
TRANSFORM
Akhila Tadinada
Co-founder and CTO, Xemelgo
Prof Henrik von Scheel
Futurist and Industry 4.0 Strategist
SMART MANUFACTURING: A WINNING BET
GOOD FOR BUSINESS, THE ECONOMY, AND THE PLANET
APRIL 2024
#SmartManufacturing
HUAWEI

IN THIS ISSUE, WE LOOK AT SMART MANUFACTURING

www.huawei.com/en/media-center/transform

04 **Editor's Note**
Smart manufacturing is all about playing your cards right.

06 **The bright side of the digital revolution**
When it comes to manufacturing, high-level tech advisor Henrik von Scheel is a die-hard optimist.

12 **I find your data very attractive**
Xemelgo CTO Akhila Tadinada on the allure of operational visibility in the modern factory.

16 **Merging multiple dimensions of tech**
Huawei CTO Tao Jingwen says integration will deliver big advantages to manufacturing enterprises.

19 **Hop on the bus, Gus**
You don't need to discuss much. Just choose the right partner and start digitalizing your operations, says Haydar Vural of Karsan Automotive.

22 **Process manufacturing wants to be smart**
And it'll get there eventually, says Dr. Min Zhou, CEO of Thingple. Here's how.

26 **It's an uphill climb, but the view will be awesome**
MIT researcher Bill Lehr says we're at the foothills of smart manufacturing. Here's what things may look like at the summit.

31 **Fiber to the which?**
To the curb, to the home, to the... assembly line? Absolutely, as FAW, one of China's largest car-makers, has proved.

34 **Manufacturing risk vs. reward**
Dr. Sabine Pfeiffer, Professor of Sociology at Friedrich-Alexander University of Erlangen-Nürnberg, takes a hard look at both.

38 **Nothing could be finer than to drink Moutai in China**
With the best network and the right partners, the country's top baijiu brand just got even better.

49 **Can you find the carbon hidden in your home?**
Probably not. But Keith Wiggins, CEO of Econic Technologies, can tell you how it got there.

42 **From humble beginnings come great things**
Midea is one of the biggest appliance makers – and the most digitalized.

44 **Better and cheaper: the connection at the heart of manufacturing**
Tech is giving factories heretofore unimagined capabilities. A talk with advisor David Vasko

48 **Build Your Dreams with better network infrastructure**
BYD, a top maker of Electric Vehicles, has done just that.

52 **Got Mengniu?**
Driving innovation in bovine lactation.

54 **First slowly, then quickly**
That's how digitalization will transform manufacturing, says Prof. Goh Puay Guan of Singapore's NUS Business School.

58 **Robots need lots of data to work properly. Thanks to 5.5G, they can get it wirelessly.**
Tomorrow's factories will be simple and powerful, says Professor Boy Luthje of Germany's Institute of Social Research.

OPPORTUNITY PROFIT TECH SUCCESS

EDITOR'S NOTE

Tech spells opportunity for manufacturers

Gavin Allen
Editor-in-Chief
Huawei Technologies

Peeking at the world of smart manufacturing can instantly feel like tumbling headlong into a cauldron of alphabet soup.

IMV, MCM, and PAM – and don't even get me started on IWSN, MES, and IIOT. Pity the naïve business leader who thought they "only" had to master those two quintessentially modern letters, AI.

Smart manufacturing is systems, sensors, and cybersecurity. It's fiendishly complex, it's a Hail Mary data gamble – and, of course, it's prohibitively expensive territory to enter.

Isn't it?

At this point, Professor Henrik von Scheel takes a languid draw on his cigar. "No," he tells me, patiently.

"Smart manufacturing is one of the most misunderstood topics," says the influential strategist and self-styled "Godfather of Industry 4.0." "The core element is people. And the core to any successful change in your organization always resides in people's ability to adapt."

The former adviser to the likes of Elon Musk, Steve Jobs, and Angela Merkel quietly dismisses three more letters from smart manufacturing's doom-laden dictionary: ERP.

"Companies treat smart manufacturing like an ERP system. But digitalization should never be focused on processes. If you're spending more than $150k, you're making a mistake, big time."

In any case, an investment of any size is a tiny down-payment on what von Scheel describes as a "humungous" business opportunity. It's already a market that one global analyst valued last year at US$108.9 billion – and estimated would more than double to US$241 billion by 2028.*

Akhila Tadinada is among those who've gone all in. The co-founder and CTO of Xemelgo – which designs software that's "drop-dead simple, so as to not intimidate our customers" – says manufacturing is the lifeline of any country and agrees that people, in turn, are the lifeline of its success.

"Offering access to technology and upward mobility is a huge hiring imperative to hire the best and the brightest," she says. "For lack of better words, to make manufacturing sexy again."

Both von Scheel and Tadinada urge newcomers to start small, learn from any failures, and slowly build out as required. Or: "Do it incrementally," as Rockwell Automation's former director of advanced technology, Dave Vasko, put it to me.

"You'd hate to see people betting their entire business on the outcome of this if they don't really know what they're doing."

But Vasko is excited, rather than cautious, about the future. "Simulation and the digital twin of a factory can provide you information for solutions nobody's ever tried before," he told me. "That can have extreme impacts and be incredibly transformative."

The three enthusiasts are joined in this Smart Manufacturing edition of *Transform* magazine by:

A Turkish bus-design executive who says you either invest in smart manufacturing, or go out of business.

A Singaporean professor who highlights the central choice facing humans: manage algorithms or be managed by them.

A German analyst who hails 5.5G technology as the key to providing a cheaper, more gradual, evolutionary way into factory digitalization.

An English manufacturer harnessing data to create an environment-saving catalyst that "upcycles" carbon and uses it in everyday products.

An American researcher who compares digital transformation to a shark: "If it doesn't keep moving, it dies."

Another global array of insightful thought leaders, helping to shed light on another global technological innovation. And all agree on one thing: Smart manufacturing is revolutionizing our factory production and supply processes. The world continues to *Transform*.

*marketsandmarkets.com's smart manufacturing market report 2023

UNVEILING THE VISION OF SMART MANUFACTURING

Professor Henrik von Scheel

Futurist and Industry 4.0 Strategist

Professor Henrik von Scheel coined the term "**Fourth Industrial Revolution.**" He has served as an advisor on digital strategy at the highest levels of the German government and is currently a sought-after speaker and author.

In an interview with Huawei *Transform*, Professor von Scheel tells Editor-in-Chief Gavin Allen that revolutions unfold in stages – and explains the stage we've reached now.

Gavin Allen: I've seen you described as an unshakable optimist who believes in a bright future. Presumably, your optimism extends to smart manufacturing?

Henrik von Scheel: Manufacturing has never had a better time than now. It has never had so much opportunity in terms of financing, workforce, and automation systems. The wealth of opportunity is immense.

Smart manufacturing is one of the most misunderstood topics. Understanding is driven by what's in the media, but that's like a short-term drug hit. AI is so great now, right? AI is the automation of Intelligence, and when I talked about AI in 2009, they thought I was smoking marijuana. By 2016, they were all afraid AI would take away their jobs. And now AI is, "Oooh, ChatGPT is so important."

But really, AI is in its infancy. Organisms are algorithms [a quote made famous by historian and author Yuval Noah Harari], and the AI revolution will only really emerge full-blown into manufacturing when we decode our DNA and can communicate chemically. Now AI is only based on language models – it's the biggest thief of intellectual capital. It's just stealing content and regurgitating it.

Gavin Allen: So we've never had it so good, and you're confident it's going to get better?

Henrik von Scheel: I'm an optimist because the core element of the Fourth Industrial Revolution is people. And people have the ability to adapt. If you invest in people, you develop skills. Specialized skills become an expertise. When you have several people with expertise, you create capability. You combine capabilities, focus your solutions, resources, and research and development, and develop competency. Competency is what companies compete on – but you cannot change competencies. You can only change and adapt your capabilities. The core of any successful change in your organization always resides in people's ability to adapt.

A capability only lasts for five to seven years and has to be renewed consistently. For example, let's say that you're a really good 100-meter runner. That doesn't mean you can export the same competence to another sport. Running 100 meters very fast will not necessarily make you a good soccer player because soccer players don't run 100 meters in a straight line. Your competency is running fast; the capabilities are what you need to adapt.

Gavin Allen: Why isn't it sufficiently understood that investing in people is at the heart of these advances?

Henrik von Scheel: When we announced the Fourth Industrial Revolution in 2007, we also said it would emerge in eight different stages [see graphic below]. Stage Six will be a consumer revolution that will be as disruptive as AI and will turn the internet inside out.

It will not be the internet you have today. You will decide what comes to you and how you manage your information. The phase after that is the fusion science revolution. The last phase is the quantum reality revolution.

Industry 4.0 is the collision of the digital, virtual, and physical worlds. The centerpiece of that is the human being. It's the merging of 77 megatrends across those eight paradigm shifts. They're disrupting every aspect of our lives: how we interact, how we produce and consume, how our economy works, how the government is structured. It changes everything about the human experience from the ground up. And the core of Industry 4.0 is manufacturing. It changes everything about how we produce, ship, and manufacture.

Gavin Allen: Can you understand why continuous change might be potentially quite scary for a manufacturer?

Henrik von Scheel: Yes, but set aside manufacturing and take your personal life instead. Everything in your life is unhinged. You don't trust your banking system today in the same way you did 15 years ago. You don't trust businesses, churches, governments, or the media in the same way you did 15 years ago. All the stable pillars we had in our lives are gone.

> "Managing the present and designing the future have become core skills."

The same goes for companies. Every stable element they had was unhinged. But adapting to something is how you thrive in uncertainty. Managing the present and designing the future become core skills.

Gavin Allen: But how do you get a company to appreciate that and prepare for it?

Henrik von Scheel: The core of a company is never a product. Again, it's people. People have the ability to adapt, to build the expertise and skills needed in their market. Companies don't need to make it more complicated than it is. But they are often structured in silos. Between 70% and 85% of projects don't conclude on time, produce any value, or deliver on promised revenue streams. They're just projects to fix problems, bottlenecks, and challenges.

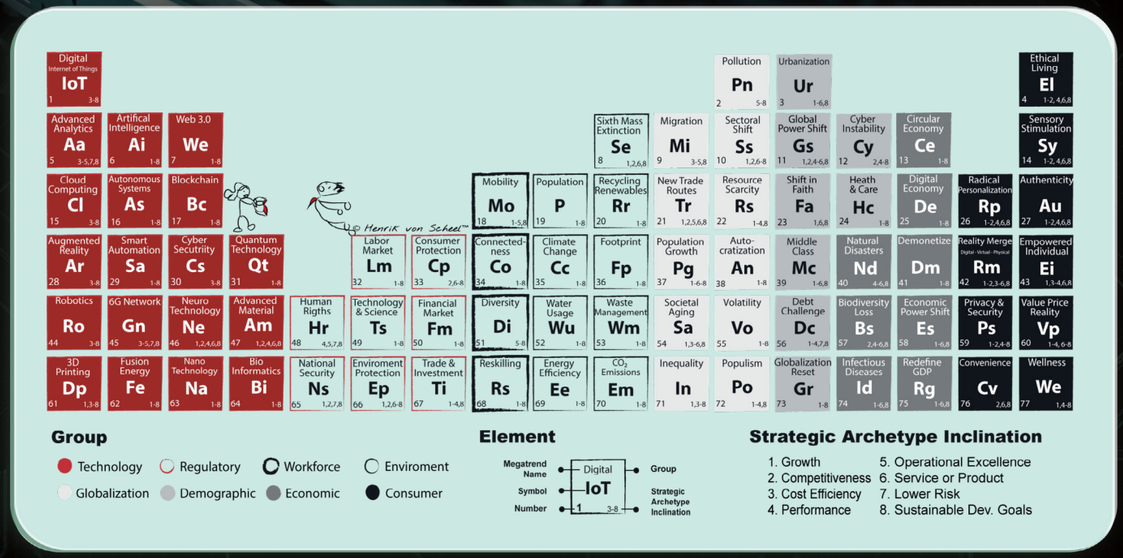
But an executive is designed to manage the future. Innovation only happens in times of uncertainty, when you don't know what to do, or when you make mistakes. Most companies talk about innovation, but they also do transformation. Using ChatGPT can help you integrate, optimize, align, and transform, but it will never bring you innovation. Innovation can only come from people.

Gavin Allen: Are you saying not enough companies, even in the smart manufacturing field, are being smart?

Henrik von Scheel: Manufacturing is not very mature for digitalization because companies treat it like an ERP system, focusing on processes and costing US$2.5m to US$10m for a digitalization project.

Digitalization should never be focused on processes. Nobody cares about HR or financing digitalization. I tell companies, "If you're spending more than $150k, you're making a mistake, big time." For the first $15k, you gather your teams together: Where do I need to connect and sensor? What is the workflow I want

> Industry 4.0 is the collision of the digital, virtual and physical worlds.



to measure? You focus on smart automation, sensoring, and agile workflows, and you connect the systems with robots and people.

The system and the robots give you input. But the main governing elements in digitalization are the people and the workflow. Digitalization is always related to people. Then, you do digital engineering. You have your customer-centric data, engineering data, product data, the life-cycle management of the products, the shipment, the supply chain, your digital twin, and you combine them all into one to integrate and optimize because now you have your main workflow. This should cost you around US$30k to US$45k. Then you commit US$50k to US$100k on the shop floor, integrating it into your execution and operating management systems. You're connecting to your workflows, putting a robot in the 3D printer, using AI production measurement systems. And then you're done. If you do it from the system up, you are failing by design. The process does not matter. It's the workflow that matters.

Gavin Allen: What's the opportunity waiting for manufacturers if they actually implement this correctly?

Henrik von Scheel: The opportunity is humungous. You can save up to 25% on your HR and financing costs immediately through robotic process optimization. Do digitalization on everything that is complex in nature – supply chain, warehouse management, and everything in your main workflows, and you can save around 20% to 50% on your productivity line.

But you have to invest first to get it out. And you have your tactical operations, where it's performance and value governance. And CBAM is coming [the EU's Carbon Border Adjustment Mechanism, a tariff on carbon-intensive products], so for any product you source or any product you export, you need to go through your value chain to do things smartly. You need to be proactive. For most manufacturers, CBAM and regulatory disruption are like a fog they cannot see through. The normal manufacturer will not spend two hours reading the CBAM document because, after five minutes, their brain is exploding. But it's an additional tax of 15% to 20%. Tell me a manufacturer that can take 15% to 20% away from their profit margins. It will bring most manufacturers to the ground – and the golden rule is that they are not allowed to increase the product price. Any company not prepared by this October will be surprised – they will freak out.

Gavin Allen: Investments need to be made, but an awful lot of savings and future-proofing can be gained. So, why isn't smart manufacturing universal?

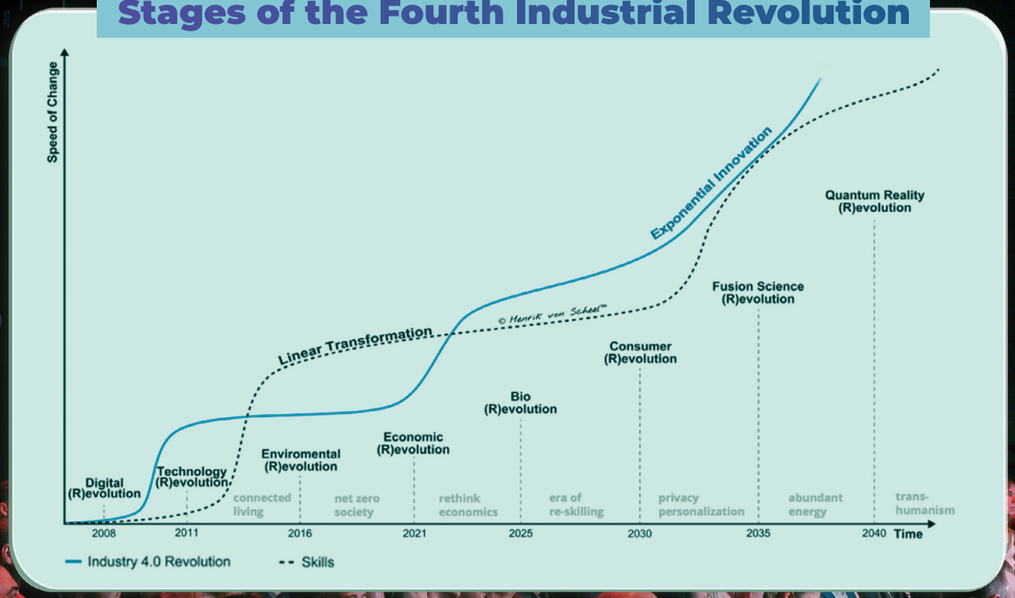
Henrik von Scheel: Manufacturing has some of the hardest-working, most skilled people. But it's also the industry that invests the least in project management – and in people as well. People within manufacturing are promoted to their level of incompetence, according to the famous Peter Principle. They are really good with people and know the company inside out, but suddenly they're promoted and they don't have the skills they need. They have been promoted to incompetence. But it's not their fault.

Gavin Allen: What's your advice to companies looking to embark now, or wondering whether they should embark, on that smart manufacturing journey?

Henrik von Scheel: My tip is to embrace the challenges, invest in skills and people, and accept failure. We have become schizophrenic: we are afraid of failing, but in failure resides innovation. You have to fail to succeed, but failing is not accepted in society today. I always advise executives that when they're deciding which door to go through, if it's a door you cannot exit again once you've gone in, then don't go in. As an executive, you must be able to open the door, walk in, and go out again because you need to be able to learn. You do your digitalization projects, and it's okay to fail at two or three things, because your team needs to learn and be very good at them.

My advice is to see it as a game. Competitiveness and strategy are games. You must allow yourself to go back and do better. But in summary, for people and manufacturing, we do live in the best times. We have never had so much money, so much possibility, so much free time, and so many equal rights. Everything we have today is greater than ever before. Yes, the future is challenging, but innovation resides in people, and we will find the way.

Stages of the Fourth Industrial Revolution



> "We have become schizophrenic – we are afraid of failing, but in failure resides innovation."

“MAKING MANUFACTURING SEXY AGAIN”

Why it’s smart to fall in love with tech

xemelgo

Akhila Tadinada

Co-founder and CTO
Xemelgo

The right tech is giving manufacturers visibility into factory and warehouse operations. It could also help them attract the best and brightest employees.

What does Xemelgo do?

Our software provides real-time visibility to factory and warehouse operators and eliminates the need for employees to manually enter data.

Companies lack visibility throughout their entire operation. Our customers told us, “I don’t know when things are going to get done or if they got moved at the right time.” So, we offer four applications: one for inventory tracking, one for work-in-progress tracking, one for tool tracking, and one for shipments.

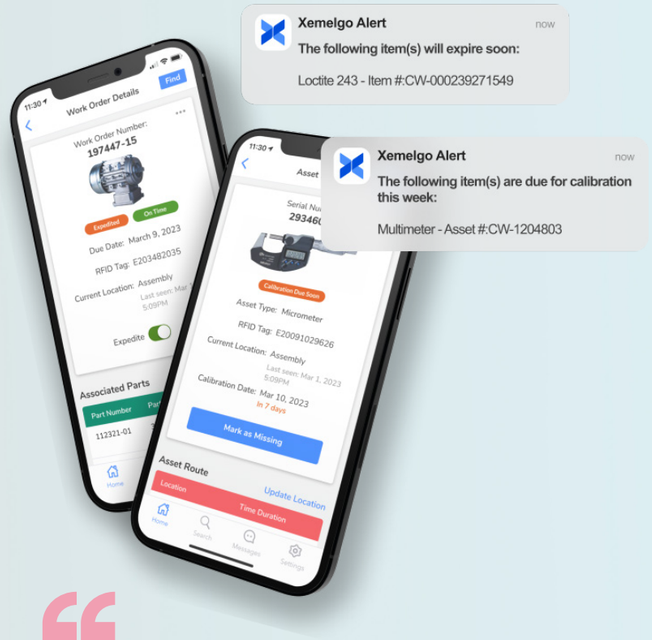
It’s all pre-built; there is no IT infrastructure to set up. Once you plug in and start [RFID] tagging things, the data starts flowing to our platform. We start giving you real-time operational data right away. It’s pretty much up and running in less than half a day, which is like setting up your Alexa or Google Home but in a factory or warehouse.

What does that do for the customer, and how is your offer distinctive within a very competitive market?

Sensor data effectively is dumb. What does it tell you? “I’m tag number 123, and I’m here.” Does that mean my inventory has gone up or gone down? You have no idea.

So we give you business data. We tell you, “Hey, your blue paint can has come through the door, and you have enough blue paint. But you only have three more cans of red paint, so you’d better replenish that.”

Previously, how did somebody know they were low on something? They pretty much had a person sit down and count everything once a week or once a month. It was time-consuming. But now we look across their end-to-end operation,

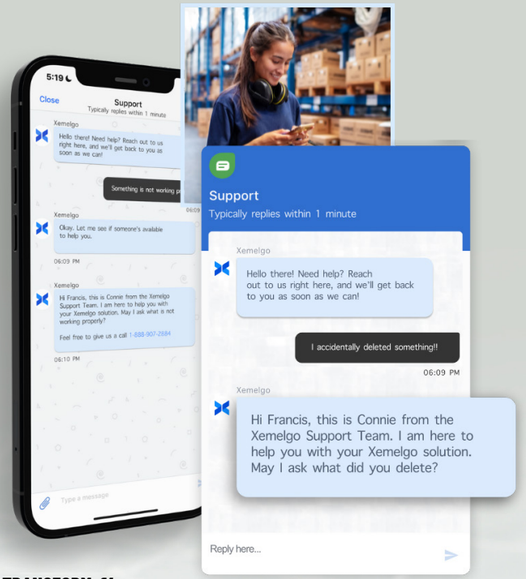


“Our installs are up and running in half a day. It’s like setting up Alexa or Google Home but for a factory or warehouse.”

and we can tell them if there are bottlenecks emerging on the floor, if their shipment is delayed, if their finished goods haven't made it to the customer. This all happens in real time, without human intervention.

How do you stop them from being swamped with data? How do you sift through it for insights?

To the end customer, it's a black box. Every second, the sensor wakes up and sends real-time data – there's millions of data points. We built an extensive backend that de-noises and de-duplicates that data. So, when the customer logs into our UI, all they really see is how much inventory they have or what their bottlenecks are, or, "Here's an alert." They really don't see all the data being captured because, to them, it's meaningless. They just want to know if something needs to be taken care of.



How do you address questions about security and privacy?

It's central to every conversation that we have with customers – and we work with top Fortune 500 and Fortune 1,000 automotive, space, aerospace, and defense companies, so our customer base is the most paranoid when it comes to security. We are secure by design: everything from the connection from the reader to our cloud software is all encrypted in transit. Our data is also encrypted at rest. And we're not transmitting any sort of PII, or Personally Identifiable Information.

What challenges do manufacturers face when implementing a smart manufacturing solution?

We've designed our software to be intuitive and simple so as not to intimidate our customers. Most software is built for manufacturers, not with manufacturers. We work with them and say, "Tell us your problem, we will co-create a solution with you, and then we'll take it to other manufacturers."

> We put sensors on your parts, tools, work orders, and shipments – everything that moves in and out of the door.

The customer really feels they've been listened to, and that's the first barrier to cross. We also always ask our customers to take a crawl-walk-run approach. Don't try to boil the ocean. This is not an ERP implementation where you have to change everything overnight. Start with a small area, set up sensors there, and pick the hardest problem for you right now. Learn from that, then move on to the next step.

We keep it super simple – not trying to complicate the software, really designing it for factory floor operators and truck drivers. Small details matter: we keep our buttons really large because it's easy for people to fat-finger stuff. And with an aging population, we need to make sure the font is visible to them. It's about a very human-centered design.

You've said that manufacturing is just getting started when it comes to ICT. Where do you see the journey going next?

With global competition, you can no longer just run businesses whichever way you want. You have to be extremely competitive when it comes to your efficiency and at what rate you're able to build things. Here in the US, there's a renaissance going on in manufacturing, with a lot of on-shoring. But there's also a labor shortage, and if I get skilled people, if I get millennials, they don't want to come in and be typing stuff or writing Excel files. So, offering access to technology and upward mobility is a huge hiring imperative to be able to hire the best and the brightest. For lack of better words, make manufacturing sexy again.

> Manufacturing is the lifeline of any country.

Secondly, everyone is gung-ho for AI right now. But AI and machine-learning are only as good as your data. It's garbage in, garbage out. We now provide machine learning models for customers to do real time inventory and production forecasting. We look at consumption and production trends to arm the supervisors on the floor with data on how they can best serve their customers. Think of an operator or a sales guy on a floor trying to figure out which SKUs (Stock Keeping Units) they need to replenish. There's 40,000 SKUs sitting out there, and all they can do is run a bunch of Excel reports and PivotCharts to figure out how they should replenish it. We now have a large language model, a ChatGPT UI, where you can ask: "What SKUs require replenishment? What else do I need to do in order to serve this customer?" And it pretty much runs those queries for you in a big machine-learning model and then comes back with answers in human-readable form.

So, like NVIDIA founder Jensen Huang, I think AI is going to make software more human. It is actually going to reduce the barriers to entry. Before this, unless you were a data analyst, you couldn't really be an effective sales guy because you couldn't punch through all of this data. But now, if AI can call on all your data, it makes it a lot more human because people who are not tech-savvy can still serve their customers the right way.

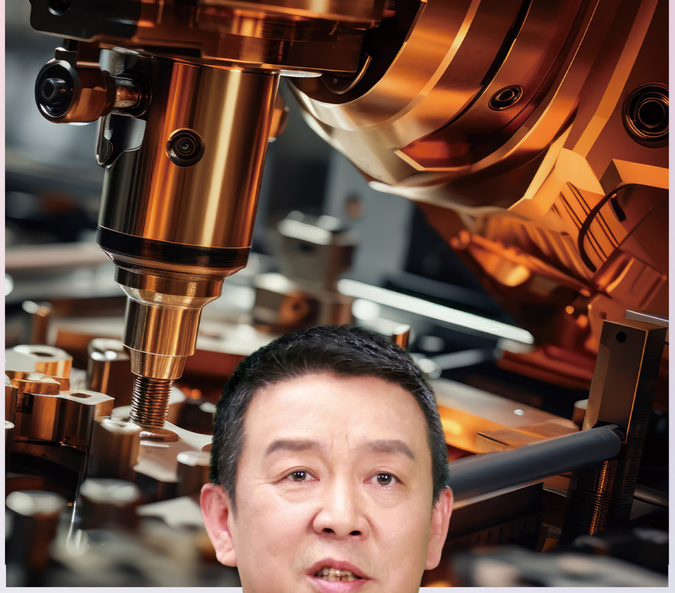
The greater the tech gets, the more human the process potentially becomes?

Yes, it really comes down to enabling operators to do their best job. Manufacturing workers are some of the most dedicated and hardest-working professionals anywhere. But they are riddled by inefficiencies. And I'm not one of those who believes AI is going to take over our jobs – particularly physical jobs. Those are going to stay. There are operational experts who make spacecraft parts and satellites, and to design these things – we will always need people at the center of this. But we need to ensure that they can do their best work by giving them the best form of assistance. That's what IoT, machine learning, and AI can do. If you subscribe to the idea that all of these jobs will be taken over by robots, then go visit a factory floor. To get these robots to work effectively requires a lot of very talented humans...

So, what holds businesses back from digitalization? What is your message to those who resist it?

A lot of the resistance is because it's like crossing the chasm. Manufacturers want to see their partners and competitors doing this before they take the step. They don't want to be the first ones putting their foot out there and then having a false start or a failed project... That requires leaders to really encourage innovation and risk-taking. Again, don't boil the ocean. Start small. Start with your hardest problem. If you empower the right people in the right places, the right results are going to happen.

A HOLISTIC PERSPECTIVE ON SMART MANUFACTURING



Vertical, horizontal, and security integrations fuel manufacturing innovation and growth

In *The Year in Tech 2024: The Insights You Need from Harvard Business Review*, scholar David De Cremer wrote, "This year, tech is driven not primarily by new technologies, but by new integrations that are more advanced and efficient in existing technologies." This is especially true for smart manufacturing, a field marked by the integration of ICT (information and communications technology) and OT (operational technology). The merging of previously separate domains is creating digital production lines that are more efficient and adaptable than anything seen previously.

Tao Jingwen
Board Member and Chief Information Officer, Huawei

Huawei has over 30 years of experience in manufacturing and has accumulated a large amount of data that can support the innovation and evolution of smart manufacturing. Since 2015, we have been upgrading our production systems to make them standardized, automated, digital, intelligent, and capable of continuous improvement. We have summarized this upgrade as a program of "vertical, horizontal, and all-around security integrations."

Vertical integration: connecting all elements through the industrial IoT

When they think about smart manufacturing, many enterprises tend to focus only on the production process flow, including factory automation, process improvement, and efficiency gains. Huawei, by contrast, has created two other flows for smart manufacturing.

The first is the engineering data flow, which integrates and digitalizes design and manufacturing activities. This means digitalizing the entire process, from product R&D and innovation all the way to manufacturing. The engineering data flow has shortened our product development and trial-run period by 20% and cut manufacturability problems by 30%.

Second is the business information flow, which visualizes customer order information, allowing us to deliver products more quickly to customers and partners. Through the business information flow, we have achieved large-scale customization, intelligent and balanced production scheduling, and on-time material kitting based on customer requirements.

Horizontal integration: efficient collaboration and interconnectivity

A cross-industry smart manufacturing value chain has already taken shape across the globe, with high-level division of labor and collaboration. This means manufacturing enterprises must expand the boundaries of their data and exchange data with their suppliers, partners, customers, and even other industries.

To that end, it is essential to realize effective data sharing between industries and enterprises while ensuring they respect each other's data sovereignty. Data is inherently non-exclusive and easy to disseminate and replicate. It is also difficult to confirm data ownership and assess its value. As a result, there is naturally a lack of trust between enterprises when they exchange data.

To address this problem, we have developed an Enterprise Data Space (EDS) that enables us to exchange and share data with ecosystem and industry partners. The EDS can clearly define data responsibilities and ownership and effectively control data flows and exchanges between enterprises and industries, thus realizing efficient interconnectivity throughout the value chain.

Security integration: An all-around security system based on zero trust

An integrated manufacturing system connects an enterprise's employees, devices, and applications, carrying vast manufacturing data. When attacked by hackers, such a system faces the risk of information leakage and may even cause production to be halted.

Just as more powerful train engines require better braking systems, larger smart manufacturing systems require better security.

Huawei implements the hierarchical management of multiple scenarios and security domains based on zero trust. Our zero-trust security solutions and services have helped us build one-stop security detection and operations capabilities and ensured the security of the entire manufacturing system by overseeing manufacturing security strategies, private manufacturing networks, machines, segment-based application isolation, and impact control, and by perceiving and tracking the dynamic situation of manufacturing security.

AI, the biggest transformation of the modern era, is reshaping the traditional manufacturing model. Based on algorithms and large-language models, we have integrated high-quality enterprise data with manufacturing scenarios to develop powerful applications. For example, we have incorporated AI into equipment processing for intelligent visual inspections and programming equipment. We have also integrated AI algorithms with process know-how for smart recommendations of dispensing parameters, welding parameters, and so on. Furthermore, we have integrated AI with manufacturing know-how to build a knowledge foundation model and an intelligent assistant for the manufacturing industry.

> AI is reshaping the traditional manufacturing model.

Jumping with a parachute, we made ourselves

Huawei has dived deep into smart manufacturing and launched smart factory solutions for the manufacturing industry. Our solutions that integrate IP, industrial PON, 5G, and other technologies can facilitate the seamless connection of equipment on a large scale across multiple scenarios. With a data collection efficiency of 1 million data points per second, our solutions have connected the engineering data flow, business information flow, and production process flow. This has effectively supported enterprises in transforming production models, improving production efficiency, and promoting green and sustainable development.

Vertical, horizontal, and security integrations have fueled manufacturing innovation and growth, and the incorporation of intelligence into manufacturing brings several advantages for both enterprises and their employees. Enterprises can now better understand the market, more accurately allocate resources, and make more scientific decisions during operations and management. Employees can work more efficiently and constantly innovate. Eventually, these developments will help enterprises gain more competitive advantages for future development.

START SLOW, BUT START NOW

Smart manufacturing is no longer optional, says this Turkish executive

Haydar Vural

Chief Digital Officer, Karsan Automotive

What does Karsan Automotive do?

Karsan designs and manufactures electric, hydrogen, and autonomous buses, from six meters to 18 meters long. We sell them in Japan, the United States, Canada, and all of Europe, including Türkiye.

We've also provided manufacturing services to companies such as Hyundai and Peugeot, and right now, we have a manufacturing partnership with Renault.

What's your mission as Karsan's Chief Digital Officer?

I'm responsible for using digital technologies to ensure that Karsan is competitive, has very good brand awareness, and manufactures high-quality buses. Our business model is very different from that of traditional car manufacturers. Each municipality or government transport institution wants buses specially designed for them – not standard ones. So, we have to be digitally flexible and strong, and our quality has to be top-level.

What difference has smart manufacturing made to your production process?

To be a smart manufacturer, you first have to collect data from your Tier 1 suppliers for your manufacturing plants and after-sales services. You have to gather data when the bus travels around so you can learn about the product and then reflect the lessons back into the new products you're designing. If you don't manage your data, you'll suffer delivery delays and supply chain shortages. When we make a promise to a customer, we have to keep it.

And how is Huawei helping you in that process?

We have a strong partnership with Huawei. They provide IT infrastructure – for example, we run our applications on their servers and store our data on their equipment, which is maintained locally, making it secure and accessible at the same time. Security is critical for us. Ransomware attacks, for instance, are a serious problem for lots of manufacturing companies. Criminals attack them rather than targeting banks, financial institutions, or insurance companies with a stronger cybersecurity culture.

They're potentially the weak link.

Right. But Huawei ensures that our customers have ransomware protection automatically. We're also planning investments in computer networks, wired and wireless networks, and our data center. In Türkiye, for example, Huawei has a wonderful local presence, always listening and seeking to ensure the best customer experience. Just comparing cost and performance versus their competitors, I can honestly say Huawei is a top performer. And their long-term vision to develop the products makes them unique: their second-biggest R&D team after China is in Türkiye. This also makes us very happy.

What is your ambition for the company five years from now?

Well, the amount of data created within our existing buses is enormous. We have to capture that, filter it, send it to a cloud, and then process it for after-sales service.

The R&D life cycle of the buses is very, very long, so you need that working product data to shorten your design time, keep your costs down, and stay competitive. There are, for example, significant performance differences depending on the environment in which an electric vehicle is operating. Driving in the Swiss Alps is quite different than driving in Saudi Arabia.

Also, even small-town authorities want customized bus products, but customization can only be achieved through smart manufacturing and information-gathering from the working product. This is our focus.

What are the challenges to going down this smart manufacturing road?

First, it's not cheap. But if you don't invest, you will be out of business. So, you don't have an option, and therefore you could argue it's not expensive.

Second, beginners or those unfamiliar with IoT and smart manufacturing are sometimes just following fashion or trying to target niche markets instead of focusing on core business objectives. This isn't the way. My advice for someone new in this business is to choose the right partner and start slow (but don't wait another two years to invest).

Instantly establish a core team in your company and, when making a transformation like this, understand the three key elements: your people and culture; the technology; and the business outcomes. Change that order, and it won't give you the results.

If you invest half a million euros and buy some products, but without the right technical people to transform that into business outcomes, then you're doing nothing. Unfortunately, I have seen many instances like that, and they've not been good investments.

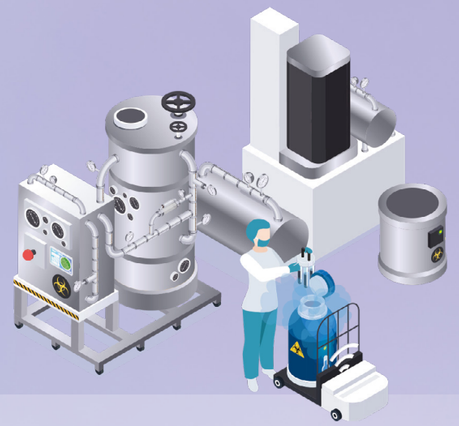
Smart manufacturing has to be combined with AI to predict the life cycle of your machinery, your battery lifetime, etc. It's about collecting data and investing in technology, but also about focusing on profitable projects, not the tiny ones or the Proof of Concepts. Do it right, and you'll make money. Do it wrong, and you'll disappear.

> "Choose the right partner and start slow (but don't wait two years to invest)."

> "Do it right, and you'll make money. Do it wrong, and you'll disappear."

WASTE NOT, WANT NOT: BRINGING INTELLIGENCE TO PROCESS MANUFACTURING

Dr. Min Zhou
CEO, Thingple PLC



Process Manufacturing

- Formulas or recipes are used to make products
- Products cannot be reduced to to their raw components
- Produced in batches
- Involves mixing, churning, grinding, boiling, etc.

Discrete Manufacturing

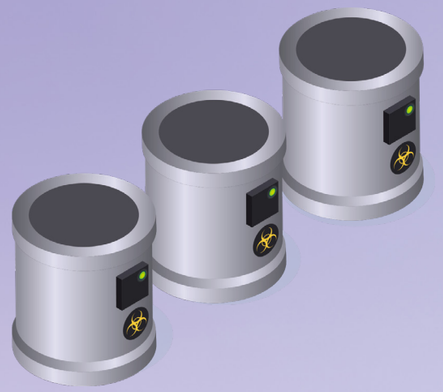
- Products are made up of touchable and countable components
- After manufacture, parts can be disassembled and disposed of or recycled
- Bills-of-Material are used
- Builds in a linear or routed fashion
- Involves assembling, fixing, joining, and other such operations
- Doesn't involve change of volume or density

Smart manufacturing is a hot trend these days. But its effects have mostly been confined to what's commonly called discrete manufacturing.

Discrete manufacturing makes things you can count: cars, toys, and vacuum cleaners. Component parts are conveyed on belts, rails, or production lines. Separating one product from another is easy.

Process manufacturing makes goods in bulk, such as cosmetics, soap, and paint. Raw materials are stored in tanks or vats and conveyed through pipes or pumps from one part of the factory to another.

Process manufacturing has the potential to get smarter, and eventually, it will. In the meantime, it faces several challenges.



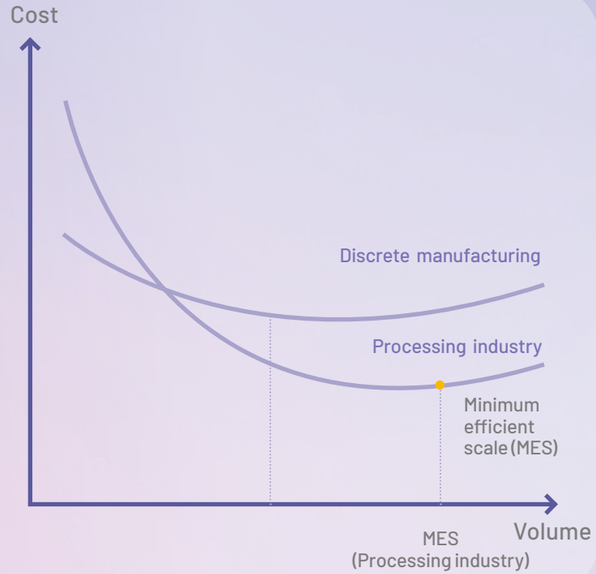
> In processing plants, about 10% of existing chemical stock is wasted daily – about a ton of waste per day.

A labyrinthine process

First, it's hard to digitalize what you can't count. Keeping track of pens, phones, toys, and washing machines is a relatively straightforward matter. By contrast, things like paints, gels, and lubricants are measured by weight or volume. They come in containers whose weight must be subtracted from the weight of whatever is produced.

Second, economies of scale are achieved only at very large volumes. Once a plant is built, manufacturers have an incentive to produce at maximum capacity. Plants are often huge, and exact volumes are hard to track, making it difficult to operate efficiently.

Third, products such as paints, cleaners, and lubricants have expiration dates, as do their ingredients, – all of which must be discarded once they expire. In processing plants, about 10% of existing chemical stock is wasted daily – about a ton of waste per day.



Make it measurable

Making discrete manufacturing "smart" is one thing. Doing the same for process manufacturing requires a completely different approach.

Granted, you could use 50-year-old barcode technology to digitally track uncountable goods. But workers would have to scan those goods manually. That's inefficient and increases the chance of human error; a single item must be scanned more than 20 times as it moves through a warehouse.

Thingple's solution uses RFID technology to track goods and update factory managers on their progress. RFID can duplicate everything that a barcode scanner can do, but at greater distances and without the need for a line-of-sight connection. It can also scan hundreds of labeled containers at once, accurately, while barcode readers can only handle one piece of inventory at a time.

This way, digitalization makes process manufacturing more precise, trackable, and easy to measure. That, in turn, reduces waste and makes operations more efficient.

> It's hard to digitalize what you can't count.

R.I.P. manufacturing waste

Here's an example: adhesives and their ingredients have expiration dates. As mentioned, 10% daily wastage of chemical stock is typical. One ton of daily waste is 30 tons a month – an expensive, environmentally unfriendly problem.

With a digital tracking system, goods on the verge of expiry can be used first, so they won't have to be thrown away.

A digitalized processing factory will also use analytics to precisely measure the weight and volume of goods shipped. When connected to a sales and delivery system, the production line can react quickly to changes in demand. That means even a gigantic factory will have a better handle on how much of its products are needed, allowing it to produce only as much as necessary.

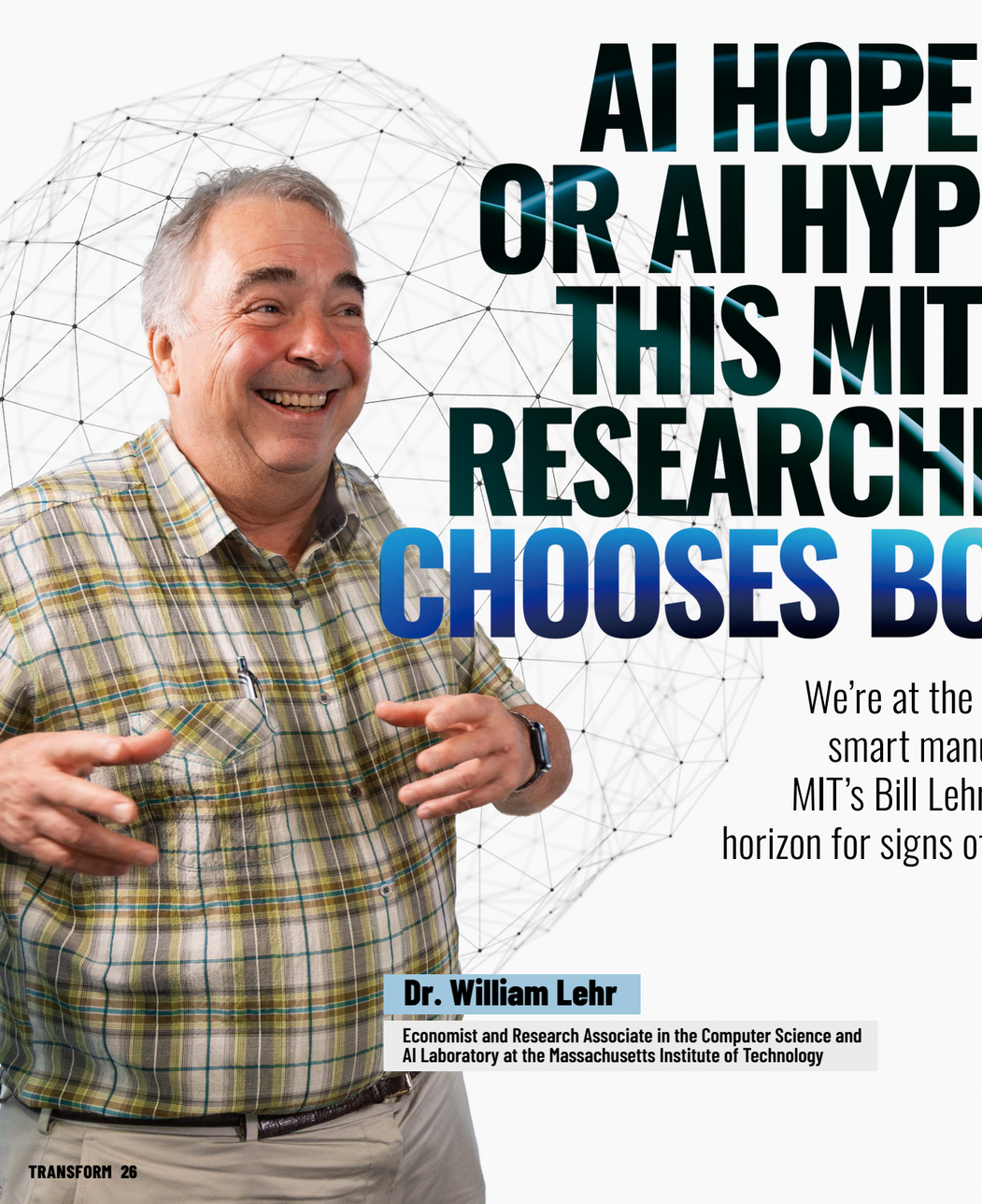
When goods can be located digitally, forklifts will travel shorter distances to reach them, leading to smaller carbon footprints. And of course, less paperwork means fewer trees are cut down.

Even if you reduce the 10% daily waste to just 5%, you'll prevent 15 tons of chemical waste a month – 180 tons of waste each year.

By embracing the principles of connectivity, precise measurement, and digital technology, the process manufacturing sector can not only improve its operational efficiency but also play a pivotal role in mitigating environmental impact. Ultimately, it's a win for everybody.

AI HOPE OR AI HYPE? THIS MIT RESEARCHER CHOOSES BOTH.

We're at the foothills of smart manufacturing. MIT's Bill Lehr scans the horizon for signs of progress.



Dr. William Lehr

Economist and Research Associate in the Computer Science and AI Laboratory at the Massachusetts Institute of Technology

William Lehr: I don't think the economic impact and potential of 5.5G is sufficiently understood. 5.5G is part of a trajectory; it's a vision. Robert Browning said in a poem that a man's reach should exceed his grasp. The technology of this whole industry, and of wireless, digital transformation, is a bit like a shark. If it doesn't keep moving, it dies. But part of the issue is that the value case for the specific applications of development and evolution is a bit of a bet on the future. It's an incremental thing that's happening in a bunch of different steps – a vision of where we're going. But because different people disagree about what those incremental steps are, they still aren't adequately understood. And there are a lot of problems confronting the industry.

Gavin Allen: Such as what?

William Lehr: Well, to deliver the kind of capabilities that 5.5G aspires to deliver, advances are needed in a bunch of areas. You need a next-generation network, and a lot of policy folks seem to think all that means is broadband and fiber connectivity. But no. If you want the capabilities to do the things that are really interesting – virtual reality, autonomous vehicles, extended reality, digital twins – then you need computing resources. Those resources have to be integrated with the connectivity. The kind of connectivity you need is very different in a factory setting where you have little widgets talking to other widgets that may eventually be talking to a human in some more complicated way.

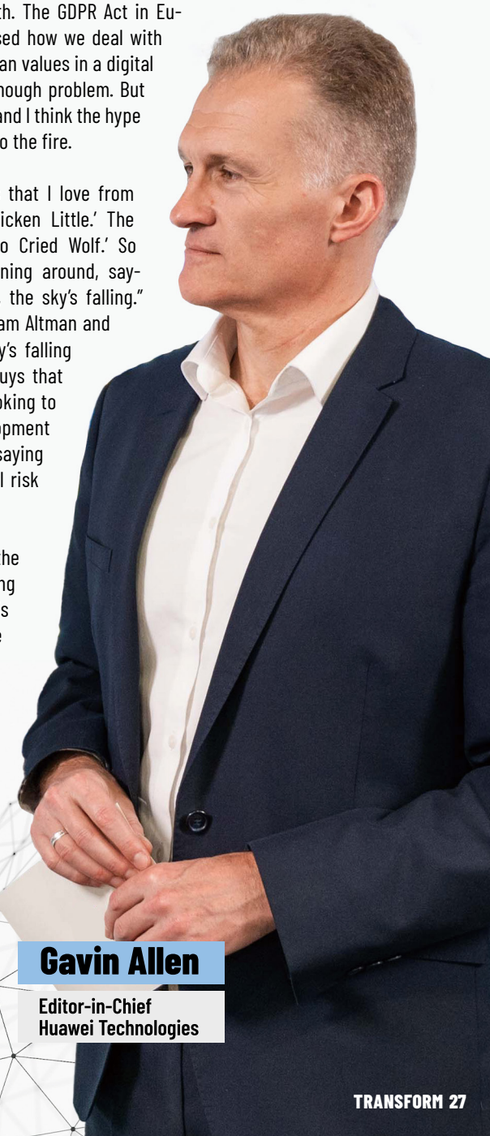
Everybody in a digital economy needs to be digitally enabled, and all business functions and processes will be impacted. AI is really about the capability to deliver smart applications and to allow the great IT that's already out there – much of which is not AI – to be configured and to introduce applications into market situations or contexts where previously the smart digital applications were not economically viable because the cost of adoption would have been too high. AI can help solve those problems. If this stuff becomes infrastructure, as will be necessary in a digital economy, then, as infrastructure, it'll become the thing you're not aware of until it doesn't work. Then, when it doesn't work, you'll be angry.

Gavin Allen: So, are you a hope or a hype man when it comes to AI?

William Lehr: I'm both. The GDPR Act in Europe basically addressed how we deal with privacy and basic human values in a digital world. That's a hard-enough problem. But AI is about everything and I think the hype added too much heat to the fire.

There are two stories that I love from childhood. One is 'Chicken Little.' The other is the 'Boy Who Cried Wolf.' So 'Chicken Little' is running around, saying, "The sky's falling, the sky's falling." It doesn't help when Sam Altman and Elon Musk say the sky's falling since those are the guys that the rest of us were looking to for leading AI development efforts. Now, they are saying AI poses an existential risk for the planet.

I do not dispute that the potential for creating a superintelligence is real and could pose an existential risk in the long term. However, we would be so lucky to live so long. Our problems are much more immediate – we're probably going to die from



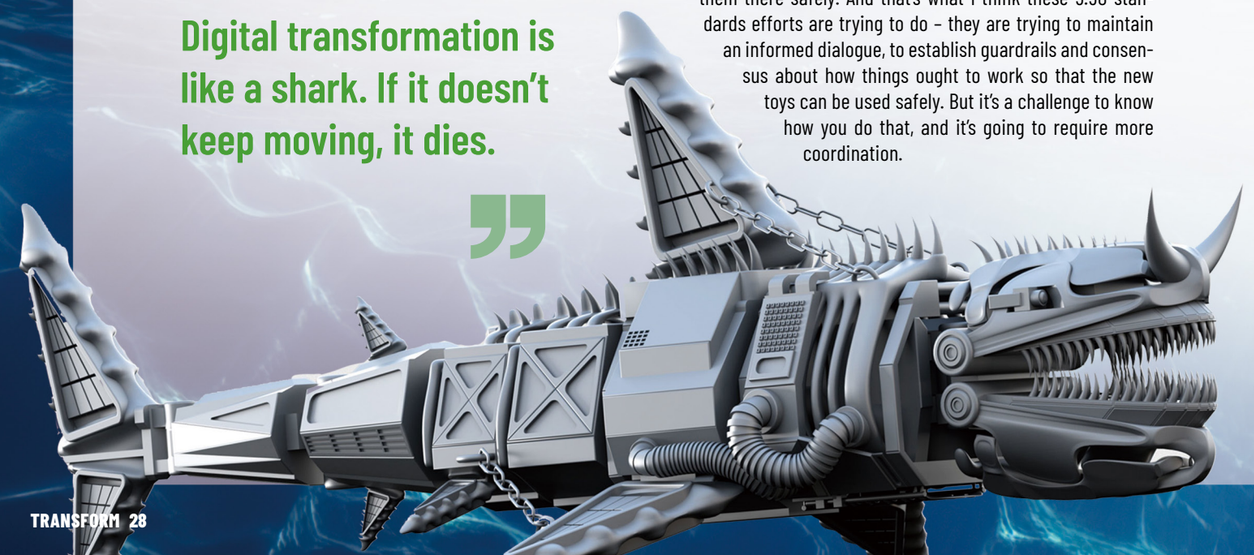
Gavin Allen

Editor-in-Chief
Huawei Technologies

climate change before superintelligence kills us. I don't believe that AI is enough to save us from climate change or the other geopolitical threats that challenge us today and in the immediate future, but I believe AI and digital technologies have to be part of the solution...

And, despite 'Chicken Little,' the sky's not falling. The 'Boy Who Cried Wolf' says that when I push this button, everyone will come scrambling. But when you push the alarm button too many times and nobody comes, folks may decide there are no risks and no need for policy. We do need AI policy, and as a baseline, let's start with the idea that nothing we want our technology to add to the world should be able to do things that, if a human did it, they'd be in trouble. If a human screws around with the financial markets, we've got a whole infrastructure for dealing with that – a really complicated set of rules. The same is true about healthcare and criminal activity, problem domains with existing frameworks for addressing those problems. Those are the places to start. The problem with AI policy is that you're trying to regulate the future, and people are trying to move too fast and aren't listening enough to each other. We need to keep the dialogue going.

> "Digital transformation is like a shark. If it doesn't keep moving, it dies."



Gavin Allen: Is this a high-wire act? Are you worried we're about to tip off one side or the other?

William Lehr: Well, we've been here before – for example, consider the original net neutrality debates, which led to folks arguing whether every bit [of data] should be treated the same, an idiotic misconception of what network management is all about. Obviously, we do not want every bit treated the same, and non-neutral traffic management that excludes bad bits (such as malware) while supporting good bits (i.e., for good traffic) is what you want to do.

Those debates took a decade to resolve themselves. With AI, I think the situation is a bit more like the challenge of supervising a kindergarten: hopefully, there aren't any toys out there that are really going to hurt anybody, and there isn't any kid that's a bully that monopolizes the toys or whacks some other kid in the head. When the kids need to cross the street or go to the playground, the supervisor needs to get them there safely. And that's what I think these 5.5G standards efforts are trying to do – they are trying to maintain an informed dialogue, to establish guardrails and consensus about how things ought to work so that the new toys can be used safely. But it's a challenge to know how you do that, and it's going to require more coordination.

Gavin Allen: So, is there currently a fragmented, rather than coordinated, approach to this?

William Lehr: There's a number of tipping points. People worry about all this automated digital stuff constantly observing you and automating things, asking if humans will lose control, etc. To understand AI, look at the world before the first Industrial Revolution, when nobody had horses or steam engines. Then look at the world after. Only then can you really understand the scale of that change 100 years later and realize, "Oh, the world's totally different now."

Now, we're in the early stages of a Fourth Industrial Revolution, and again, the change is not going to happen overnight, and it's not going to happen evenly. There are going to be winners and losers at every level, both within and across industries. There'll be fast-adopting sectors and slower sectors. And as you push the technology more into people's lives, you're repeating something that happened when we went from mainframes to PCs. That totally changed the way businesses operated, with computers on everybody's desk, which was wonderful in many ways. But the lifecycle costs of managing that situation weren't necessarily better. You know, we didn't immediately get it completely right. And the same thing's going to be true of AI. So, we have to build a measurement ecosystem. You have the users, the applications, the economy, national and regional governments, and international coordination. All those things are moving at different levels, and we need all of them to be talking and to have measurements that work. A technical person may say, "This tech protocol is better because it has lower latency." But an economist goes, "Yeah, but at what cost?" And with all these things, you have to ask: What's the trade-off?

Gavin Allen: Will AI fundamentally transform smart manufacturing processes or simply make them more efficient?

William Lehr: It potentially has a really transformative effect, transformation has significant economic implications for how we organize work, what it means for jobs, and who benefits from the transformation. The evidence says no jobs are safe from potentially being replaced by AI. But that hasn't happened yet, and preliminary evidence suggests it is unlikely to lead to mass unemployment. It's more likely that it will change everybody's jobs.

> "You don't want to give a bully a baseball bat."

So, it won't get rid of lawyers, but lawyers who aren't able to work with or understand how to operate in digital businesses, are probably going to be out of jobs. You'll need to adapt. It is a global world, and we've got too many people on the planet with too many problems that we cannot solve without AI. On climate change, if Africa follows the same trajectory of per-capita GDP growth and per-capita energy consumption as the developed world did through the First and Second Industrial Revolutions, then we're all going down; we're all sunk. The only solution is a more renewable world, and that's going to take a lot of information technology. That issue is replicated across every domain.

With smart manufacturing, one of the questions is: does it allow more onshoring or offshoring of production? The answer is that it's ambiguous. Adopting smart factory production technologies for companies in the developing world can help them get into new markets and upscale what they do. But it also means that if you have production in the US, where labor costs are higher, you can use smart production technology to manage those costs better, and retain manufacturing onshore. AI helps make labor and digital technology both closer

substitutes and complements: substitutes because AI enables more flexible management of factor inputs, complements because AI can augment the productive potential of other factor inputs.

Gavin Allen: And are we still at the foothills of smart manufacturing?

William Lehr: There's actually been a lot done to augment manufacturing with digital technology, and much of that has not involved AI, although AI is finding many more applications in manufacturing processes. For example, AI can enhance robotic process automation technologies and simplify deployment in new environments. AI can help train people who aren't appropriately skilled. Access to such training via AI can be expanded to wider audiences and more folks, bypassing the expense of flying trainees to the U.S. or wherever training was managed in pre-AI/pre-connected times.

> **We've got too many problems we absolutely cannot solve without AI.**

Today, AI applications can help upskill local workers faster and at a lower expense, which makes more markets more attractive for deploying manufacturing processes. What's even more interesting is IoT and the ability of AI to take in a continuous flow of information in ways that humans simply can't do. We have six senses and don't even understand how they work. Now, we can use XR (Extended Reality) to augment them. We can look three blocks ahead, understand what the traffic looks like there – even though nobody can physically see it – and get back and say, as a result of what's happened three blocks away, you want to drive differently here now. That's adding additional senses.

Expanding human capabilities can make a bully worse – you don't want to give the bully a baseball bat. But it can also help the other guy defend himself better. Ideally, what AI offers are expanded and better choices: the kindergartners are happier, they're progressing faster, and they're getting across the street safer. The challenge for regulation is managing the markets and keeping the kindergarten safe, but relying on markets doesn't mean we don't need regulation.

Gavin Allen: It's about devising the necessary regulation.

William Lehr: Yes, one of the metaphors described in the European Union's AI Act, is around the Prohibition era in the United States. Blocking whisky was motivated by the Baptists, social do-gooders who argued that alcohol should be banned because it was harming people. But gangsters were also in favor of banning alcohol. They saw it as a license to steal – which, of course, it was. And there's no evidence that Prohibition actually did anything to stop harmful drinking in the US. It is not that alcohol should be unregulated, but that bad regulation can be worse than the problem it was supposed to address.

Gavin Allen: So, be careful what you regulate?

William Lehr: Yeah. Not that you shouldn't do it; you just shouldn't do it badly. And there are aspects of what they've done in Europe around regulating AI that I would rather they hadn't done. There's been a rush to do something – not helped by people who should have known better and who, in the public policy debate, have been irresponsible. But, if I were a betting man, I'd suggest you're not ultimately going to see anything that looks like what some of the initial proposals were. It'll hopefully be better.

To detect what's needed, we need to build the right apparatus. That means multidisciplinary capacity. We need economists and other social scientists talking more closely with engineers and working together, just as I'm trying to do at MIT.

> Huawei's FTTM network solution has been adopted by more than 20 industries.

FTTM enables smart manufacturing

Automobile manufacturing has been one of the first industries to undergo digital transformation, a phenomenon that has enhanced product development, design verification, quality control, and process improvement.

Last year, First Automobile Works (FAW), a Chinese automobile manufacturer, opened the FAW Technology Innovation Space, a smart industrial campus in the northeastern city of Changchun. Aimed mainly at developing and testing new energy vehicles (NEVs), the facility performs passive security tests and verifications using digital simulations and real vehicles. (Passive security refers to any measure aimed at preventing injury.) The facility also supports testing of electronic controls, human-machine interaction, and vehicle parts.

FAW Technology Innovation Space uses many high-tech systems related to data collection, particularly systems that collect data using high-speed cameras. Each system requires a network with high bandwidth and fixed latency to ensure that concurrent services are transmitted quickly, reliably, and securely. (Latency means delay on the network when traffic gets heavy; fixed latency means the network has a known maximum latency – in other words, a guaranteed performance standard that keeps delay to a minimum.)

For example, high-speed cameras in the labs can generate up to 1000 frames per second, while data bursts may occur on the network, threatening to slow network traffic to a crawl.

Traditional networks use one "pipe" to transmit services, leading to bandwidth congestion. It's hard to accurately evaluate the metrics on traditional networks, so performance can't be guaranteed.

Such shortcomings meant that traditional networks were unsuitable for FAW's Technology Innovation Space.

FAW Technology Innovation Space, Changchun

A future-proof network built to last

To solve this problem, FAW implemented a solution called Fiber to the Machine, or FTTM, which applies fifth-generation fixed network technology to support technology innovation and testing.

The FTTM network uses fiber as the transmission medium. It is immune to electromagnetic interference and corrosion and has a long service life of more than 10 years.

High-density 10G fibers (i.e., fibers that can transmit 10 Gigabits of data per second) extends to each room, desktop, lab, and—crucially—each machine in the entire factory. These high-capacity fibers carry all applications on a single optical network, delivering premium performance.

This allows the system to adjust the service bandwidth and expand capacity dynamically. A powerful network analyzer is also provided to visualize many network metrics and meet the network requirements for automobile development and testing. More importantly, the technology is highly reliable.

For example, the battery lab needs to detect data such as voltage, current, temperature, capacity, and internal resistance, then upload it in real time to a cloud data-management platform. This would be impossible without the ultra-reliable low latency of FTTM.

Fueled by the Huawei FTTM solution, the FAW Technology Innovation Space has created a campus network that features ultra-high bandwidth and reliable services, helping FAW embrace the trend of smart manufacturing.

Redefining productivity

The digital transformation of manufacturing should center on technoloThe digital transformation of manufacturing should center on technologies and devices that upgrade production lines, workshops, factories, and the supply chain. The ultimate goal is to create a smart, dynamic, efficient, and secure system that integrates the virtual and physical worlds.

Thus far, Huawei's FTTM network solution has been adopted by more than 20 industries, including education, healthcare, energy, transportation, and manufacturing, and has redefined their capabilities in the process.

Smart manufacturing represents the ever-increasing requirement of manufacturers for data connectivity and convergence. The FTTM solution can help unleash the potential of digital development by providing stable connectivity and excellent network performance.

TO GET THE MOST FROM AI MANUFACTURING, AVOID SHORT-TERM THINKING

From the shop floor to the university lecture hall, Dr. Sabine Pfeiffer has spent decades studying industrial manufacturing. Now, in the age of AI, she weighs the rewards against the risks.

Dr. Sabine Pfeiffer

Professor of Sociology
Friedrich-Alexander University of Erlangen-Nürnberg

Digitalization is transforming the workplace. What are its main benefits and challenges?

Tough question. First, there is no "one" type of digitalization. Instead, there are different facets of new technologies – from AI to collaborative robotics, from low- or no-code to Industry 4.0.

Secondly, work activities are heterogeneous and complex; the same professions can require very different tasks in different sectors, companies, and even departments. Third, it depends on how much digitalization has been driven forward in a working environment in previous decades. Many companies are only now digitalizing work processes with technologies that have been around for 10 years. Others have always introduced state-of-the-art technology and can therefore really utilize the potential of AI.

But across all differences, there is the challenge of designing digitalization in a way that supports human autonomy and learning ability in the long term and, at the same time, does not leave too large an ecological footprint (a major problem with AI in particular).

The greatest dangers are using digitalization primarily for control or exploiting the supposed short-term potential of replacing humans prematurely without considering the costs of fallback solutions, redundancies, and maintenance (e.g., also necessary for learning systems).

You are one of the few researchers who have looked into the implementation of AI solutions in typical blue-collar environments such as manufacturing. What are your key findings, and what are the main implications you see for businesses?

A typical application of AI on the store floor is predictive maintenance. If the AI is well trained and the maintenance personnel have been involved from the outset, AI can help to predict faults and, for example, forecast the failure of an expensive spare part. What is often forgotten is that even the best AI predictions are never 100% correct. There can be false-positive and

false-negative results. So, qualified maintenance personnel are still necessary.

When implementing AI on the shop floor, companies often forget that it's not just about designing a man-machine system. For example, if the AI predicts a spare part failure, it is not maintenance that orders the spare part, but procurement. But procurement is reluctant to order the expensive spare part because of a suspected impending failure. Who decides whether the order is economically justified at a certain point in time? It is, therefore, very important to always design the organizational processes "around" the AI application. This has hardly been done to date. So, it's not just about "keeping the human in the loop"; it's also about "keeping the organization in the loop."

From your own experience of working on the shop floor and providing technical support to customers in manufacturing, what would you say are the biggest fallacies in the current discussion on AI and smart manufacturing?

The greatest danger lies in truly believing in the intelligence of AI. AI uses stochastic models and makes predictions. You cannot always tell from its results whether they are correct, and you can never rely on it 100%. AIs are learning systems, so they change over time and can unfortunately become worse and less precise.

> **The greatest danger lies in truly believing in the intelligence of AI.**

In production, just as in critical infrastructure or medicine, every decision has real-life consequences, and these are often irreversible. That's why we need to be aware of the limits of AI. Only then can we really exploit its potential and implement it well and sensibly.

How can we overcome these issues?

Above all, those who decide how to use AI must understand its limitations. Unfortunately, managers sometimes naively believe in the omniscience of AI. All too often, they overestimate AI and underestimate the expertise and experience of their employees. It is important to bring both together in participatory implementation processes.

We first need to train decision-makers so that they really understand AI.

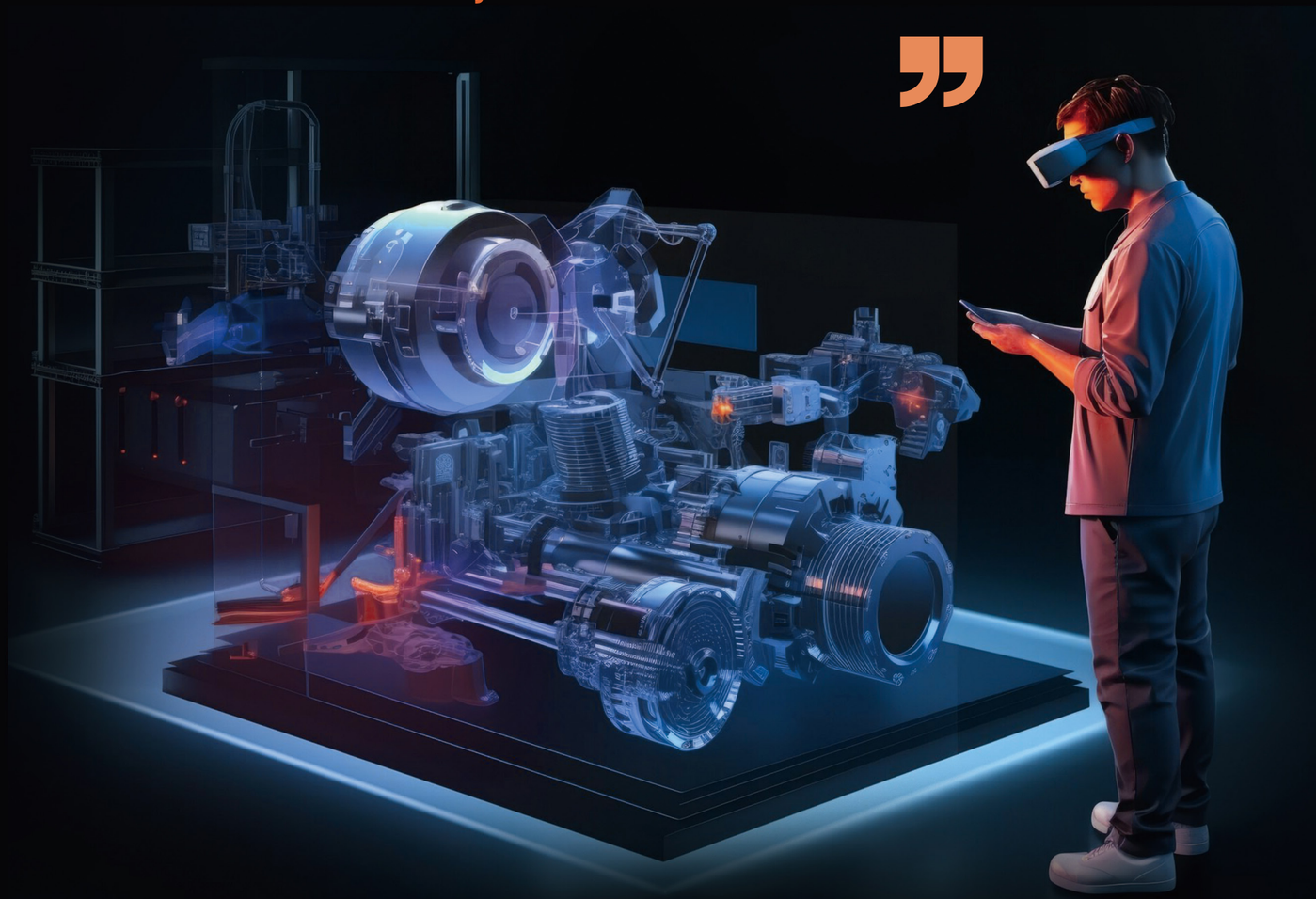
In light of accelerating digitalization, what can policymakers do to promote a meaningful upgrade in working conditions?

When it comes to the use of technology within companies, politicians can only intervene to a very limited extent. But politics can shape the primary conditions of digitalization and mitigate its negative consequences.

For example, it would be important to develop fundamental IT and AI knowledge on a broad scale; no degree course, apprenticeship, or secondary school should be designed without such qualification topics. In view of the coming transformative digital change, it is clearly a political task to organize and broadly ensure the qualification of the population on these topics.

Politicians should create good framework conditions where jobs are lost for further training or retraining those affected. An important factor shaping digitalization in the world of work is also lively co-determination in companies. Thus, it is up to politicians to set the right political course for more co-determination.

> **We need to train decision-makers so they understand the limits of AI.**



HIT ME WITH YOUR BEST SHOT

China's most famous liquor embraces the industrial internet

In the small town of Moutai in southern China's Guizhou province, liquor manufacturer Kweichow Moutai teamed up with Huawei in 2020 to achieve a digital transformation. Three years on, the results are showing.

Fierce and pungent, with an alcohol content of more than 50%, Moutai is arguably China's most famous baijiu – a word translated as "white liquor." There are different types of Moutai, but the higher-end products can go for several thousand dollars a bottle. Because it is so expensive, people usually serve it at special occasions such as weddings, diplomatic functions, or high-end business dinners. Similar to France's Appellations d'Origine Contrôlée, only wines made in the town of Moutai can use the Moutai name.

To create its prized nectar, Kweichow Moutai follows strict manufacturing processes and tightly controls its supply chain. Key ingredients like water, sorghum, and qu (a mix of yeast and mold) are sourced locally. Surrounded by a range of mountains, the Moutai valley has an unusual microclimate with low rainfall but high humidity. Summers are hot, and winters are mild.

Making Kweichow Moutai is complex. The wine is distilled nine times, filtrated eight times, and fermented seven times. It's labor-intensive work.

Then there's storage. The most basic bottle of Kweichow Moutai takes five years to make, and sells for several hundred dollars (if it can be found at all, since demand far outstrips supply). The most promising vintages are aged in earthenware jars for up to 80 years and eventually sell for tens of thousands of dollars per bottle.

A lot can go wrong before a bottle of Moutai is produced. With so much human labor involved, it's hard to control for errors. When wine is aged for decades, it requires constant monitoring to ensure that temperatures never change. Then there is the risk of pilferage from visitors, contractors, or even employees succumbing to temptation: sneak a bottle out of the factory, and you could re-sell it on the black market for hundreds or even thousands of dollars.

> "Deploying IoT infrastructure keeps managers aware of small changes in warehouse conditions."

> "Resting on one's laurels is not the only option."

Digital transformation to the rescue

Deploying a fully-fledged IoT infrastructure keeps managers aware of even small changes in warehouse conditions. When a quality problem is found, it can easily be traced back to ingredient sourcing, failure to comply with manufacturing standards, or some other root cause.

In April 2020, Moutai and Huawei agreed to a long-term partnership agreeing to cooperate in the areas of digitization, new infrastructure construction, and the development of industrial Internet platforms.

The outcome will eventually be "Smart Moutai" wine produced with the help of Huawei technologies, including 5G, AI, and cloud computing.

Digital transformation is a long journey. But when walking into Moutai's production area, a visitor can already see that almost all wine-making procedures are digitally monitored. A new system supports wine storage safety, manufacturing process management, security of premises, fire prevention and response, emergency management, and administrative operations management.

The digital transformation of Kweichow Moutai is well under way, illustrating that resting on one's laurels is not the only option – even when one is already at the top of the market.

WHERE HAS ALL THE CARBON GONE?

You might be sleeping in it, sitting on it, or wearing it on your feet. Keith Wiggins, CEO of Econic Technologies, explains.

Keith Wiggins

CEO, Econic Technologies

Your website says you "transform waste carbon dioxide into valuable materials" used in products such as running shoes, furniture, and mattresses. How does this work?

Econic does not actually capture carbon. Other companies offer that technology – for example, capturing carbon released in emissions from factories and power plants.

We specialize in what happens next: carbon utilization.

Today, nearly all manufactured plastic products already contain carbon derived from fossil-based inputs such as natural gas and petroleum. Refining those inputs involves chemical reactions and combustion that release carbon dioxide (CO2) into the atmosphere.

Econic has developed an industrial process for taking carbon that has already been captured and using it in products, including footwear and other materials. So, if your company makes running shoes that require plastic inputs, our process lets you use carbon that's already been captured, instead of relying on new fossil-based materials that contribute to greenhouse gas emissions.

> **Captured carbon costs less than the raw materials it replaces.**

Does carbon enhance the performance of shoes and other products?

When formulated correctly, products made with captured carbon do perform better. At the same time, captured carbon costs less than the raw materials it replaces. So, it is possible to make higher-performing, more sustainable products that cost less.

What's your business model?

We license a proprietary process and sell a catalyst that companies use as part of that process. Our direct customers are manufacturers who make ingredients called polyols, a precursor ingredient in foams for mattresses, furniture, and footwear. We engage with major mattress and furniture companies, helping them develop comfortable mattress foams that work as well as—or better than—their existing products. Our technology will also be used in laundry detergent and household cleaners.

Can you calculate how much your technology has reduced greenhouse gas emissions?

When used in polyols, our technology can reduce greenhouse gas emissions by up to 30%. It can accurately tailor how much CO2 is utilized in the polyol. The more CO2 used, the better the reduction in greenhouse gas emissions compared to traditional materials.

We also see significant emissions reductions when our technology is used in surfactants, an ingredient in household cleaning products. The LCA results are still pending, but we estimate that full market adoption of our technology would prevent 10 million tons of CO2 emissions annually, equivalent to planting 160 million trees.

> **Our technology could prevent 10 million tons of CO_2 emissions annually.**

Shoes and other products eventually wear out. Does the carbon finally get released when they're thrown away?

When products wear out, recycling is the best option because the materials can continue to be useful and the carbon stays trapped inside. If the products are incinerated (without carbon capture), then carbon is released. That's one reason why many companies are working with each other and with governments to build more recycling systems. Econic is committed to the development of these processes and helping wherever possible.

Smart manufacturing is typically understood to involve the use of data to make production processes more efficient. Does Econic use data in its technologies?

Leveraging data for predictive analytics, operational optimization, and efficiency are the cornerstones of smart manufacturing. Econic's approach integrates data-driven methodologies in manufacturing and in the development of new molecules. While specifics vary, our utilization of data aims to enhance process insight, streamline operations, and drive sustainable outcomes.

FROM BOTTLE CAPS TO SMART MANUFACTURING:

MideaGroup

humanizing technology

From humble beginnings, Midea has leveraged tech to become one of the world's largest home appliance makers

Founded in 1968 as a small workshop for making plastic bottle caps, China's Meimei Group entered the home appliance industry in 1981 by manufacturing small electric fans.

Today, the renamed Midea Group is a global company operating in more than 195 countries. Its 190,000 employees work across business lines, including HVAC (heating, ventilation, and air conditioning), robotics and automation, smart home and IoT, as well as smart logistics and components.

With annual revenue of 373 billion Chinese yuan (US$51.5 billion) in 2023, it is not just one of the world's largest makers of home appliances but also a leading technology group with intelligent manufacturing capabilities.

Midea's pursuit of growth has paved the way for its digital transformation over the past 15 years. In 2018, with the increasing adoption of IoT technologies, Midea began researching ways to connect individual home appliances to a data network. By 2021, it had partnered with Huawei and China Unicom, a telecom operator, to upgrade an existing kitchen appliance factory to a 5G-powered smart demonstration site in southern China's Guangdong Province.

This innovative project has made progress in intelligent warehousing, intelligent vehicle management, and AI-intelligent monitoring.

Building intelligent factories

By the end of 2021, Midea had begun working with China Mobile and Huawei to launch a fully 5G-connected factory project in Hubei Province. This was the first time Midea applied 5G to all industrial production and business operations in one of its factories. Private 5G networks cover all production and warehousing areas, providing connections for production and processing, quality inspection, operation and maintenance of equipment, environmental health and safety, and energy monitoring.

The benefits from the project are tangible. It now takes just 15 seconds for the production line to make a single washing machine. The factory also doubled its delivery rate, cutting inventory in half and reducing labor costs by 30% per unit. In February 2023, the project won the "5G Industry Partner Award" at the GSMA Global Mobile Awards, earning industry recognition for comprehensively integrating 5G and smart manufacturing.

In 2023, Midea cooperated with Huawei to upgrade its production campus network in Foshan, Guangdong Province. Using advanced industrial network architecture, Midea aims to achieve ubiquitous interconnection and low carbon output.

Numbers don't lie

From the production site to the cloud, Midea has raised the level of automation in its manufacturing operations from 30% to more than 50%. After this digital transformation, Midea's annual revenue soared from 100 billion yuan (US$13.8 billion) 10 years ago to more than 340 billion yuan (US$47 billion) as of 2022. Its profit during the period rose from 3.3 billion yuan (US$456 million) to 33.7b yuan (US$4.6 billion), while its market value increased 10-fold.

By applying information technology, network technology, and intelligent technology to the industrial field and combining advanced manufacturing with energy-saving and carbon-reducing technologies, the manufacturing industry can upgrade the traditional production and operation paradigm to a new stage of intelligence.

> "The factory doubled its delivery rate, reducing labor costs by 30% per unit."

David Vasko

Inventor, industrial advisor, board member

LOW-COST LIFT-OFF:

SMART FACTORIES EMBRACE SIMULATION, AUTOMATION, AND DIGITAL TWINS

David Vasko is an inventor, industrial advisor, and board member. Formerly, he served as an executive in advanced technology at Rockwell Automation.

Gavin Allen: How would you define smart manufacturing?

David Vasko: Smart manufacturing is the connecting of data developed on the manufacturing floor and the use of that data to perform analysis for organizations, allowing both computers and humans to optimize the process for whatever the intended purposes, be it increasing production, reducing waste, or increasing quality. Making that connection is the heart of smart manufacturing – that entire chain of creating the foundation, building it up, and using that data.

Gavin Allen: How transformative has that been?

David Vasko: Incredibly transformative. It's allowed manufacturers to take their operations, look at the data, and see things they've never seen before. There's incredible potential for optimization from this.

That transformative impact is accelerating in two dimensions: things get better, and the cost of entry becomes lower every year. That means more manufacturers will adopt it. Larger manufacturers tend to be able to adopt the changes much faster than smaller ones. But as these changes become well known and cheaper to implement, they are pushed down to small and medium manufacturers. It really lowers the opportunity cost to do this.

Gavin Allen: As a member of NIST's Manufacturing Extension Partnership Advisory Board, what is your priority for action?

David Vasko: To get the right information to people so they know what to do and can make decisions. Small and medium-sized manufacturers just don't have time for a lot of experimentation like big companies do. The key is to make sure they invest their dollars wisely to future-proof their operations and not lose that opportunity. Providing the right information at the right time is absolutely critical.

Gavin Allen: So what do you think is the current state of smart manufacturing globally?

David Vasko: It's not universal. A lot of small and mid-sized manufacturers don't even have a basic security professional for their operations, so it is difficult. They need help from experts to make these changes.

Gavin Allen: And if they don't get that help?

David Vasko: There really is attrition. If you're a small company supplying parts to a bigger company, you'd better be able to connect and have security systems in place to avoid causing a risk to your customer. If you don't – and some companies are hesitant or unable to make the changes – then you're not going to survive.

Gavin Allen: So they can't afford to make the upfront investment, but they can't afford not to, either, as they're part of a supply chain?

David Vasko: Yes, that's absolutely it. A lot of these smaller companies are held by the owners and their families and transferred from generation to generation. But they don't always make it, and that's sad.

Gavin Allen: What do you hope will be possible five to 10 years from now?

David Vasko: Obviously, artificial intelligence will help create a more level playing field. You can become more productive quickly, and as new people enter the workforce and try to understand the best practices, they can see and leverage the expertise out there. That's a baseline.

But I'm much more excited about simulation and digital twins. AI enables you to see what somebody has done and to compare actions against that, seeing the patterns that occur. But simulation and the digital twin of a factory can provide you with information for solutions nobody's ever tried before. That can have extreme impacts and be incredibly transformative. That's really where the critical opportunities are in the future.

Gavin Allen: So, a relatively low-risk, low-cost lift-off for experimentation?

David Vasko: Well, one of the issues is that the modeling can be expensive, and you can spend a lot of time doing it. You'll have to pick and choose where you're going to do that. But

> The impact is accelerating in two dimensions: things get better, and the cost for entry becomes lower every year.

there are applications using digital twins that are working today, and you're going to see more and more of those optimizing processes. Understanding disruptive technology is incredibly important for anyone leading change. Without that, you really aren't looking at the future.

Gavin Allen: It also demands prioritization. The wrong choice can be a real profit killer.

David Vasko: Absolutely, yes. From a manufacturing standpoint, you want to look at the biggest problems impacting you today and in the future, and then work on solutions to those problems. And make sure you can measure those things. You can have a real impact. It sounds really simple, but it really is that simple.

But if you're just entering this because it's a cool technology, you're going to be very surprised by the outcome.

Gavin Allen: Is that the biggest mistake that people make – "going digital" without any clarity about what, specifically, they're trying to achieve?

David Vasko: Yes, that's absolutely it. You read about Industry 4.0 and want to install systems that support that. But if you can't say what your problem is, how you can measure its state today and where you want to go, you're just shooting in the dark. You're not going to be able to really optimize your operation. You may be able to make improvements, but not in the most cost-effective way.

Gavin Allen: How important to global economic growth is continued standardization in this area?

David Vasko: It's crucial. When I was at Rockwell Automation, I managed the group heading all those standards engagements, and they really allowed different companies to interconnect. Small companies can create new products that solve niche problems and interconnect with larger solutions. It's crucial, not just for small and medium-sized companies, but for large companies as well, to have that large base of suppliers working together to solve problems. Without that, you're doing customized solutions; it's more expensive and doesn't have scale.

Digital transformations, Industry 4.0, and sustainability all rely on standardization. The work done in eco-design in Europe defines the standards for how things are measured. That's the crucial first step. Until you have the standards and the metrics, it's difficult to set goals or assess improvements.

Gavin Allen: The digital skills gap is another major issue. You've written that "the employee you're looking for may already be working at your company today." How important is investment in existing staff and continuous learning and adaptation?

David Vasko: I think it may be underappreciated. What keeps me awake most is that we don't have enough people to solve the problems ahead. Training people will get you part of the way, and manufacturers are always looking for talent. But somebody on the production floor watches stuff go by day in and day out. They see what works and what doesn't. They're perfect candidates to bring into the process, optimize your lines, and make them more efficient. So, invest and bring your entire staff up a notch for more impact. That's a crucial thing to grapple with: increasing your current staff's productivity, value, and education.

> Understanding disruptive technology is incredibly important for anyone leading change.

At Rockwell Automation, we also took former military veterans and, in an intensive 12-week program, brought them up to speed for manufacturing. We gave them the skills they needed – working with manufacturers – to be productive. The students don't pay a cent. They're paid, given room and board, and then walk out into a high-tech job. It's important to get people into these jobs quickly and to make a productive impact.

Gavin Allen: Is enough being done to address the disparity between the number of men and women in tech?

David Vasko: Innovation comes from diversity. You don't put together 10 people with the same background and experience and expect an innovative breakthrough. It's more important now than ever that we bring diverse sets of people together to drive future innovation. We've seen women step into those roles and be incredibly productive, and there's just no reason they can't be there, so we need to do more to attract and keep them.

Gavin Allen: Finally, what is your top tip to a manufacturing company boss still wavering on whether or how to adopt smart tech?

David Vasko: You definitely have to get involved and do something. But do it incrementally. Start with the biggest problem you're facing, and look at how you can solve that. As you apply the technology, try to create an infrastructure and a foundation that allows for future improvements. Once you solve that problem, take the money you saved and apply it to the next problem, and the next one, and the next one. That allows you to be involved and understand the changes that are happening. That's the best way to go.

Gavin Allen: So, start at the shallow end of the pool; don't jump in and splash about frantically at the deep end?

David Vasko: Yes, you'd hate to see people betting their entire business on this outcome if they don't really know what they're doing.

DIGITAL TRANSFORMATION HIGHWAY

BYD chooses Huawei to help it intelligently manufacture Electric Vehicles

BYD, the world's largest seller of Electric Vehicles (EVs), provides a valuable reference for manufacturers seeking to go digital using intelligent networks.

Originally a maker of car batteries headquartered in Shenzhen, China, the company began manufacturing vehicles in 2003. Since then, it has produced more than 4 million EVs, including 1.86 million in 2022 alone. Last year, BYD exported more than 240,000 vehicles and is ramping up its global market expansion.

Infrastructure under stress

BYD is growing fast. In 2022, it made the list of the Fortune Global 500, ranking third by market value among global automobile companies.

To support this growth, BYD needed to migrate more of its design work, R&D, applications, and production lines to the cloud. With the number of network devices on the rise, handling operations and maintenance (O&M) manually was becoming a serious burden.

These changes posed enormous challenges to the network infrastructure on BYD's campus.

First, diversified applications and cloud adoption for production and R&D put a strain on the network. Periodic interruptions slowed down R&D simulations; freezing or disconnections during video conferences hindered communication.

So, a key question was: how do you build a network that performs well for a wide variety of services?

Second, production lines had begun to rely more on wireless networks, placing a huge burden on signal strength and roaming coverage. In addition, wireless devices began to outnumber wired ones. At this point, BYD had over 100,000 wireless devices on the network. The system had to reconcile differences in how permissions had traditionally been granted for wired connections versus the increasing number of new wireless ones.

Finally, automated network O&M needed to be added to the agenda. As more devices were connected, the scale of the network expanded, and user queries and network issues were also on the rise. Therefore, BYD urgently needed to transform its labor-intensive, passive O&M into a proactive, automated, and intelligent O&M.

> "BYD urgently needed a proactive, automated, and intelligent O&M."

Transformation on a solid foundation

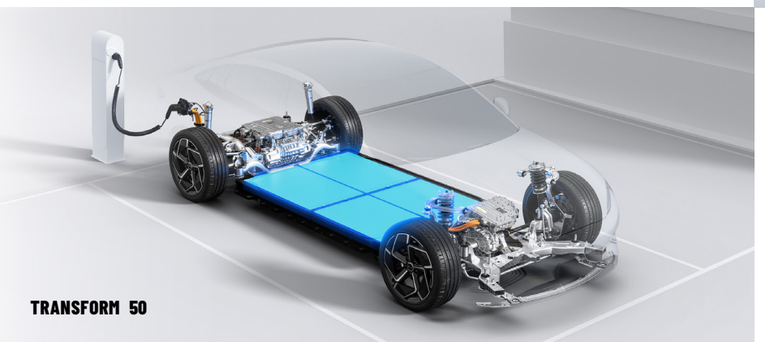
BYD chose Huawei to help it build a high-quality campus network featuring ultra-fast access, high reliability, enhanced user experience, simplified architecture, and simplified O&M.

BYD's production relied increasingly on high-bandwidth networks. For example, R&D simulation involves a lot of high-definition graphic rendering, the process of generating a photo-realistic image using a computer program. This requires the transmission of huge volumes of data between cloud servers and local terminals, as well as ultra-low latency (delay) on the network, despite the high quantity of data being transmitted. Even simple high-definition video calls from one office to another needed high bandwidth and low latency.

The campus network they built together supported 10 Gigabit Ethernet (10GE) for wired terminals. Access switches supported on-demand GE and 10GE downlink to meet the needs of different devices, as well as network slicing to allocate different "lanes" for different services.

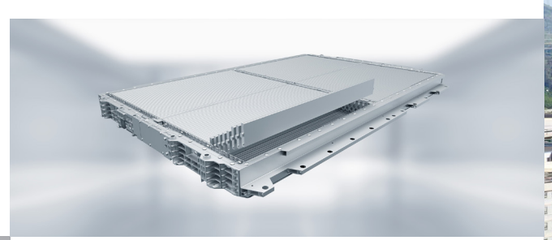
Huawei and BYD jointly built a high-quality wireless office network offering 10GE uplink speeds and other benefits for office scenarios. The new network was supported by leading AI technologies and ensured every employee got a signal. Users could roam anywhere without interruptions in service and join a meeting without the video freezing up.

Many production scenarios, such as battery and semiconductor production and warehousing, require wireless networks for backhaul – sending signals from terminal devices back to the network. Various types of terminals need to be connected, including barcode scanners, dashboards, tablets, and automated guided vehicles, a type of industrial robot.



To address these needs, BYD conducted site surveys using Huawei's advanced 3D network planning tool and deployed Huawei's next-generation access points, which act as a bridge between wired and wireless networks. Compared to previous technology, these APs provide more stability, faster access, and higher concurrency (the ability to send and receive data from multiple active services). They can be used for the Internet of Things (IoT), connecting more than 500 work-in-process vehicles and thousands of smart terminals and sensors. Furthermore, big data technology and algorithms were used to monitor hundreds of devices, providing a more reliable network for the wireless backhaul of production data.

Besides offering superb experience at the network and application layers, Huawei's high-quality campus network also ensures touch-free terminal access and free mobility.



The platform also harnesses the power of AI. Huawei's iMaster NCE-CampusInsight, an intelligent network analysis platform, applied AI to operations and maintenance. It collected performance metrics and network device data, combining AI algorithms with other technologies to free O&M personnel from handling alarms and masses of logs.

Building a traffic highway

With this future-proof platform, network administrators can grasp the network experience of each Wi-Fi user and the status of each network device anytime, anywhere. When something goes wrong, it takes just minutes to find and address it, ensuring production and services remain uninterrupted.

Since its commercial deployment, the intelligent O&M system has helped BYD improve network O&M efficiency by 48%, with 60% fewer complaints about network faults.

BYD also needed a high-capacity data center network. It chose Huawei's most advanced CloudEngine 16800 series switches and CloudEngine 6800 series switches, creating a digital highway for interaction between hundreds of thousands of terminals and over 2,000 servers across the entire network. These devices also offer powerful scalability, preparing the network for upcoming rapid service development.

The successful commercial use of BYD's high-quality 10 Gbps campus network and high-capacity data center network has set new standards for sustainable EV development. To achieve further development, BYD still needs to integrate processes and data by bridging the data gap between R&D, production, and sales through data governance. This way, BYD can achieve efficient collaboration between production and supply while reducing costs.

In the future, Huawei will work with more customers to innovate designs and carry out in-depth service cooperation to connect even more industries and their corresponding scenarios.

> "BYD's 10 Gbps campus network has set new standards for sustainable EV development."

BYD Headquarters in Shenzhen, China

RAISING COWS IN THE CLOUD

At the world's largest milk factory, automation has transformed production of one of the world's oldest foods

MENGNIU

A transport truck full of fresh milk slowly approaches the gate of the Mengniu factory in Lingwu, an industrial city in southwest China's Ningxia Hui region. Once the truck's license plate number is identified, the factory gates open automatically to allow the vehicle inside.

Drivers entering the factory use an app to follow a series of instructions sent by the Operations Center. The instructions govern activities including inspecting samples of ingredients brought into the facility, weighing those ingredients, and even cleaning the trucks after they've made their deliveries.

Beneath this small app sits a larger, enterprise-level program based on Huawei's smart campus solution. It uses IoT, AI and big data technologies to give Mengniu unified management and control over its entire factory.

> Traditional animal husbandry is becoming a highly digitalized industry.

Digital cockpits and smart pastures

A remote central control system known as a digital cockpit links all the devices in the factory, which has 24 production lines. Each package of milk must pass through more than 100 business process nodes and more than 100 separate inspections. The whole process is digitally controlled.

Mengniu has 38 production bases in China and three more in Australia, New Zealand, and Indonesia.

In addition, the company has established a smart pasture system that uses the Internet of Things to keep track of more than 1 million cows across 800 pastures run by Mengniu's partners. Cows wear biometric collars that monitor their vital signs, automatically recording their location, heart rate, breathing, and degree of daily physical activity. This data is transmitted to a cloud-based system for analysis, allowing veterinarians and others to track the health of the cows and ensure maximum milk production.

Powered by digital technology, traditional animal husbandry is becoming a highly digitalized industry, and this can be seen along Mengniu's entire industry chain.

SUPPORTING THE BACKBONE OF INNOVATION

Change from smart manufacturing will be incremental – and eventually, exponential

Prof. Puay Guan Goh

Associate Professor, National University of Singapore

Gavin Allen: Where do you see manufacturing heading in the near to medium term?

Prof. Puay Guan Goh: We may not see huge leaps and bounds or exponential change in smart manufacturing in the next five to 10 years. For instance, quantum computing or using hydrogen rather than oil are paradigm changes, but those are the playbooks for very large companies with major R&D budgets or deep tech startups.

For most companies, we'll see a lot of incremental improvements in operational processes that drive the backbone of innovation. There'll be more integration, automation, dashboards, and the use of analytical tools and AI to help with these manufacturing processes.

And more co-creation: the human-machine interface will become more important. I always ask my students whether they want to be managed by algorithms or be the ones managing the algorithms. Obviously, we hope they will be the ones defining the algorithms and managing the machines.

Gavin Allen: I hope so too! What's the responsibility and expectation of a major global company like Huawei, with its considerable annual investment in R&D, in this field of smart manufacturing?

Prof. Puay Guan Goh: First, segmentation by verticals, defining what solutions will look like within an industry, and simplifying the solution set. Traditionally, Huawei sold hardware, but it's going through a process of creating a services-and-solution approach. A solution approach has tight margins and is more value-added, which is helpful, but it also means IT companies need to better understand the industry's needs, so every solution would need to be customized to that industry's requirements. Second, as Huawei does a lot of in-house manufacturing, there is some level of control over pricing and ability to package hardware and software solutions that are cost-effective.

Gavin Allen: In terms of adoption, are we still in the early days of smart manufacturing?

Prof. Puay Guan Goh: There's a big difference between large multinationals, which are highly automated, and small local enterprises, which, unfortunately, are in many ways starting off. Many do understand the importance of digitalization, but maybe they don't know where to start, or it's a cost issue. It can be hard to have enough economy of scale and enough future efficiency cost savings to justify the investment.

> "SaaS has helped the adoption of smart manufacturing by small companies and probably increased their digitalization as well."

> I always ask my students whether they want to be managed by algorithms or be the ones managing them.

Gavin Allen: And is that changing as technology costs come down?

Prof. Puay Guan Goh: Yes, with two major drivers. COVID generated a lot of digitalization as multinationals pushed for supply chain integration and visibility to really plan sourcing and shipping. That pushed their suppliers to comply and share information.

There is also the prevalence of software-as-a-service (SaaS) applications which you can essentially rent or pay per use. It's hosted on a cloud, and you can store your information and do transactional-based or subscription-based pricing for various applications, including manufacturing execution systems on the shop floor. That has helped small companies adopt it and probably also helped increase their digitalization as well. When service providers come on-site to understand your business and configure the software system to fit your processes, the companies themselves also learn a bit about digitalization and the use of IT and discover it's not as scary as they may think.

Gavin Allen: It's interesting you use the word "scary." How do you overcome those fears – whether they're based on cultural, financial, regulatory, data security, or other reasons?

Prof. Puay Guan Goh: That depends on whose perspective you come from. For the management or owners, the concern will most likely be cost. If the ROI can be addressed, or if the multinational customer requires it as a condition of doing business, then it is more likely to go ahead.

> You can't remove humans from all this. You still need people to interpret what is happening, and to troubleshoot when things go wrong.

For the rank and file, the concern may be about job security. One of the issues around transformation is always the fear that implementing technology could potentially take away my job. So, that's about how change managers work with existing staff to convince them that it is a positive change: taking away the tediousness of some of what they are doing and letting them focus on higher value-added work or giving them other opportunities. Building trust and assurance from the company is needed.

And it's really not the case that we can remove humans from all this. You have data, but you still need people to interpret what is happening and troubleshoot when things go wrong – and actually, troubleshooting and interpretation are higher-level functions that require a fair bit of experience. Machine learning only works well within a box that we define.

But if something is exceptional or they haven't encountered and interpreted it before, then the machines still need to learn, and that learning will have to come from human input. I think for the foreseeable future, human experience will be required. And in the future, when people rely on these machines and fresh grads have not been through the operational and day-to-day functions? Even that could potentially be solved by technology. VR goggles, for example, could train them on the fly, showing them where to look for issues, where to troubleshoot, or where the manuals are that you can access on-site. Simulations can teach them. They may not have worked through the whole gamut of scenarios, but virtual training can speed them along the learning curve.

Cybersecurity concerns are harder to address for small companies – and even many large ones – because they're quite technical. You have to trust that the cloud or proprietary systems you are using have the necessary tools in place to protect you.

Gavin Allen: There are obvious benefits for businesses in embracing smart manufacturing – efficiencies, profit, sharper analysis, and a better service to customers. But amidst these job fears, does smart manufacturing offer a wider societal benefit, too?

Prof. Puay Guan Goh: Again, it depends on perspective. More developed economies don't have many low-cost workers to rely on, so smart manufacturing helps alleviate resource issues. Even China has one of the most highly technical robotic implementations because it has a shortage of young workers. There are more issues for developing societies because a lot of low-cost workers may be affected. The biggest challenge is probably for less educated workers who are unable to use the tools of AI and ChatGPT for productivity gains. For the well-educated, it's a huge jump: better tools, generating ideas, better productivity. So, it has different impacts on different segments.

Generally, there are some potential benefits for society if you have more efficient, smarter cities, with sensors and cameras – you can plan in advance, get through traffic and airports quicker, etc. Privacy would be an issue, but different societies would have their own perceptions on that, and different willingness to share information. It's why you see a lot of concerns about data sharing and where data is being stored.

Gavin Allen: As a university professor who is the Academic Director of a Master's Program in Industry 4.0 and teaches in it as well, do you think education systems are sufficiently prepared to give students the required skills?

Prof. Puay Guan Goh: Industry 4.0 is very broad because it encompasses various technologies that cut across the smart manufacturing space: robotics, IoT, 3D printing, and then on the software spectrum AI, data analytics, etc.

In the program, we want to create T-shaped individuals: a combination of breadth and depth. Breadth across different technologies to understand how they work and enable you to manage implementation and projects, and also to manage expectations and evangelize within the company. The depth looks at one or two specializations, such as IoT or the digital supply chain, cybersecurity, 3D printing or robotics, etc. It's a hybrid of both the business and technology worlds.

And there's applied experiential learning as well, where they go and work with companies for six months to solve a company-sponsored project. Sometimes they say, "Oh, it's a lot of work," but that's the point: you learn in school, but you have to learn extra things and gain real experience outside school. Capstone projects are important, to bridge this industry gap. Careers are now all about continuous learning.

FOR FACTORIES, 5.5G IS SIMPLY BEAUTIFUL

Wireless 5.5G-powered robots will run the factories of the future.

Professor Boy Luthje

Institute of Social Research, Germany
Sun Yat-sen University, China

Note: In this interview, Prof. Luthje refers to both 5.5G and 5GA, which stands for 5G Advanced. Both terms refer to the same technology.

What is 5.5G, and what does it enable us to do?

It's just an enhanced version of 5G. But it is a huge leap in capacity and in latency: the reaction time of the network gets much shorter. You need this to deploy 5G in the networks of advanced factories.

That's especially true when you want to connect robots. You need a lot of data to move them. Previous generations of mobile communications have not been powerful enough to do this. But with 5G, it's possible to use mobile communications in factories.

What specifically does it enable in vertical industries such as mining, manufacturing, and health care?

For manufacturing, it enables us to put the whole digital network for the factory on mobile communications. Until now, big data networks have always operated using cables. So in factories with a lot of robots, you'd also see a lot of cables – in the corners and on the factory floor. These cables are usually very difficult to maintain and often difficult to install. They are the main source of failure for these networks: someone can hit a cable, or a cable can get wet, or someone runs it over with a forklift. This is one of the main causes of downtime in production in digitalized factories.

Now, as everything is transmitted by mobile technology, you don't have this problem. In addition, the 5GA standards simplify the data architecture. Before that, you needed one channel for upload and one channel for download at different speeds. That meant two cables for each device. So this is a big step towards simplicity. That's the beauty of this technology: it makes things simple.

Tell us about the importance of data protection when it comes to 5.5G.

Data protection is the key issue for the digitalization of production. Companies are eager to protect their production data, as it's potentially the secret to their success. This is one major reason why many small and medium-sized enterprises have been hesitant to go on the cloud. There is widespread fear that the cloud operator may do some bad things with the production data. For this, you need standard architecture and manufacturing companies to protect the data.

This is not just one company; it's about whole industries. When you want to connect a whole industrial park with 5GA, you need a unified architecture of data protection for all the companies – something that's easy to use, easy to understand, and safe. This is something we can learn from mobile communications technology, where this kind of data protection has been deployed in a public space. We are talking about making manufacturing infrastructure public.

What about some of the other challenges we'll face, the obstacles ahead for 5.5G?

From a business point of view, of course there's a cost. That's the first thing. The second big challenge is data protection. The third challenge is the human factor. You need engineers, you need specialists who can run this new technology. This holds big potential for small and medium-sized enterprises because it is easier to use. You won't have to hire a large number of engineers when you introduce new digital equipment. For example, when you introduce robots today, usually the biggest bottleneck for small and medium-sized enterprises is the engineers you need to hire. So 5GA may provide a more gradual, evolutionary way into factory digitalization, which also means the issues of labor, training, and education may be easier to solve in the future if we do it right.

> "5GA may provide for a more gradual, evolutionary way into factory digitalization."

Transform

IN THE NEXT ISSUE,
WE LOOK AT SMART CITIES.

Visit us at www.huawei.com/en/media-center/transform

Contact us via transform@huawei.com

HUAWEI

Printed on recycled paper