment their planning and inventory management systems with real-time information on product location obtained from RFID tags and vehicle telematics systems. They know more about customer behavior by tracking their purchasing and browsing activities online. They have new information on the performance of their own products, which can report their status over the internet.

These advances have already brought a host of benefits, allowing products to be tracked more accurately, delivered more quickly and stored more efficiently. Now

the supply chains of many businesses are set to undergo an even more radical transformation, with the advent of technologies that can sift through all this data to identify hidden opportunities to improve supply chain performance and then make the smart decisions required to capture those opportunities.

Today, it is consumer-facing companies that are at the forefront of this revolution. British grocery retailer Ocado, for example, is using artificial intelligence and machine learning techniques to ramp up the performance of its logistics operations. As technology director Paul Clarke told a recent conference: "If you want to build really smart systems, you are going to have to feed them with a huge amount of data." As he put it: "Artificial intelligence literally eats data science for breakfast."

BIG DATA:

A worker checks a server in a data center.





TAKING STOCK:

Staff picking stock in a logistics center.

Ocado collects data from across its business, with clickstream data from mobile apps and its grocery website, business data, and what Clarke calls “the data exhaust” from the automated warehouse and the data streamed back in real time from vans as they make deliveries across the country. This is complemented by unstructured data from customers, such as emails, telephone calls and social media posts.

Sense, forecast, react

“We use this data to drive our forecasting, to drive predictive analytics, to optimize our platform in real time and to monitor its performance. But we also use it to feed our voracious smart systems,” Clarke told the conference. For instance, Ocado uses data to improve the layout of its warehouses by using machine learning algorithms. The data tells the digital team how long it takes to pick certain items and how the orders flow through the warehouse, allowing them to plot the most effective routes to picking goods. If there is a fragile product it can be moved to a different location to make it easier to pick.

The retailer stores data about 5,000 business transactions that occur in its fulfilment centers every second, using the Cassandra NoSQL database. This type of modern database makes it possible to store many different types of data, both structured and unstructured. It is an important enabling technology for the new generation of intelligent supply chains. The older relational databases that businesses have been using since the 1980s struggle to handle today’s complex and diverse data streams.

Not just for the unicorns

It isn’t just the world of fast-moving consumer goods that stands to benefit from data-driven decision-making. Consultancy Accenture cites the example of an industrial equipment maker that used advanced analytics techniques to find failure patterns hidden in its warranty claims, thereby improving the reliability of its products.

5,000

The number of transactions that take place every second at online retailer Ocado’s fulfilment center

Carmaker BMW is already working on a “connected logistics” concept for its upstream supply chain, using automation, analytics and connectivity to build a supply chain that is faster, more robust and more able to respond quickly to problems or changes in demand. “In the long term, we want to move away from central steering towards the self-steering of objects in the supply chain,” BMW Group’s board member for production, Oliver Zipse, told a German automotive conference last year.

Today, these examples are the exception rather than the norm, however. Accenture found that only 17 percent of companies report having already implemented analytics in one or more parts of their supply chain. But it also found that many companies are on the verge of making significant investments in big data analytics.

First, get the right data

The first barrier to the widespread use of big data is the difficulty companies have in actually finding the right information about their stock and supply chains. There are examples of companies that know they have hundreds of thousands of stock keeping units, but have no dimensional data about them – they don’t know whether each product is tiny, small, medium, large or enormous.

A company without in-depth data about its own operations will struggle to get the most out of big data. There are fears that companies may jump into big data because they have been told it is the future. But first, they need to be clear about exactly what are they trying to achieve. How will big data analysis make their business better and will it help them serve customers better?

Accenture believes these companies can learn lessons from the small group of businesses that have generated a high return from their investments in big data analytics. The high performers tend to use data analytics across the whole enterprise and embed them into supply chain operations to improve decision-making. They use data systematically and strategically across their whole organization rather than on an ad hoc basis for specific situations. They also hire staff with a combination of analytical skills and business acumen who can produce actionable insights from data.

Handling uncertainty

There are other significant complications on the path to using big data to make supply chains more intelligent. Çağrı Haksöz, a researcher on supply chain, risk and operations management at Sabancı School of Management at Sabancı University in Turkey, says big data’s ability to predict events depends on the underlying stability of the supply chain. “First you have to understand the context,

the environment and the setting in which you are taking a decision. It may be a stable environment – Northern Europe is different from Southern Europe, while the Balkans are different again,” he says.

Handing supply chain decision-making over to a mathematical model, however sophisticated, risks creating overconfidence in managers, notes Haksöz, which can lead to real problems if the model fails to predict an uncertain event. One way to improve the way models handle the unexpected, he suggests, is to collect as much information as possible on “near misses” or “close calls” that are avoided, but which might lead to a disruptive event – such as poor driving that nearly leads to a truck crashing.

“In the supply chain, if you are managing a fleet, the information you might collect on those near misses could be the drivers behaving differently on different routes, or reckless drivers who take reckless risks,” he says. If the behavior of their driving patterns could be understood through the internet of things or telematics without interfering with the driver’s behavior, this could reveal any problems that potentially become a major disruption.

The same approach can be applied to more prosaic events, he notes, like analyzing the behavior of customers to determine why they come close to buying a product but pull out at the last minute. “If the behavioral pattern of the customer could be analyzed, you could do something to ensure there is a successful purchase,” he says.

Industrial supply chains can offer similar telltale warnings, if the right data collection and analysis approaches are there to spot them. Vibration or temperature monitoring sensors attached to machinery can provide

early warning that a bearing is nearing the end of its life, allowing a replacement to be ordered, for example.

External data sources can help as well. Consumer goods companies can learn about upcoming demand by monitoring social media data generated by the customers. In the industrial sector, a commodity price spike might be an early warning indicator of an upswing in demand for new equipment or spare parts, as producers ramp up production in response.

Overall, says Haksöz, big data is suitable for predicting “white swan” events, which are everyday occurrences, and monitoring near misses can help predict “gray swan” events, which are uncommon but foreseeable. Big data will always struggle to handle truly unpredictable “black swan” events, however, which are not foreseeable but can occur in extreme circumstances.

Algorithmic decision-making can have unexpected consequences even when the world performs as expected. In the financial markets, for example, “flash crashes” have occurred when thousands of automated trading programs react instantly, and in the same way, to market events, causing wild swings in asset prices. In logistics, similar effects have been seen when automated navigation tools send many vehicles down the same narrow streets to avoid congestion, causing their own “algorithmic traffic jam.”

Adopting big data analytics requires significant investment in technology, data collection and skilled staff to make sense of the data. It also requires a transformation in the way senior managers understand the future of their businesses. Intelligent supply chains need an abundant supply of human intelligence and a significant commitment from company leaders. ■ *David Benady*



KEEPING TRACK: Autonomous transport, including driverless trolley trains, are already in place at a number of BMW’s plants in Germany, with plans to expand their use.

GOODS AND SERVICES TAX – COULD IT BE INDIA’S GAME CHANGER?

On 8 August 2016, the Constitution Amendment Bill for Goods and Services Tax (GST) was approved by the president of India after approval by both houses of Parliament and ratification by more than 50 percent of state legislatures. The government of India says it is committed to replacing all the indirect taxes levied on goods and services by central government and the states and implement GST by April 2017.

Implementation of a national GST replacing a plethora of central and state taxes in India is the most critical economic reform being attempted since the “economic liberalization” program in the 1990s, when India dismantled government controls on private and foreign ownership and drastically reduced barriers to trade. Just as the economic reforms of the 1990s unleashed new entrepreneurship and economic growth, the GST could potentially be a game changer for the Indian economy.



The existing system of multiple levels of taxes under different central and provincial administrations creates significant hurdles for the integration of production networks and supply chains, while imposing substantive transaction costs in business and logistics operations in India. Logistics costs in India are estimated to be around 14 percent of GDP, compared to below 10 percent in most other major economies. Similarly, the additional cost of compliance in dealing with a multiplicity of taxes is estimated to be around 1.5 to 2 percent of GDP.

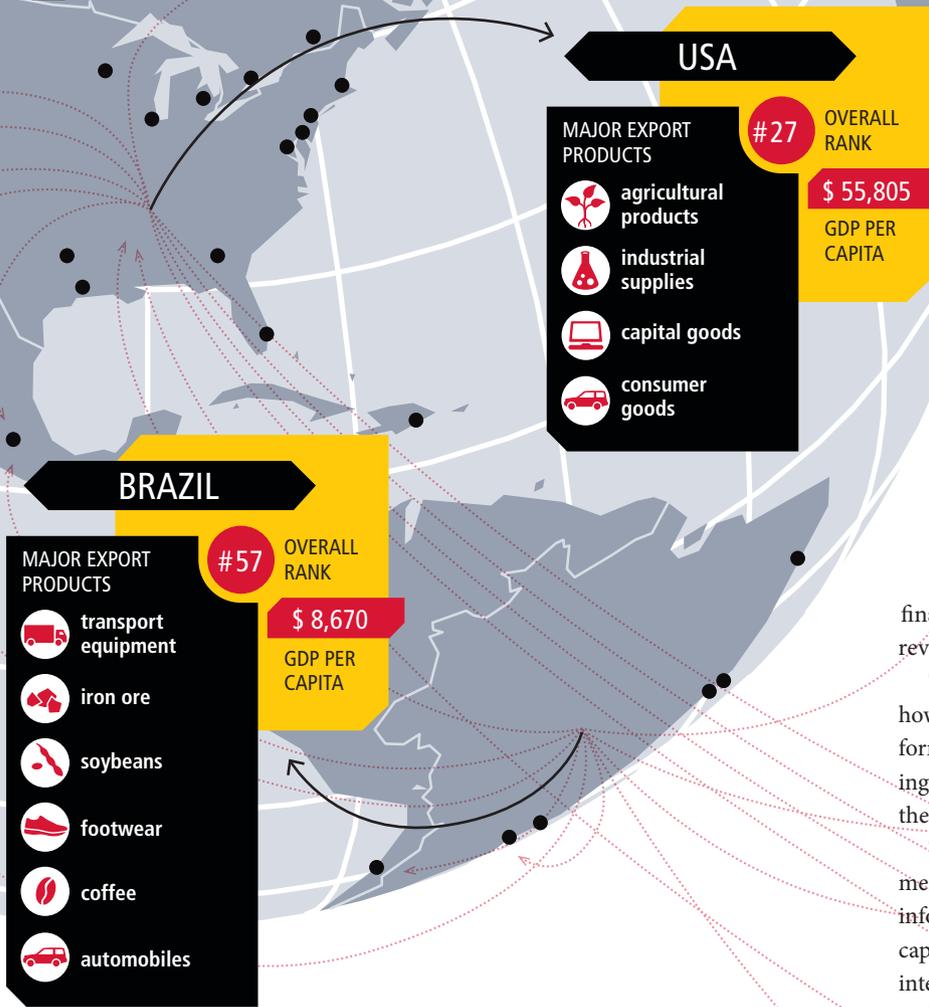
An easier and more transparent taxation regime would make the Indian market even more attractive to foreign investors. Indian and global firms already based in India could look towards rationalizing their production and distribution networks to leverage economies of scale and increase productivity, instead of focusing on tax arbitrage. This could open up the potential for new investment in bigger and more technologically advanced facilities, and more centralized and efficient warehousing solutions.

While GST provides a great opportunity for the logistics sector in India to be a partner and a catalyst for this transformation, it also means the industry must get “GST ready” and be ahead of the curve in anticipating the transport and warehousing solutions customers in different sectors would want. The specific needs and channels of distribution of different sectors need to be considered. For example, the e-commerce segment would be impacted by new taxation rules under GST for online transactions, as well as for movement of goods between warehouses owned by the same entity (referred to as “stock transfers” in Indian tax parlance).

All the benefits of GST discussed here assume that implementation of GST would be smooth and the existing bottlenecks imposed by the current system – i.e. impediments to efficient intra-state movement of goods and dealing with multiple tax administrations – would be eliminated. There is still some uncertainty whether or not all the states would agree to all the administrative reform measures, and lack of success on this front could lead to much-diluted gains from GST. ■ *Pritam Banerjee*

SUMMARY OF KEY FACTS ABOUT GST AND THE NEXT STEPS TOWARDS IMPLEMENTATION

- The GST will have a four-rate tax structure; 5 percent on items of basic consumption such as food, rates of 12 percent and 18 percent on most other goods and services, and 28 percent on what the government defines as “luxury” goods that would cover expensive consumer items.
- Aside from both houses of Parliament, all state legislatures also need to ratify the GST bill. So far 23 state legislatures have done so, while eight states are yet to do so, including some large states such as Uttar Pradesh, Karnataka and West Bengal.
- Central government and the states are also negotiating key issues related to administrative jurisdiction and powers of assessment. While the microlevel issues need resolution, there is macrolevel political commitment at both the central and state government levels to roll out GST in 2017. India stands at the cusp of a transformational reform.



The 2016 DHL Global Connectedness Index (GCI) provides a comprehensive and up-to-date view on the state of globalization. It shows that the world's level of connectedness actually surpassed its 2007 pre-crisis peak during 2014 and advanced modestly in 2015. The available evidence indicates that the world was roughly 8 percent more connected in 2015 than in 2005. In other words: Although globalization is not advancing as rapidly as it was before the financial crisis, the GCI suggests it has not gone into reverse.

The biennial index offers the most complete view of how globalization is evolving, and compares the performance of 140 countries around the world, accounting for 99 percent of the world's economic output over the two-year period from 2013 to 2015.

The level of global connectedness is gauged by measuring the international flows of trade, capital, information and people. Uniquely, the study not only captures the depth (the proportion of crossborder interactions) of countries' connectedness, but also how widely those international flows are spread around the world, rather than just focused on a few key trading partners – dubbed the “breadth” of connectedness.

Trade slowdown

The information pillar – measured by international internet traffic, telephone call minutes and trade in printed publications – showed the strongest growth over the reporting period (2013-2015). The gains in capital and people flows have been more modest, while the decline in the proportion of goods traded across borders – which began in 2012 – accelerated in 2015.

Merchandise trade fell 13 percent in dollar terms from 2014 to 2015 – with China's export depth falling from a peak of 35 percent in 2006 to only 21 percent in 2015 – prompting speculation as to whether world trade has reached saturation point. But merchandise trade volume rose a modest 2.7 percent in 2015, roughly in line with global output. That still remains a far cry from the 17-year period before the banking crisis, when trade was regularly expanding at twice the pace of world GDP growth.

Europe remains the world's most connected region, followed by North America. However, most international flows take place within rather than between regions – and nowhere is this better illustrated than Europe, where nearly three-quarters of the average country's trade takes place with other European nations.

HOW CONNECTED IS THE WORLD?

The newly released DHL Global Connectedness Index 2016 shows that despite protectionist tendencies, globalization has not gone into reverse – though the future of world trade will depend heavily on the decisions of policymakers.

The world appears to be an increasingly fragile place. Slowing economic growth, geopolitical volatility, the threat of terrorism and rising inequality in many countries provide the backdrop against which both nationalism and protectionism seem on the rise. There is a widespread perception that countries and regions are drifting apart while the world is entering a phase of de-globalization. But despite these apparent setbacks to a more connected world, new evidence points to the fact that globalization is not dead.

All but two of the world's most connected countries are in Europe, with top spot going to the Netherlands, followed by Singapore, Ireland, Switzerland, Luxembourg, Belgium, Germany, the U.K., Denmark and the United Arab Emirates.

However, the star performer is undoubtedly Singapore, which also came top of two new city-level indices introduced to the 2016 report – Globalization Hotspots and Globalization Giants.

The Hotspots index looks at the depth of a city's connectedness – comparing its internal flows with international dealings – while the Giants index takes a broader look by directly comparing the size of cities' international activity.

Singapore tops charts

On both measures, Singapore topped the charts. The “Lion City” – one of the world's only city states (apart from the Vatican City and Monaco), with 5.6 million inhabitants and the third-largest global financial center – was the top Hotspot, followed by Manama (Bahrain), Hong Kong, Dubai, Amsterdam, Tallinn, Dublin, Geneva, Abu Dhabi and Skopje.

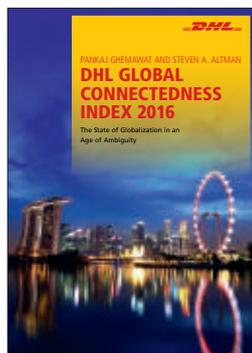
Meanwhile, in the Globalization Giants index, Singapore also led the way, ahead of Hong Kong, London, New York, Paris, Tokyo, Shanghai, Seoul, Beijing and Toronto. However, London and New York – the world's two biggest financial centers – ranked only 47th and 76th in the Hotspots index.

Remarkably, Singapore also topped the country rankings when gauged on depth of global connectedness alone. Other outperformers on this metric were Cambodia, Vietnam, Malaysia and Mozambique.

The U.K. was the top country when judged by breadth of flows alone – the extent to which international flows are spread around the globe – followed by the U.S., the Netherlands, South Korea and Japan.

Some might be surprised that the U.S. ranked just 27th out of the 140 countries measured over the two-year period, even though North America as a whole had the largest gain in overall global connectedness.

However, as the index points out, one easily overlooked reason for this is that the vast majority of economic activity in a large country such as the U.S. takes place within the country's borders, while smaller countries tend to have a much higher proportion of their business activity involving foreign buyers or sellers.

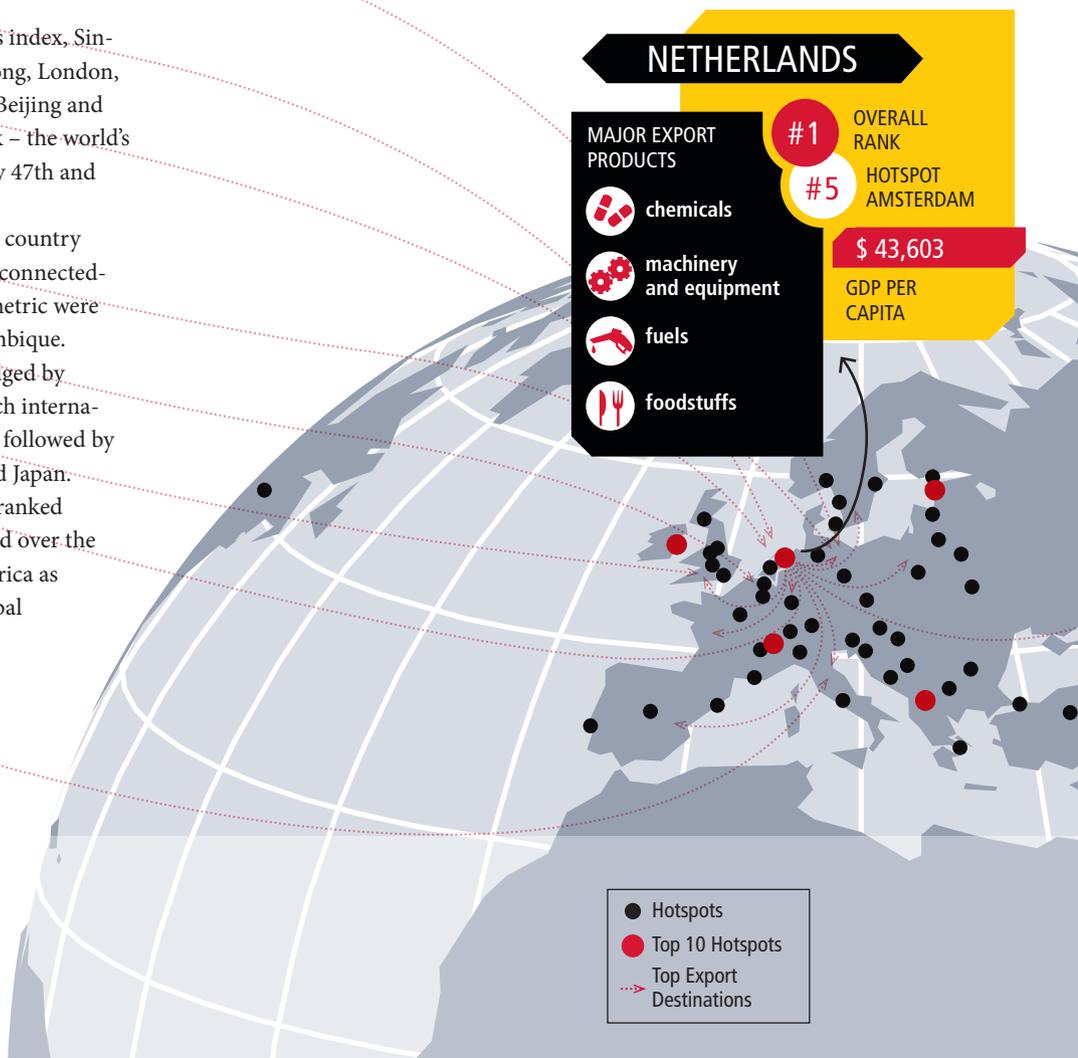


To download the report, please visit:

 bit.ly/gci-2016

Perhaps unsurprisingly, advanced economies are four times as deeply integrated into international capital flows as emerging market countries, five times more so on the movement of people, and nine times greater on information flows. Language also makes a huge difference to flows, with 22 percent of trade and 34 percent of migration taking place between countries that share a common language.

Despite the political uncertainties, Frank Appel, CEO, Deutsche Post DHL Group remains optimistic about the future. “Globalization has served as the world's engine of progress over the past half-century,” he says. “The GCI documents that globalization has finally recovered from the financial crisis, but faces an uncertain future. It is imperative that policymakers and business leaders support an environment in which globalization can continue to flourish and improve the lives of citizens around the world.” ■



AN INTERVIEW WITH PANKAJ GHEMAWAT

To what extent do you think the decision of the U.S. government to pull out of the Trans-Pacific Partnership (TPP) will influence globalization and future global growth?

We are already starting to see effects. Countries in TPP are realigning for the new reality, eyeing a future in which the only major trade deal on the table in Asia is the China-led Regional Comprehensive Economic Partnership (RCEP). And back in the U.S., President Trump is celebrating, among

other things, a deal struck with Carrier Corporation to scale back the company's plans to relocate work to Mexico. The U.S. president pledges to renegotiate trade deals, and there is still a great deal of ambiguity about what such renegotiation will entail. A retreat from globalization would be a negative signal for growth, but President Trump has also promised much faster U.S. economic growth. The transition from politics to policy is still in its early stages, and many difficult tradeoffs have to be managed along the way. Meanwhile, one definite implication is a heightened level of uncertainty about the prospects for both globalization and growth.

Why did Singapore score so well (both at city and country level)? What can we (and other countries) learn from Singapore's outperformance?

Part of Singapore's large role in international flows can be chalked up to the general pattern that economies with structural characteristics like Singapore's tend to be deeply globalized. Countries that are small, rich, on the sea, fluent in major languages and close to major markets tend to have deeper global connectedness than those that are not. Singapore shares all of these characteristics, as well as a unique location and mix of cultures that make it an ideal hub for its region.

Credit, however, must also be given to the role of public policy. In 1972, just seven years after Singapore's independence and decades before the term "global city" became popular in academic and policy circles, Singapore's first foreign minister, S. Rajaratnam, gave a speech titled "Singapore as a Global City." He articulated a vision in which Singapore's economic development would be driven by its growing connections beyond its immediate neighborhood.

Singapore went on to implement a multipronged approach to globalization, tying together industry-specific strategies, infrastructure development, promotion of inward foreign direct investment, and so on. A 2014 article in Time magazine summed up the results: "No other place on earth has so engineered itself to prosper from globalization—and succeeded at it." Indeed, our analysis affirms that even after we statistically control for Singapore's structural advantages, Singapore still outperforms on the depth of its international flows.

What does the performance of small cities such as Tallinn, Dublin and Skopje in the Hotspots Index tell us about global connectedness, and how have they managed to outperform much bigger cities?

This is an interesting question, and one that we cannot yet answer based on statistical analysis. However, the general lesson I take away from this pattern at this point is that cities across a wide size spectrum can enjoy the benefits of global connectedness. And smaller cities with strong specializations, in particular, can play important roles beyond the borders of the countries where they are located.

What was the probable cause of the slowdown in the growth of global connectedness in 2015?

TOP 10 GLOBALIZATION HOTSPOTS

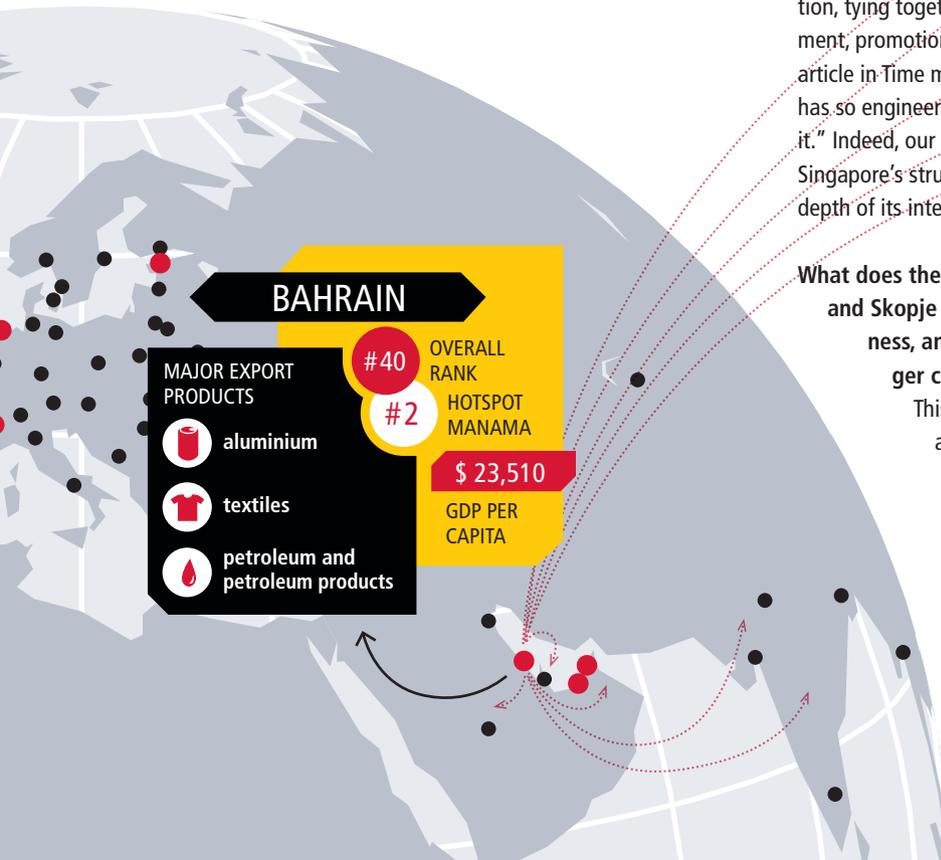
1	Singapore
2	Manama
3	Hong Kong
4	Dubai
5	Amsterdam
6	Tallinn
7	Dublin
8	Geneva
9	Abu Dhabi
10	Skopje

Source: DHL Global Connectedness Index 2016

TOP TEN COUNTRIES

1	Netherlands
2	Singapore
3	Ireland
4	Switzerland
5	Luxembourg
6	Belgium
7	Germany
8	U.K.
9	Denmark
10	United Arab Emirates

Source: DHL Global Connectedness Index 2016



The largest contributor was declining depth on the trade pillar of the index, and even more specifically the merchandise trade component. While merchandise exports as a percentage of world GDP has been on a declining trend since 2012, its fall accelerated in 2015. The causes are multifaceted. First of all, trade value is affected by commodity prices and exchange rates – the trade picture looks somewhat brighter if analyzed in terms of volume instead of value (merchandise trade value in U.S. dollar terms fell 13 percent in 2015 but merchandise trade volume grew a modest 2.7 percent over the same year). But even in volume terms, trade flows remain weak. The causes involve a combination of cyclical (macroeconomic) factors, structural factors (e.g. China’s rebalancing from an export-driven growth model to one that relies more on domestic demand), as well as policy measures. With regard to the latter, there is mounting evidence that protectionist policies are dampening trade growth.

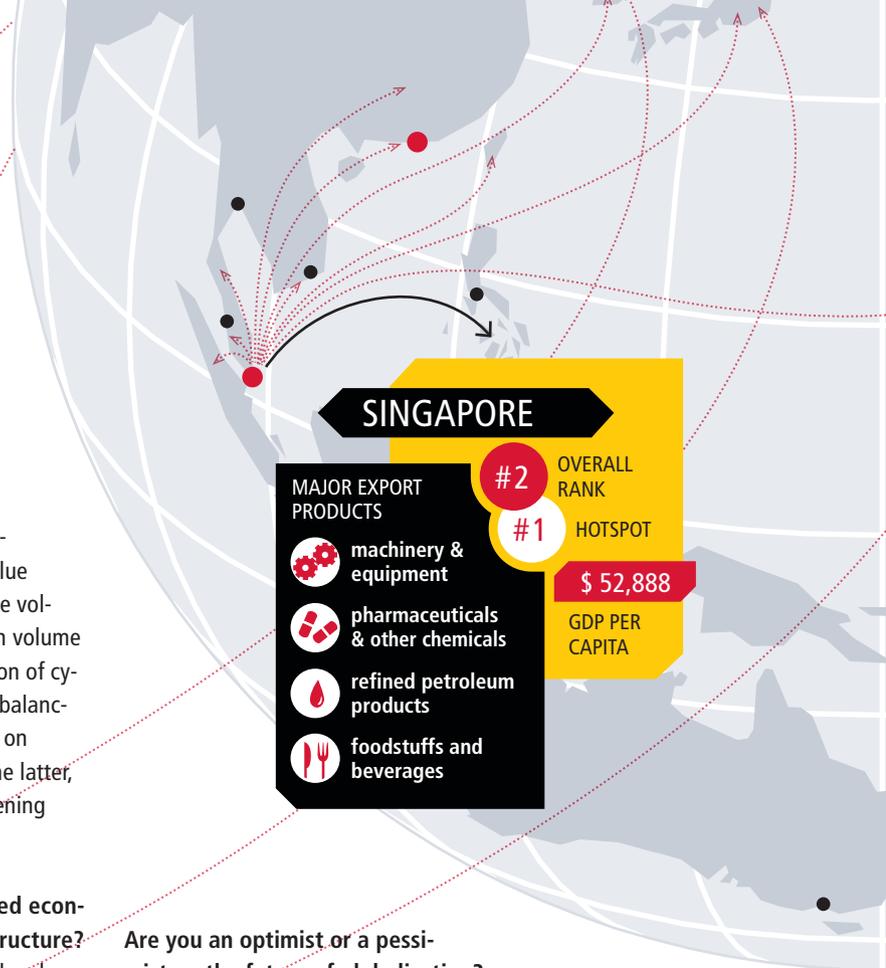
Why are emerging economies less connected than advanced economies – other than obvious factors such as poorer infrastructure?

Whereas global connectedness can contribute to faster growth, low levels of economic development can also constrain connectedness. As you mentioned, infrastructure is an obvious barrier. However, physical infrastructure constraints are of maximum importance for merchandise trade, and that is the only type of flow on which emerging economies match advanced economies’ levels of integration.

The largest discrepancy is on international information flows, on which advanced economies are nine times as connected as emerging economies. This presumably reflects both bandwidth limitations as well as lower levels of digitization overall in less developed countries. On the people and capital pillars, policy constraints also come into play to a greater extent. Citizens of emerging economies face more stringent visa requirements when traveling abroad, and emerging economies also tend to place more restrictions on their international capital flows.

What is the most encouraging takeaway from the 2016 survey for you personally – and the most discouraging?

In my view, the most encouraging finding is that people tend to greatly overestimate levels of globalization, and that correcting those misperceptions can soften or even reverse many common concerns about it. To cite a very concrete example, immigration was a big issue in the Brexit debate, and surveys indicate that Britons think there are more than twice as many immigrants in the U.K. as there actually are. Moreover, simply telling them the actual level of immigration into their country cuts the proportion thinking there are too many immigrants by 40 percent. To me, that illustrates the value of a study like the DHL Global Connectedness Index. Globalization will remain controversial, but it is essential to strengthen the debate by grounding it more effectively in hard data. The most discouraging finding, in my view, is that growth on the depth dimension of global connectedness slowed in 2015. This is a serious concern because the depth dimension of global connectedness has been associated with faster economic growth.



Are you an optimist or a pessimist on the future of globalization?

Is the continued growth of global connectedness inevitable in the longer term, regardless of short-term hiccups, given the information and technology revolution?

Globalization can go into reverse over very long periods – decades or more – as we saw in the mid-20th century. But over even longer time horizons, I still tend toward optimism. Human progress over centuries and even millennia has been marked by expanding circles of cooperation. We have advanced from small bands of several dozen people up to larger tribes and eventually to nation states and beyond. Pushing these boundaries has always involved taking real risks, and there have often been setbacks. But the gains have been enormous and are worth continuing to pursue.

For globalization to prevail, do political adjustments need to be made to allay public concerns?

Absolutely. There is still much to be gained from strengthening the links between countries, and many of the problems blamed on globalization result more from domestic than international causes. But just because the problems of globalization tend to be exaggerated does not mean they are not real at all. International flows can sometimes have negative consequences. The solution, however, is not to draw back from international engagement across the board. National governments actually have far more power to manage it than is commonly presumed – more can and should be done to assist people who are harmed by the side effects of globalization. ■



PANKAJ GHEMAWAT:
Co-author of the DHL Global Connectedness Index, professor at NYU Stern and IESE.

SOLUTIONS

DELFT HYPERLOOP

Passengers could soon be crossing Europe close to the speed of sound in a pod propelled through a metal tube, or “hyperloop.” Tech entrepreneur Elon Musk launched a competition for a prototype design, and the Delft hyperloop (pictured) achieved the highest overall score in January’s tests, winning the Design and Construction award. The final phase of the competition will take place this summer. The half-size prototype is almost five meters long and weighs just 149 kilograms. The capsule, suspended by magnets, traveled in a low-pressure tube at speeds of up to 399 kph on the 1.6-kilometer test track at SpaceX in California this January. The full-size hyperloop is designed to travel at speeds of up to 1199 kph – cutting journey times from Amsterdam to Paris to just 30 minutes. ■



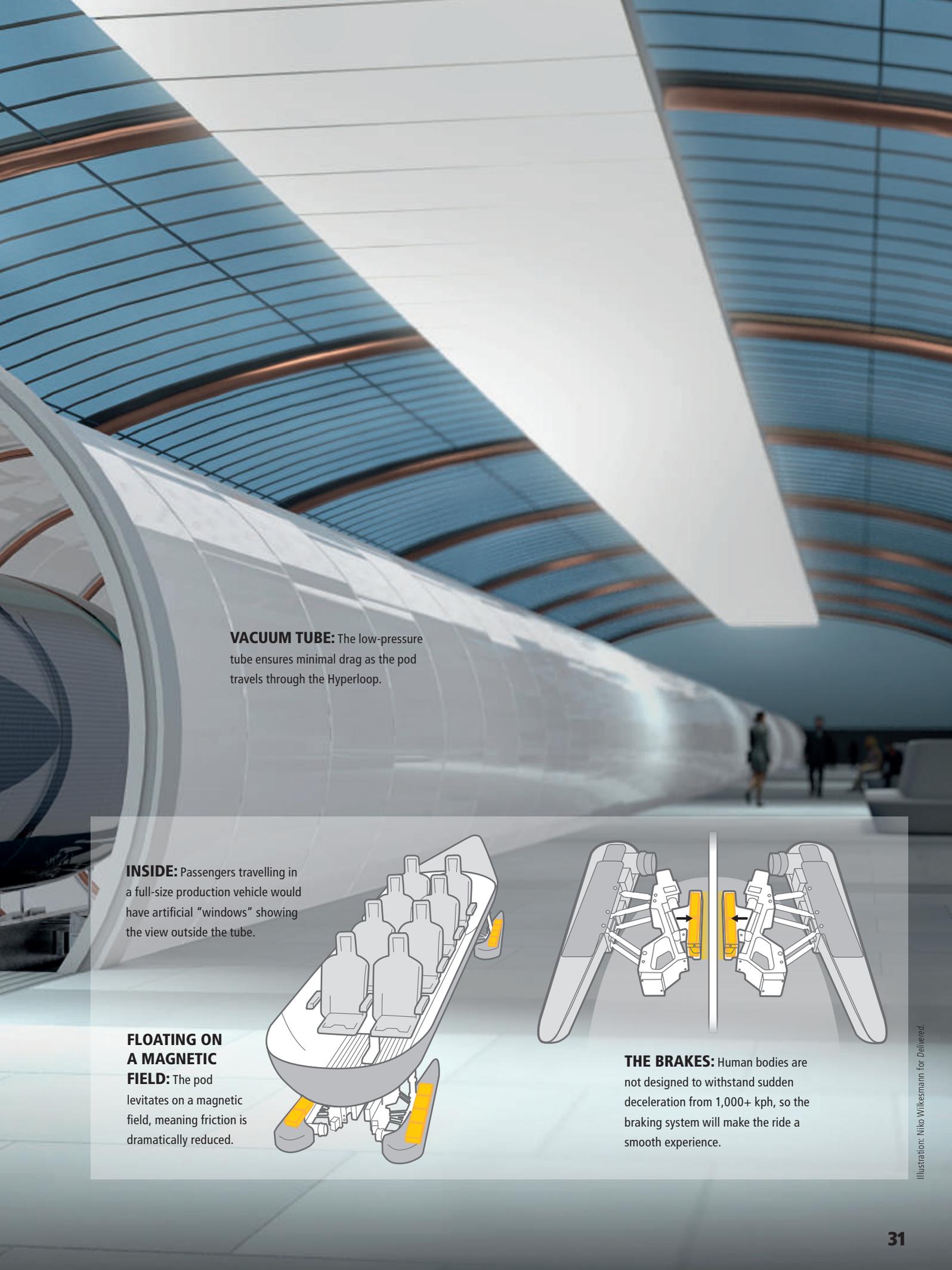
www.delfthyperloop.nl

AERODYNAMIC SHAPE:

The rounded shape of the pod allows the prototype to travel at speeds of up to 399 kph through a low-pressure metal tube raised above the ground on pillars.

ALUMINUM TRACK:

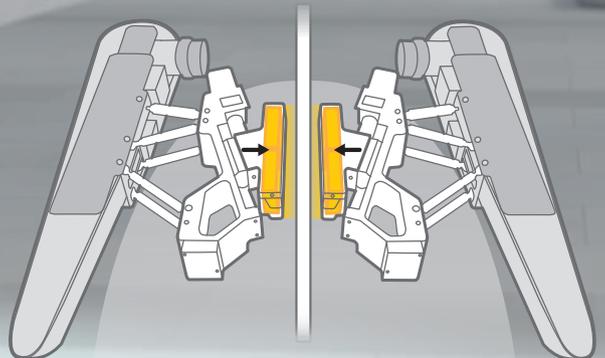
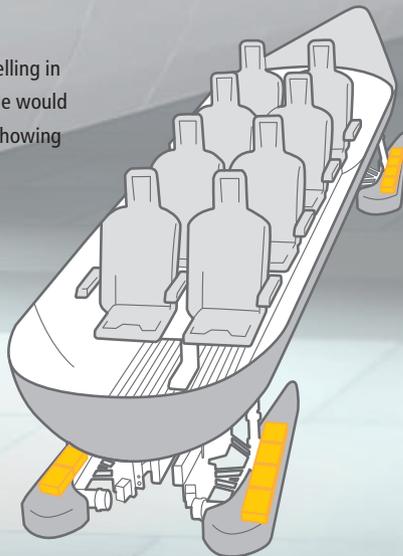
The pod floats above an aluminum track which guides it through the tube.



VACUUM TUBE: The low-pressure tube ensures minimal drag as the pod travels through the Hyperloop.

INSIDE: Passengers travelling in a full-size production vehicle would have artificial "windows" showing the view outside the tube.

FLOATING ON A MAGNETIC FIELD: The pod levitates on a magnetic field, meaning friction is dramatically reduced.



THE BRAKES: Human bodies are not designed to withstand sudden deceleration from 1,000+ kph, so the braking system will make the ride a smooth experience.



ARE YOU READY FOR INDUSTRY 4.0?

Job skills are changing rapidly as automation advances across almost every area of industry. What skills will people need as business embraces the fourth industrial revolution?

At Festo, a family-owned automation technology specialist in southern Germany, the future is on display in Room 55.4.275. This is where the company houses its “cyber physical factory” – a training camp for the skills you need for the fourth industrial revolution. It’s just minutes from the factory floor and easy to reach for both workers and managers. No training takes longer than 30 minutes, barely disrupting the workflow.

Festo calls this new method of learning “One Point Lessons,” where the company teaches staff how to resolve one real-life problem using skills such as programming, data management or systemic thinking. The lessons are administered by Festo Didactic, a consulting unit the firm has founded to carry out the lifelong training of its 19,000 employees worldwide.

Training – or retraining – the workforce will be the “number one challenge” in the fourth industrial revolution, or Industry 4.0 as it is dubbed, argues Markus Lorenz, a partner at Boston Consulting Group (BCG).

Simple tasks will be taken over by robots as factories and supply chains become ever more digitized; humans will need to oversee these tasks, and must be multidisciplinary and able to adapt to changing roles.

Advanced robotics

The PwC 2016 Global Industry 4.0 Survey agrees: “The biggest challenge for industrial leaders isn’t technology – it’s the people.” Meanwhile the World Economic Forum (WEF) thinks that four years from now, more than a third of skills (35 percent) considered important in today’s workforce will have changed. “By 2020, the fourth industrial revolution will have brought us advanced robotics and autonomous transport, artificial intelligence and machine learning, advanced materials, biotechnology and genomics,” it forecasts.

Clearly this will transform both the way we live and the way we work. All experts agree that routine jobs will disappear first – both in industry but also in the service sector. “Creativity will become one of the top three skills workers will need,” the WEF predicts. Complex problem-solving and critical thinking are the other two – exactly what computer algorithms and robots so far can’t do as well as humans.

And humans will still be needed to supervise the robots – for the time being, at least. “Complete automation is not realistic,” argues Ingo Ruhmann, a special adviser on IT systems at Germany’s Federal Ministry of Educa-



tion and Research. “Technology will mainly increase productivity through physical and digital assistance systems, not the replacement of human labor,” he says.

Management consultancy BCG foresees completely new job profiles such as a “robot coordinator” who oversees robots on the shop floor and “responds to malfunctions or error signals.” One of the most important new roles for humans will be the “industrial data scientist” – specialists who will extract and prepare data, conduct advanced analysis and apply their findings to improve products or production.

Degrees “less important”

Some experts believe university degrees will be far less important in future, with personal skills becoming more critical. “We need radically different thinking and platforms to focus on capabilities instead of qualifications – an approach similar to the dating app Tinder for the new job marketplace,” says Alexander Spermann, the former director of German labor policy at the Cologne Institute for the Study of Labor.

As an example, he says instead of looking for a mechanic certified for a specific repair procedure, companies should look for employees who are open to change, “with expertise in repairing machines during production hours, specific experience working with a given machine brand, and experience using certain types of IT interfaces.”

That fits in perfectly with the WEF analysis that problem-solving, creativity and critical thinking will be the three top skills required by industry in 2020. Quality control will no longer be required, except perhaps in high-end luxury goods, as machines will increasingly take over most of the work – and probably do it better than humans. Employees will need to shift their focus to the things machines so far can’t do – one of the skills not even listed in 2015 but required five years later is “emotional intelligence” – the ability to read people’s emotions and react accordingly.

This new skill set will be particularly challenging on the shop floor, according to the BCG report “Man and

Machine in Industry 4.0” It says employees will have to be more open to change, possess greater flexibility to adapt to new roles and working environments, and become accustomed to continuous interdisciplinary learning.

Companies will have to drastically increase their in-house training, predicts Theodor Niehaus of Festo Didactic. “There will be a huge amount of retraining necessary in industry,” he says. BCG partner and study author Markus Lorenz says retraining will even become a lucrative business in its own right – his own company is debating whether to enter the market itself and set up small “learning factories.”

Given the scope of change, it is clear that retraining for the fourth industrial revolution should not be left solely to HR departments but is also a CEO issue. Nonetheless, there is a lot that individuals can do to upgrade their skill sets. For example, many experts now agree that creativity is not an innate talent but can be learned – a whole library of how-to books has already been written on the theme.

Some of the books are better than others, but they all focus on a couple of central ideas: be open to new things, ask questions, doodle around, and create “firsts.” When was the last time you did something for the first time in your life? ■ *Margaret Heckel*

“Creativity will become one of the top three skills workers will need.”

World Economic Forum forecast

TOP SKILLS IN 2015

1. Complex problem-solving
2. Coordinating with others
3. People management
4. Critical thinking
5. Negotiation
6. Quality control
7. Service orientation
8. Judgement and decision-making
9. Active listening
10. Creativity

TOP SKILLS IN 2020

1. Complex problem-solving
2. Critical thinking
3. Creativity
4. People management
5. Coordinating with others
6. Emotional intelligence
7. Judgement and decision-making
8. Service orientation
9. Negotiation
10. Cognitive flexibility

Source: Future of Jobs Report, World Economic Forum



VIEWPOINTS

*DELIVERED. GOES BACK
TO THE FUTURE WITH...*

GLEN HIEMSTRA

Futurist Glen Hiemstra studies current trends to help organizations understand the challenges and opportunities facing them in the decades ahead.

Will the future be a scary, dystopian place, where societies are fractured and technology is out of control? Not according to Glen Hiemstra, who looks into the future for a living. He is decidedly more optimistic than that.

“To be optimistic about the future is a choice one makes,” he admits. “But the fact is that when things get bad, the human race has generally proven its ability to step up and solve the issues threatening us. True, we often wait until it’s almost too late – but we do it.”

And anyway, he says, while there are undoubted challenges ahead – including how we deal with global warming, the one thing that does keep him awake at night – there’s much to be positive about. “We’ve cut poverty in half in just 10 years,” he notes, “and there are now more middle-class people on the planet than in any time in our history. We’re approaching full literacy and we’re probably within a decade of everyone having high-speed internet access. More connections lead to more inventions, which lead to more progress and development. So there are lots of hopeful signs.”

As a futurologist, Hiemstra is someone who disseminates information about the future to help organizations and industries in effective strategic planning. While some of his peers might only look a few years ahead, Hiemstra will take a company decades into its future. His is a long-term view.

“I help them answer three questions,” he says. “What is our ‘probable’ future? Our ‘possible’ future? And our ‘preferred’ future? The probable future means looking at where current trends could take an organization. The possible future entails investigating the direction an organization might take if it did things differently. The preferred future is looking at the strategic direction of an organization, based on probable trends and options.” This last one is his specialty.

Hiemstra believes that “If you listen carefully, you can learn what the future is telling you.” But what does he mean by that, exactly? “I’m saying that by standing in the future and looking back at today, we get a strong sense of what we should be paying attention to in the present,” he says. “For example, take the issue of climate change. If you put yourself 50 or 150 years ahead, you can look at the world and understand what it is we have to do today to either prevent global warming, or get ready for it.”

Being able to see into the future certainly has upsides. For instance, Hiemstra’s foresight enabled him to register his website, www.futurist.com, in the early 1990s before the internet took off. “My motivating force is constant curiosity,” he says. “It’s what every futurist uses for fuel. I’m a vacuum for information. If you’re interested in finding out about new things on a continuous basis then future studies is the perfect area for you, because there is always something to learn – and staying ahead of the curve is so important in our field.”

120

The number of different nationalities visiting futurist.com every month

75
PERCENT

The share of the workforce that will be made up of millennials by 2025

What are the most interesting trends you’re noticing now?

The first is the so-called internet of everything, where machines, devices, buildings and vehicles communicate with each other on either a continuous or frequent basis. To me, that really is a significant change because it has the ability to make things like manufacturing, transportation and logistics much more intelligent. The internet of everything is going to be the largest engineering project in the history of the world.

The second is the continued improvement of artificial intelligence, where machines become capable of assessing information in real time and helping humans make better decisions. The third trend is the combination of biology, nanotechnology and artificial intelligence to help us better understand biological systems and extend healthy human lifespans.

Then there’s the rapid development of solar energy; plus space development. The number of companies and start-ups involved in the latter is astonishing. By the end of the century, living in space will be a viable option.

How will logistics develop in the years ahead?

Infrastructure will become smarter and, within a decade or two, we’ll move towards more autonomous transportation systems. This has implications for efficiency and also for the changing nature of employment. Generally, I’m not as worried as some about technology replacing humans – I think we’ll adjust to it because it will happen more gradually than people think. The other major transportation development worth watching is the Hyperloop technology popularized by Elon Musk. If we can move goods at 600 or 700 miles an hour between cities, that would be hugely significant.

What do you see as the main challenges and opportunities for organizations in the future?

We need to build a culture of innovative thinking that will help us overcome challenges: becoming more sustainable – more energy-efficient and carbon-neutral; how to take advantage of machine intelligence and smarter systems; and dealing with an older workforce. Opportunities include taking advantage of big data for more efficient delivery systems, and using young people in the workforce. That’s because they are so capable with information technology and there’s a huge opportunity to leverage their knowledge – 75 percent of the workforce will be millennials by 2025.

How can companies best ready themselves for the long-term future?

By turning the future into a continuous conversation, rather than something they look at every five years. A company shouldn’t say: “OK, we looked at the future – now let’s all get back to work.” Instead, it should make the future part of its work. ■ *Tony Greenway*

From risk to resilience: Find – and overcome – your company’s weakest link

In an interconnected, volatile global economy, supply chains have become increasingly vulnerable. Disruptions – even minor shipment delays – can cause significant financial losses and damage shareholder value. Businesses need to be prepared for any eventuality.



AN ESSAY BY JOSEPH FIKSEL

Dr. Joseph Fiksel is Executive Director of the Center for Resilience at The Ohio State University, an interdisciplinary research center that is developing a unified approach for modeling risk, resilience and sustainability in complex systems. As a research faculty member in the Integrated Systems Engineering Department, he collaborates with companies, government agencies, non-profits and other organizations to develop new methods and tools for understanding the interdependence between social, environmental and economic interests.

Globalization has made anticipating disruptions, and managing them when they do occur, more challenging. The potential risks of disruptions are often hidden, and the potential impacts may not be understood, which often results in “black swan” events – unforeseen incidents that can only be fully understood after the fact.

Although companies originally moved production offshore to countries such as India and China to take advantage of lower labor costs, events such as Iceland’s 2010 volcanic eruption and the Japanese tsunami in 2011 have shown the vulnerabilities of extended supply chains are real and serious.

For example, according to the U.S. Federal Reserve, 41 percent of Minnesota manufacturers said Japan’s tsunami affected them negatively. As a result, many manufacturers have re-evaluated their sourcing options, and some are shifting operations back to their home markets. While there are other advantages to reshoring, including improved responsiveness and domestic job creation, reducing their risk exposure has been an important driver for these companies.

The reality is that supply chain practices designed to keep costs low in a stable business environment can increase risk levels during disruptions. Just-in-time and lean production methods, whereby managers work closely with a small number of suppliers to keep

inventories low, can make companies more vulnerable due to the lack of buffer capacity.

Over the past seven years, researchers at The Ohio State University have been exploring the concept of enterprise resilience, i.e. how companies can prosper in the face of turbulent change by being able to recognize, understand and compensate for vulnerabilities.

The result is the SCRAM (Supply Chain Resilience Assessment and Management) framework, which enables a business to identify and prioritize the supply chain vulnerabilities it faces, as well as the capabilities it should strengthen to offset those weaknesses.

The SCRAM approach represents a systems view of supply chain dynamics, helping companies to understand the inherent vulnerabilities that could lead to disruptions and the capabilities that are within their control. By learning from experience and developing a better understanding of their vulnerabilities and capabilities, companies can reduce the frequency of disruptions and the severity of their impact, resulting in increased customer satisfaction and reduced supply chain operating costs. While reducing inherent vulnerabilities may be difficult, there are many options for improving capabilities. The cost of the improvements must be balanced against the expected supply chain performance benefits.

Six vulnerabilities you need to know about

Every business has its vulnerabilities, and most of the time those vulnerabilities are inherent to the business and difficult to avoid, but by recognizing them you'll be better equipped to deal with disruptions as they happen.

Turbulence

Definition: Environment characterized by frequent changes in external factors beyond the company's control

Examples: Unpredictability in demand, fluctuations in currencies and prices, geopolitical disruptions, natural disasters, technology failures, pandemics

Deliberate threats

Definition: Intentional attacks aimed at disrupting operations or causing human or financial harm

Examples: Terrorism and sabotage, piracy and theft, labor disputes, special interest groups, industrial espionage, product liability

External pressure

Definition: Influences, not specifically targeting the company, that create business constraints or barriers

Examples: Competitive innovation, government regulations,

price pressures, corporate responsibility, social and cultural issues, environmental, health and safety concerns

Resource limits

Definition: Constraints on output based on availability of the factors of production

Examples: Raw material availability, utilities availability, human resources, natural resources

Sensitivity

Definition: Importance of carefully controlled conditions for product and process integrity

Examples: Restricted materials, supply purity, stringency of manufacturing, fragility of handling, complexity of operations, reliability of equipment, safety hazards, visibility of disruption to stakeholders, symbolic profile of brand, customer requirements for quality

Connectivity

Definition: Degree of interdependence and reliance on outside entities

Examples: Scale and extent of supply network, import/export channels, reliance on specialty sources, reliance on information flow, degree of outsourcing

So in the face of all these disruptions, what's the answer? Resilience!

Resilience is the capacity of an enterprise to survive, adapt and grow in the face of turbulent change.

Resilience means improving the adaptability of global supply chains, collaborating with stakeholders and leveraging information technology to assure continuity, even in the face of catastrophic disruptions.

Resilience goes beyond mitigating risk; it enables a business to gain competitive advantage by learning how to deal with disruptions more effectively than its competitors, and possibly even using those disruptions to its advantage.

Resilient systems don't fail in the face of disturbances – they adapt.

Building resilience is not a substitute for other methods of ERM. Rather, it is an ongoing process that enables companies to embrace change in a turbulent and complex business environment by expanding their capabilities.

Establishing a culture of resilience will help companies thrive in an age of turbulence. ■

Article adapted from "From Risk to Resilience: Learning to Deal with Disruption" by Joseph Fiksel, Mikaella Polyviou, Keely L. Croxton and Timothy J. Pettit

WHAT'S THE STORY, MR. HOUTER?

MAKING ELON MUSK'S PIPE DREAMS COME TRUE

A team from Delft University of Technology in the Netherlands has built a ground-breaking prototype capsule of Elon Musk's SpaceX Hyperloop Pod Competition. What happens next? Tim Houter, team captain for the TU Delft project, keeps us in the "loop"...

For the past 18 months we've been involved in the world's latest student competition. This is the SpaceX Hyperloop Pod Competition, where teams from all over the world have been designing and building a capsule that will be able to travel at speeds of up to 745 miles per hour (1,199 kph) in the Hyperloop transportation system.

The Hyperloop has the potential to completely revolutionize transport because it will massively cut down travel time between cities. Apart from passengers, it will carry freight and has the potential to take lots of vehicles off the road, solving traffic congestion. We're a 30-strong team with expertise across the board, from aerospace, design and mechanical engineers to architecture students, physicists and economists. What excited us most is that we've been working on something that has never been done before. We felt like pioneers in the 1960s trying to reach for the moon.

In one year we've designed and built a half-scale hyperloop prototype, with a capsule that will float above the track carrying eight

half-scale passengers. In January 2016, we were delighted when it was announced that we had won Elon Musk's Pod Innovation Award, and had come second in the overall Design and Build category, earning us the right to enter the test site section of the competition.

Challenges

It's been a whirlwind since then. In June 2016, in the Netherlands, we presented the capsule to the world's press, and that was the best moment for us as a team. Then, in October, DHL helped us transport our prototype capsule from the Netherlands to SpaceX, Elon Musk's California headquarters. Not an easy challenge. First of all it's a big capsule, almost five meters in length. Secondly, we use magnets in the design and there are very strict requirements about magnetic fields in aircraft, so a steel box had to be specially made for them to travel in. The pod itself also traveled by plane in a big case surrounded by foam so it wouldn't be damaged by vibrations.

The Delft pod achieved the highest overall score in January's 2017 tests, winning the Design and Construction Award. The final phase of the competition will take place this summer.

People have concerns that the Hyperloop won't look attractive because it's a tube built on pillars. But in Japan and China they are building railways this way, and they look good. People can walk underneath the Hyperloop so areas don't have to be closed off, like they do for railway lines. Also, less damage is done to the ground in the construction process. One thing is for certain – Hyperloop is coming, and when it does, you'd better be part of it! ■

 www.delfthyperloop.nl

FACT: The Delft prototype capsule weighs just 149 kilograms and can reach a speed of 399 kilometers per hour on the 1.6-kilometer test track at SpaceX in California.

1199 kph
Top speed
of the
Hyperloop

30 minutes
The time it would take to
travel between Amsterdam
and Paris in the Hyperloop





100 MILLION

The number of working hours completed on London's £15 billion (\$19 billion) Crossrail project – Europe's largest construction scheme – now renamed the Elizabeth Line in honor of Queen Elizabeth II. The new route will run more than 100 kilometers from west to east, and will increase the U.K. capital's rail capacity by 10 percent. The middle section, tunneled under central London, is due to open in late 2018. Below the streets of the capital, eight 1,000-ton tunnel boring machines constructed 42 kilometers of new rail tunnels, with 20-strong "tunnel gangs" working in shifts around the clock over a three-year period



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