

Accelerate!

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HELPING YOU BUILD A BETTER FUTURE

INSIDE SOFTWARE

**WHAT
WE'RE
THINKING**

**DESIGNING
FOR SPEED**

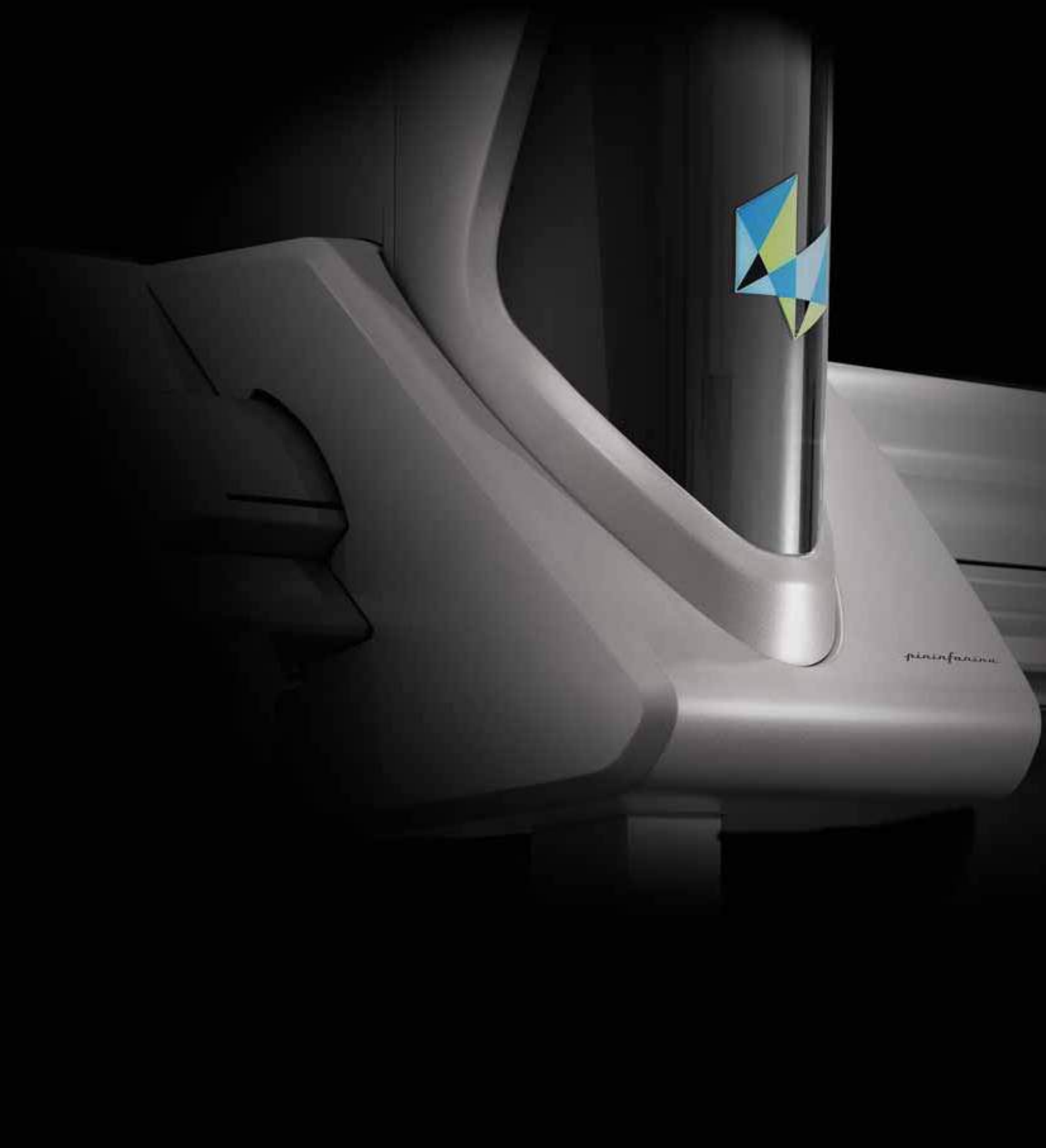
HOW PARTNERSHIPS HELP
TECHNOLOGIES EVOLVE

**SOFTWARE
SECRETS**

YOUR QUESTIONS ANSWERED BY A
PANEL OF SOFTWARE EXPERTS



IN FOCUS





GLOBAL EVO

Fast. Faster. Fastest.

Designed for speed

In the pursuit of productivity, speed matters. The GLOBAL EVO coordinate measuring machine offers accurate high-speed scanning to enable faster manufacturing throughput. Developed in partnership with legendary design house Pininfarina, GLOBAL EVO combines a tradition of quality with new performance technologies to drive productivity in automotive, aerospace and machinery applications and beyond.

EDITORIAL

THOUGHTS ON THINKING



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“You cannot mass-produce software – you cannot mass-produce the human mind.”

I recently came across these words from the theoretical physicist Michio Kaku, and was struck by the link he creates between software and thought processes. It resonated with me because our ‘sensing, thinking and acting’ approach creates very much the same connection. We talk about software as being like the mind; an amazing analytical tool that processes the data captured by sensors and enables an informed action to be taken.

Software is becoming an increasingly important part of what we do here at Hexagon Manufacturing Intelligence. So in this issue of **Accelerate!**, we delve more deeply into what we are ‘thinking’ by looking more closely at our software business. Our cover story explores how the software knowledge of our colleagues from Q-DAS is informing our development, and you can learn about how we implemented a Vero Software program to improve production in our North American facility. There are also some fantastic software tips and tricks on offer in our *Ask the Experts* feature.

When you look across all the Hexagon businesses, you see that the strategy is moving in the direction of software-centric information technology solutions, and a few people have asked me if this means we will stop developing on the hardware front. Well, our recent acquisition of AICON 3D Systems suggests otherwise, and I’d like to take this opportunity to say that we remain as committed as ever to creating innovative new technologies in both fields. In fact, in this issue, we have interviews with some of our incredible research and development (R&D) team members, who give real insight into the lifecycle of new technology. You can also read the stories behind recently-released products like GLOBAL EVO and SENMATION, so believe me, hardware innovation is well and truly alive at Hexagon.

So, what do we mean by ‘software-centric’ then? Well, I believe the role of software in manufacturing is changing. Instead of being a simple means to an end – a way to control some hardware – we can now use it to achieve much more. Software is becoming the key integrator in the new connected world of manufacturing. And just like the human mind, I’m not sure we even understand its full potential yet!

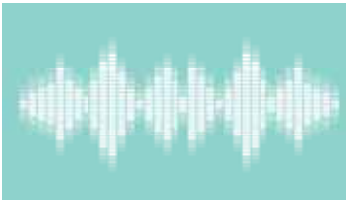
Happy reading

Norbert Hanke
President and CEO, Hexagon Manufacturing Intelligence

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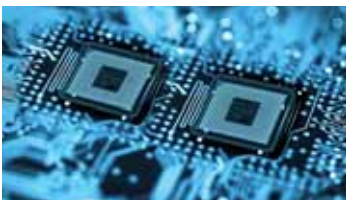
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HIGHLIGHTS

Catch up on the news, events and stories from Hexagon Manufacturing Intelligence.



Hexagon acquires AICON 3D Systems

Hexagon AB has announced the acquisition of AICON 3D Systems, a leading provider of optical and portable non-contact 3D measuring systems for manufacturing.

Founded in 1990 and based in Braunschweig, Germany, AICON has been meeting the measurement needs of automotive manufacturers and companies in the aerospace, shipbuilding, renewable energy and mechanical engineering markets for over 25 years. Its portfolio includes coordinate measuring machines and specialised optical 3D measuring systems that enable efficient, high-precision monitoring, quality assurance and control in manufacturing production. With over 140 employees, AICON has a direct presence in Germany, subsidiaries in China, Korea, Japan and the US, and a network of resellers worldwide supported by its field support resources.

"AICON is a recognised brand with strong core technical competence across its development teams and its scanner portfolio is a strategic fit," said Hexagon President and CEO Ola Rollén. "We also see opportunities for international expansion of AICON's wider portfolio throughout Hexagon's global footprint."



Photo by Mark Thompson/Getty Images

Red Bull Racing Partnership Continues

Hexagon Manufacturing Intelligence has signed a renewal of its Innovation Partnership with Red Bull Racing Formula One Team. The 3-year agreement extends the relationship into a tenth year, with Red Bull Racing continuing to use Hexagon measurement technologies in its factory and at the track.

"We work to extremely tight lead-times but can't compromise on accuracy, whether in component production or in setup at the circuit," explains Chris Charnley, Quality Manager at Red Bull Racing. "Hexagon technology enables us to perform inspection tasks at speed, but with complete confidence in the reliability of the results."

The contract consolidates the close working relationship between the two companies and will continue their collaborative approach to innovation. As well as being users of Hexagon products and services, Red Bull Racing engineers are also involved with product R&D and testing.

"Our relationship with Red Bull Racing is a partnership in the truest sense," said Norbert Hanke, President and CEO of Hexagon Manufacturing Intelligence. "We are constantly exchanging ideas and the relationship has been hugely successful. We've been inspired to push the boundaries like Red Bull Racing, and I'm thrilled to continue our Innovation Partnership."

HxGN | NEWS

Visit www.hxgnnews.com for the latest news from Hexagon Manufacturing Intelligence and all the other Hexagon brands.



New 3D Laser Scanner Launched

Hexagon Manufacturing Intelligence has released a new portable laser scanner for large-volume inspection applications. Created with a focus on usability, the Leica Absolute Scanner LAS-20-8 portable 3D laser scanner makes gathering complex point-cloud data easier and quicker.

In combination with the Leica Absolute Tracker AT960, the LAS-20-8 scanner offers excellent performance for manual freeform surface inspections even on shiny metallic or dark materials. Its user-friendly features minimise training requirements and give even the most inexperienced operators complete confidence in its use.

"With LAS-20-8, we wanted to create an affordable handheld laser scanner that delivers results without complex setups or training needs," explains Duncan Redgewell, Vice President Hexagon Manufacturing Intelligence Portable Products. "Alongside the Leica T-Scan 5, LAS-20-8 enables us to offer the right laser scanner for any large-volume measurement application."

Manufacturing software provider FTI acquired by Hexagon

Hexagon AB has acquired Forming Technology Inc. (FTI), a provider of innovative manufacturing software solutions designed to reduce the development time and material costs of sheet metal components.



Founded in 1989 and based in Burlington, Ontario (Canada), FTI serves original equipment manufacturers (OEMs) and suppliers in the automotive, aerospace, electronics and appliance industries with sheet metal design, simulation, feasibility and costing solutions. Its leading-edge technology portfolio, engineering services, and years of expertise in the sheet metal industry enable customers to validate designs before they go into production

and immediately reduce labour and material costs.

"Closing the manufacturing feedback loop to enhance quality and productivity is an integral part of our solutions strategy," said Hexagon President and CEO Ola Rollén. "Combining FTI's CAE (computer-aided engineering) technologies and knowledge of automotive sheet metal applications with our CAM (computer-aided manufacturing) and metrology solutions will enable us to deliver substantial productivity gains to our automotive customers."

Portable Display Released For Inductive Probes

Hexagon Manufacturing Intelligence has announced the release of the TESA TWIN-T10 portable display for inductive probes, offering users a clear and immediate graphical display of data.

The TESA TWIN-T10 is particularly suitable for straightness, run-out, form or geometry evaluation during fine adjustments, alignments or the assembly of mechanical parts. The hemispherical form of the analogue scale, with its 200 segments, allows an unequivocal analogue and numerical reading of form variations. This new portable display offers an exceptional operational time of more than 340 hours with standard AA batteries and features

the maximum IP63 dust protection for workshop use. The TESA TWIN-T10 is also suitable for data transfer.

"This display, which is typically used with a GT31 lever probe, is an innovation in its range. With its clear readout preventing misinterpretations, its extraordinary battery life and the memory functions, it offers unique advantages," said Blaise Vuille, Director of Sales and Marketing at TESA. ■



COVER STORY



THINKING OUT LOUD

At HxGN LIVE 2015 in Las Vegas, Hexagon Metrology described its capabilities and roadmap as 'sensing, thinking and acting' for the first time. One year and a rebrand to Hexagon Manufacturing Intelligence later, **Accelerate!** gets deep in thought to find out more about the developing software side of the business.

Ever tried using a computer without an operating system? It's a redundant question of course; without an operating system, a computer is just a collection of electronics that do not know how to communicate with each other, let alone interface with users, other devices or the wider online world that we've come to expect our computers to access on a daily basis. Yet for some reason we still make a stronger connection to the capabilities of the physical interface, the device itself, than we do to the software that backs it up. We are becoming inseparable from our technology, yet still we somehow fail to recognise how ingenious the software user interfaces have become.

The same is true with manufacturing technologies. Whether you are measuring with a portable arm, a laser tracker, a white light system or a coordinate measuring machine (CMM), you need software to get any results at all. Even if you are taking measurements with a calliper or a micrometer and writing them down by hand, the chances are that at some point they will be processed digitally for recording purposes – even if that's manual entry in a simple spreadsheet. The same is true of a machine tool or virtually any other production system, it needs software to run. But according to Michael Wagner, Q-DAS General Manager, the role of software in manufacturing now far exceeds facilitating machine functionality.

"Software has the ability to create a common layer between all hardware systems. Looking purely at a quality control and metrology level, regardless of what measurement equipment the customer chooses to use, at the end they want to collect all the data in one system, harmonise that data, and have one common database. In many cases, it doesn't actually matter what kind of database is used, as long as it enables you to get quick access to the information. The idea of the customer is always to see the status of the whole product and the related processes – aggregated to a red, yellow or green light. And the commonality provided by software enables this. Of course, then you can use the data, drilling down into information to find and analyse problems."

Using data more effectively is central to the 'sensing, thinking and acting' approach that Hexagon uses to define its capabilities in the world of industrial manufacturing. Sensing represents the measurement side of the business; typically using one or many sensors to gather data about a part or parts. Thinking is the analytical phase, where raw data is processed and packaged into actionable information to inform decision-making. Acting is the implementation of the decision, the point where the knowledge acquired through measurement and analysis is used to make improvements in the real world.

Taken at its most basic, this sensing, thinking, acting cycle actually doesn't need software at all. It could be that a user measures a part using a hand tool, compares the result to the part blueprint and notes a discrepancy, and makes a manual correction before the part is shipped. But in a mass production environment, with advanced metrology equipment making the measurement and sophisticated machine tools making the correction, the role of software broadens significantly. In fact, software touches all three stages of the process – programming the measurement device, processing the data gathered into a format that can be analysed, and controlling the machine tool as it makes the necessary adjustments.

Although all three stages are currently achieved by different types of program, for an experienced software development expert like Wagner, the fact that there are touchpoints in every area offers tremendous potential: "We see software as the integrator that can give us true connectivity between all the elements of the manufacturing process that we currently touch independently. This is what we mean when we talk about developing software-centric solutions – it's about using software to complement or even increase the effectiveness of other technologies within manufacturing."

Like its hardware portfolio, Hexagon's software solution range is extensive and includes some of the biggest name products in the dimensional metrology, statistical process control and CAD/CAM fields – all naturally related areas, but not necessarily directly compatible. And this is where the years of development experience that Q-DAS brings to the software business begins to add value. One of the company's greatest success stories has been its standardisation of the format for quality data, together with the automated statistical evaluation of this data. In fact, just a couple of months after Hexagon acquired Q-DAS, it was announced that all of Hexagon's metrology devices would directly support the Q-DAS data format without the use of data convertors by the end of 2015. This development was completed to schedule, and Hexagon and Q-DAS engineers are now working on even more ambitious harmonisation projects.

Wagner currently takes a leadership role in a cross-functional development group within Hexagon Manufacturing Intelligence, its aim being to find new ways to align and better harness the huge potential of the company's software portfolio.

"The Hexagon portfolio has all these software touchpoints in manufacturing. For sure, the idea of this organisation is ultimately to combine all these kinds of software. The company vision now goes beyond the metrology software and deeper into the process. So we start with the initial designs and drawings. Even at that point, we know we will have the responsibility to measure some characteristics of that part. And the 2015 revision to the ISO 9001 quality management system standard is also going to influence this because it includes risk-based thinking requirements. We're talking about things like assessing what features to measure, because measuring costs money. Yes, there are ways we can reduce the cost of measurement, but in some cases we might be better off looking for smarter methods and reducing the amount of measurement required overall. These are the decisions our customers are now making, and these are the capabilities we need to bring into our MMS solution offering."



The MMS software platform is designed to offer a complete solution for quality requirements throughout the product lifecycle. From recording quality information, structuring data storage, database management, analysis of data, through to user-specific result processing and dissemination to the right people, it manages all kinds of data in real time.

MMS is intended to help customers manage information throughout the process, so it is embedded in the IT landscape, with connections to manufacturing execution systems (MES), enterprise resource planning (ERP) systems or product lifecycle management (PLM) systems all planned.

Taking a wider process view to facilitate decision-making is not new. For example, in the aerospace industry it has traditionally been important to measure more; 100% inspection ensuring the traceability expected by international safety standards. But in mass production, you're typically trying to measure only the essential characteristics and then only at the frequency that's necessary to ensure acceptable product quality. Integrating the statistical process control products of Q-DAS into the MMS toolset will enable customers to get an overview of quality in the context of the whole manufacturing environment, not only measurement.

"The interfaces to the rest of the world, outside metrology, even outside manufacturing, are developing for sure," continues Wagner. "We learned at Q-DAS that ERP connections are very important. But something like MES, where you gather for example temperatures and process parameters and combine them with other characteristics measured, gives correspondence between characteristics and root cause. That's all essential for reducing costs and creating decisions."

Similar to an ERP system, the concept behind MMS is about getting the right information to the right places at the right time, to positively impact people's work throughout the business and to assist with change management. From the shop-floor level to senior management level, the system should help everyone to make the decisions they need in their specific role.

So how close are these concepts to key trends like Industry 4.0 then? Surely this data flow and access to information is beginning to engage with such ideas. Wagner thinks that the next steps are not so far away.

"As we improve machine to machine communications, more of this critical information can be passed automatically to the right places. If the statistical evaluations can happen automatically and in real time, then maybe no-one has to manually intervene at all. Customers can create their own decision trees – the parameters for when someone should be alerted, even the parameters in which an automatic response is allowed from the system. Of course, some people will always want to be aware as soon as there is a problem. But I think in the future we will see more different types of machines connecting with other systems to implement the decision trees and continue your work. And this will all be underpinned by software." ■

DIE-CAST QUALITY

Twenty-year old relationship with Hexagon Manufacturing Intelligence helps die manufacturer shape change in the Chinese automotive industry

Quality in the Chinese motor vehicle industry has been revolutionised in the last three decades, thanks to a new focus on measurement technology and the use of metrology data to improve production. As one of China's largest motor die manufacturers, Tianjin Motor Dies Co. Ltd. has been instrumental in closing what was once a noticeable quality gap between domestically-manufactured and imported car models, and has now set its sights on a share of the global market. The company's relationship with Hexagon keeps it on point with the latest technology, from gantry CMMs to portable measuring arms and more recently white light inspection. ■



Company: Tianjin Motor Dies
Location: Tianjin, China
Industry: Tooling, Mould and Die
Solution: Gantry CMMs, ROMER Absolute Arm and WLS400M



To find out more about how Tianjin Motor Dies installed quality throughout its processes, go online to read the full case study.
<http://hex.ag/10oIOP>





“Most importantly, the systems are high in efficiency, quick in data processing, and comprehensive in analyses. They have contributed greatly in our efforts to enhance testing efficiency with regard to die parts and our manufacturing equipment.”

Chang Shiping
Chairman, Tianjin Motor Dies

PROCESS CONTROL, STAT!

Statistical process control is an increasingly widespread method of improving manufacturing visibility, and to provide a beginner's guide to the technique, **Tom Stewart**, President of the North American subsidiary of Q-DAS, recorded a podcast interview. **Accelerate!** catches up with the conversation in this HxGN Radio Recap.

Could you give us an overview of what statistical process control (SPC) is?

Statistical process control is the matter of collecting data during the manufacturing process and determining whether the process is stable, in control, and trying to determine the probability that parts will be in spec or out of spec.

What challenges do manufacturers face in applying statistical processes to manufacturing systems?

Well, in many cases the traditional methods of statistical process control, which were originally derived in the 50s, 60s and 70s are simply not applicable today. So in a given plant, while they're making production parts they have to be concerned about tool wear, and tool life, and targeting a process, and so many process parameters.

Why are those 50s, 60s and 70s processes not applicable today?

In those days the production process was more or less linear. For example, in the automotive industry, it's transfer line based, where a piece part would be processed in one operation and then sequentially go to the next and the next. So in those days, they were taking the piece parts off of the production line in the order they were manufactured and measuring them in the order they were manufactured. And in that case they could develop a subgrouping of the data and something called the Western Electric Rules: runs, trends, middle thirds, were more applicable than they are today.

How does today's environment change how we look at SPC then?

In today's environment the manufacturing systems tend to be more agile in nature. The materials and the tooling; technology has greatly improved. So these days we're measuring perhaps one piece from one machine a shift, and you need enhanced statistical methods.

How does this tie in with industrial metrology?

It really ties in nicely as the technology [of SPC], also of the metrology systems, has improved over the years. Their ability to include traceability; not only serial numbers but machines, fixtures, tools, feature groups. This information is now coming from the metrology systems and can be correlated in the Q-DAS product to make sense of the data that we're receiving.

But there are also other places you might be gathering process data, aren't there?

That's correct. If you look at the typical manufacturing plant, they have a lot of suppliers. Suppliers are producing the same kind of part, shipping it to the plant. When those parts arrive they have variability in them, so it's important to understand which supplier the components are coming from and record it as well.

What else should you think about in applying SPC techniques and incorporating them into the supply chain?

Well, it always depends upon the knowledge of the process. In our case we partner with the customers and suppliers because they're the people that understand their processes, how they're producing their parts. And then we adapt the systems to suit:



a) how the data's coming, b) how it's been recorded, and c) the reason it was recorded. For example, I would look at data differently if it recorded as a station check or tool change check, as if it was recorded for the standard production.

Is this approach only for the biggest manufacturers?

We're seeing it as a coming trend. It certainly started with the larger producers but it's becoming more and more important for the middle production kinds of facilities and also job shops.

How does a company that's new to SPC get into this?

Well, if they have the desire to support continuous improvement, then they have to record the measured values of the process. If they are working with a solution provider like Q-DAS, we're instructing them, training them, teaching them about what we do. We're experts in using their process knowledge to come up with the products and support services that make it beneficial to them.

So there's a lot of consulting as well as software?

Consulting is very important. We have process experts. We have software experts. But it also needs the customers' input, the customers' understanding of their processes, because they're all different. We use a standardised but adaptable set of software tools, then work with the customer to apply them.

What industries could benefit from this kind of approach to managing quality processes?

A large portion of our business is in the automotive industry, but we're also very active inside the aircraft, heavy duty, energy markets. Aircraft is a lot more similar to automotive than a lot of people would think, because of the exotic materials and tools.

In manufacturing, do you tend to get normal or non-normal data?

We tend to get non-normal data. Inside a Q-DAS product is a statistical engine that has the ability to determine the correct data model for any given set of data and because we normalise it at

that point we're able to compare non-normal data and normal data together in the same setting. That buys us clarity into the process, which eliminates the confusion about somebody transforming the data and making an interpretation on the data. We let the data speak for itself.

Why is that a benefit going forward?

If you're trying to manually determine the normality of the data, I might do it differently to how someone else would do it. And then six months later, somebody else has to figure out how it was done. With our system we're using a configuration of evaluation which equates to a set of business rules for analysing the data that is customer specific.

How do you see SPC developing over the next few years?

With the advent of big data and Industry 4.0, there's more demand to collect more data, and the need for the correct kinds of analysis will only increase. But also we're taking it a step earlier in the process, determining the capability of the metrology systems and the manufacturing systems ahead of time to determine what kinds of data need to be collected.

What are some of the most important things to think about in deploying SPC?

It does depend on the industry, but step one is understanding the capability of the metrology systems and the manufacturing systems, then using process knowledge to define what kind of data should be collected, how frequently, and then what you do about problems.

What's the ultimate benefit then?

Productivity and quality! ■



To listen to the full podcast and more from HxGN Radio on iTunes, SoundCloud or Stitcher Radio, visit hxgnradio.com.

DESIGNING FOR SPEED

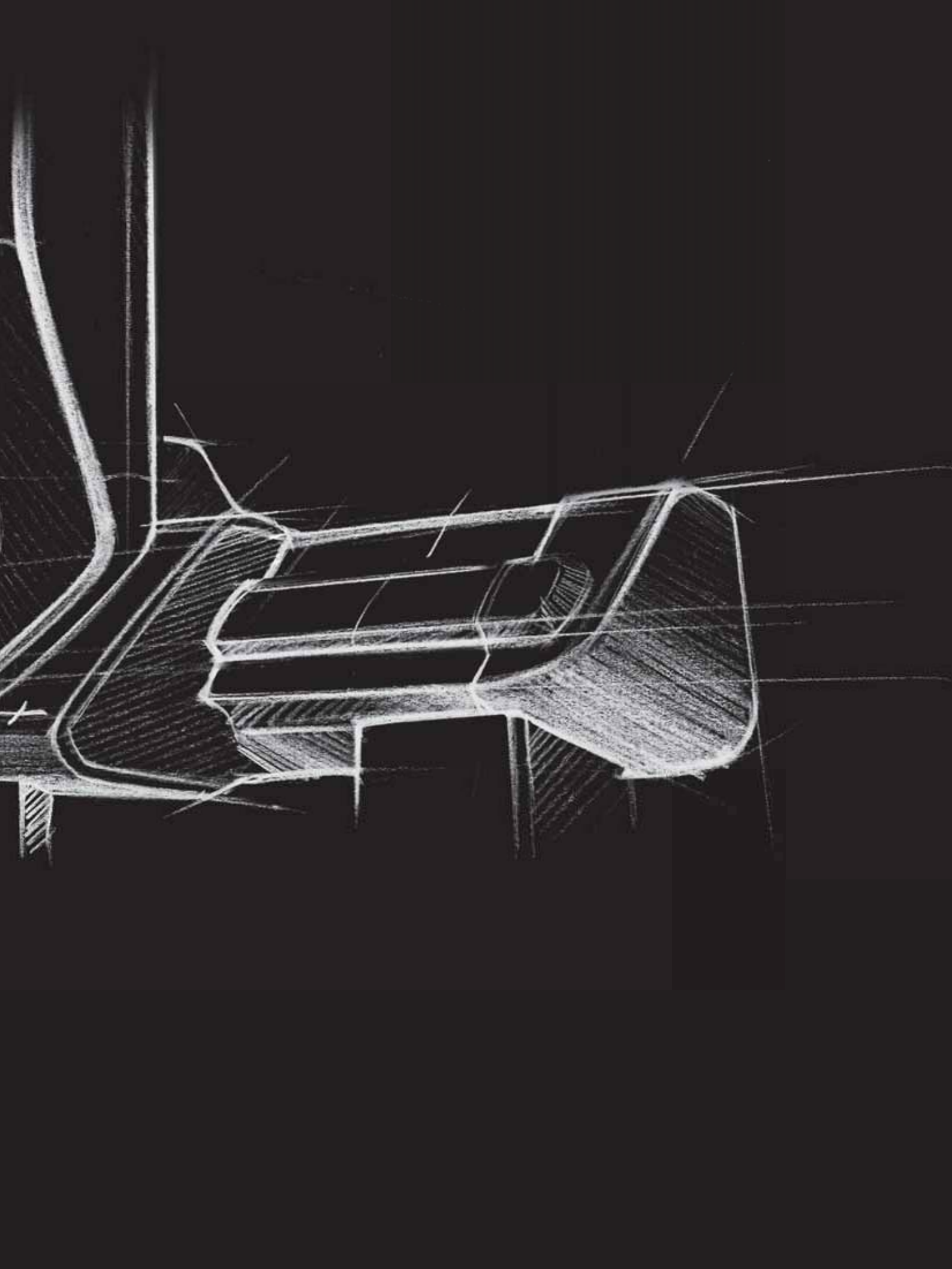
How do you design the next generation of technology? **Accelerate!** lifts the lid on the evolution of GLOBAL EVO and Hexagon Manufacturing Intelligence's collaboration with legendary design house Pininfarina.

In the crowded global markets of today, customer expectations are very different from just a few decades ago. Technology pervades every aspect of day-to-day life and as a result, people are comfortable with the process of evaluating competing products independently and making well-informed purchasing decisions. And this shift in customer expectations is having a significant impact on the way that new technologies are developed.

Where once functionality might have been the single most important consideration in product design, a wealth of new differentiating factors are opening up for product developers. User experience, man/machine interfaces, aesthetics and accessibility are all becoming significant contributors to the overall appeal of the final product, and as a result research and development (R&D) teams are more cross-functional than ever before.

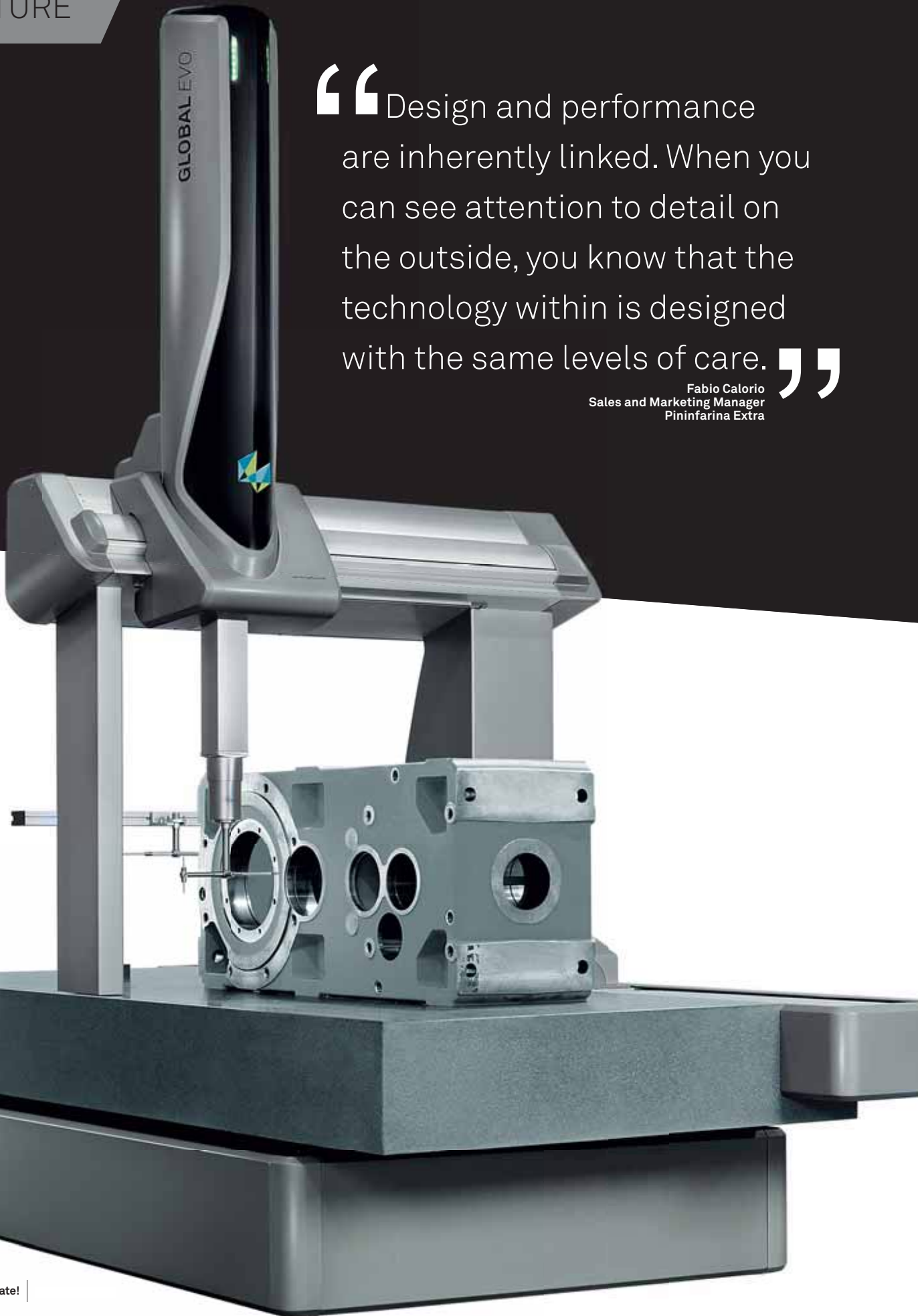
With its significant investment in R&D, Hexagon is well-known as a technology innovator. Yet one of the most important skills in R&D is knowing when to bring in external expertise and embrace the input of partners who can add value beyond your own. This is what led the development team of Hexagon's GLOBAL EVO coordinate measuring machine (CMM) to work with Italian design house, Pininfarina.

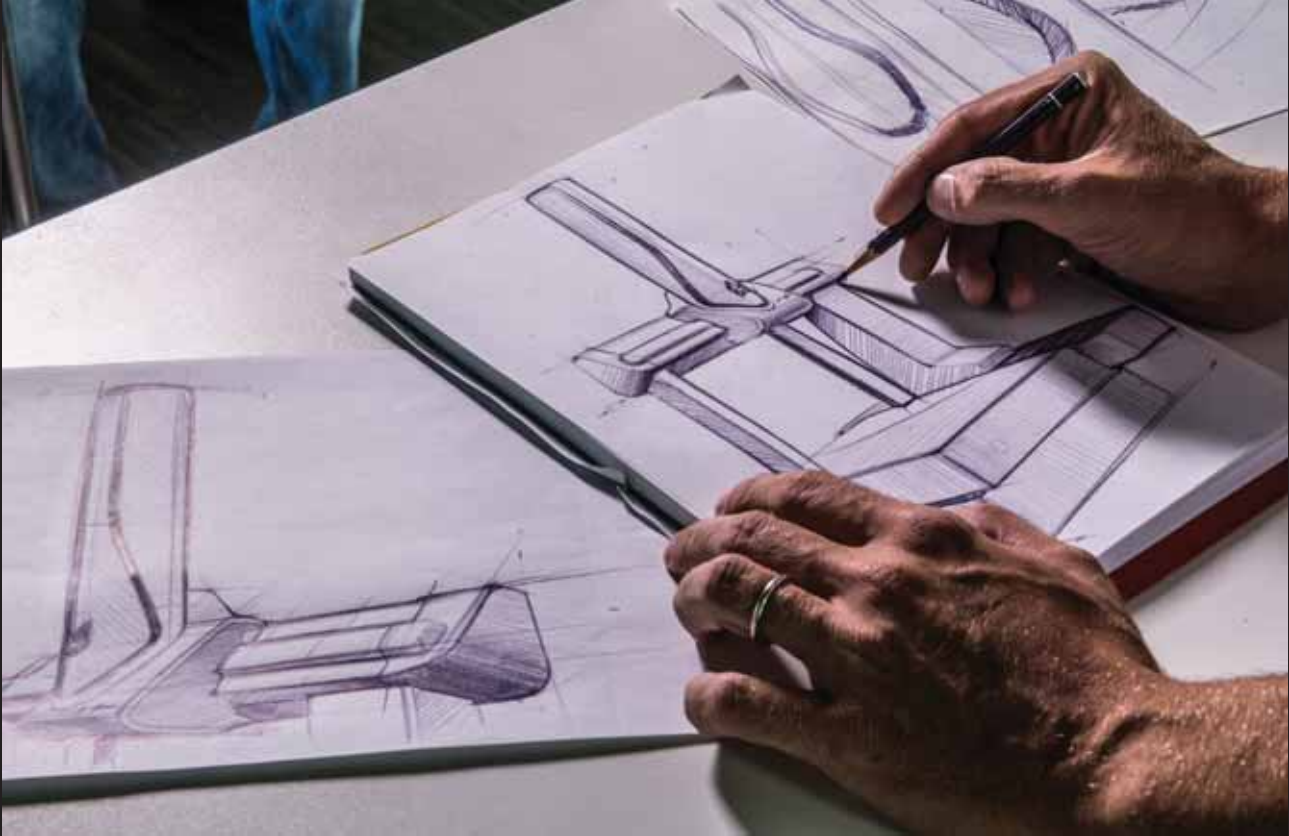




“Design and performance are inherently linked. When you can see attention to detail on the outside, you know that the technology within is designed with the same levels of care.”

Fabio Calorio
Sales and Marketing Manager
Pininfarina Extra





Pininfarina is a name synonymous with the automobile industry, and the company's dynamic designs have enhanced some of the most famous cars ever built. Perhaps less well-known, but no less significant, is Pininfarina's contribution to wider engineering, architectural and industrial design – and it was this expertise that Hexagon sought to bring on board.

Fabio Calorio, Sales and Marketing Manager at Pininfarina Extra, feels that natural synergies between the two companies were apparent from the beginning of the project: "Hexagon and Pininfarina share the same values. Hexagon is about technology, performance, innovation and leadership. At Pininfarina, what we tried to do was to meld our common values together in the machine, adding elegance and sportiness. And, of course, we put into this machine all of our 85 years of unbeatable and unparalleled design experience."

Based on a proven platform enhanced by the latest innovations, GLOBAL EVO is tailored specifically to offer process speed and efficiency to manufacturers that require accurate tactile scanning and high-throughput. Featuring no less than four new technologies,

the machine provides best-in-class scanning performance to cut the time spent on measurement.

Pininfarina worked on augmenting the visual identity of the machine, complementing Hexagon's leading-edge technological developments with an aesthetic and ergonomic design. The study of the Pininfarina design team focused in particular on the vertical measurement axis. After several iterations, this element was given a shape derived from the automotive world, with elegant sports lines and surfaces. The elliptical, aerodynamically-inspired section of the Z-axis covers effectively conveys the machine speed, while the contrast between the translucent, dark front and the painted back adds dynamism. Under the polycarbonate band, the user-friendly status indicator LEDs are placed in columns, a small nod to Pininfarina's automotive pedigree. The result is a machine truly designed for speed and driven by technology.

"Our main goal as designers is to dress technology. The design of GLOBAL EVO thoroughly expresses the innovation in terms of technology and performance," concludes Francesco Lovo, Vice-President Operations at Pininfarina Extra. ■

FINDING SOLUTIONS WITHIN



Accelerate! lifts the lid on production practices at Quonset Point, Rhode Island to see how Hexagon Manufacturing Intelligence engineers use Vero Software technology to improve their own manufacturing workflows.

The North American headquarters of Hexagon Manufacturing Intelligence is located in Rhode Island, the smallest state in America. Just twenty miles south of Providence, the state capital, the North Kingston site has 220 employees. The facility is located on Quonset Point, an area that is home to a combination of industrial concerns and an active Naval Air Station. Sited just a few yards from Narragansett Bay, it offers a waterfront view and picturesque outlook on the Jamestown and Newport bridges.

The building is the workplace of approximately 40 engineers and 40 production staff; the design and manufacture of Hexagon products occurs under one roof. In addition to these technical assets, senior regional management, accounts, sales, services, shipping, human resources, marketing, and all of the other functions necessary to run the North American wing of a global corporation are headquartered here. And while the Quonset Point office may be located in the smallest state, the mindset and ambition of the employees working here certainly is not. Staff members are encouraged to think big and always look over the horizon when it comes to selecting the best tools for building transformative metrology and manufacturing solutions. In some cases, this might mean consulting with an external specialist. But in others, there is a solution much closer to home.

As leading manufacturers know, investing in powerful computer-aided manufacturing (CAM) software can make the difference between being innovators and being eclipsed by new technology. This is why engineers at Quonset Point are staying sharp by using the latest version of Edgecam.

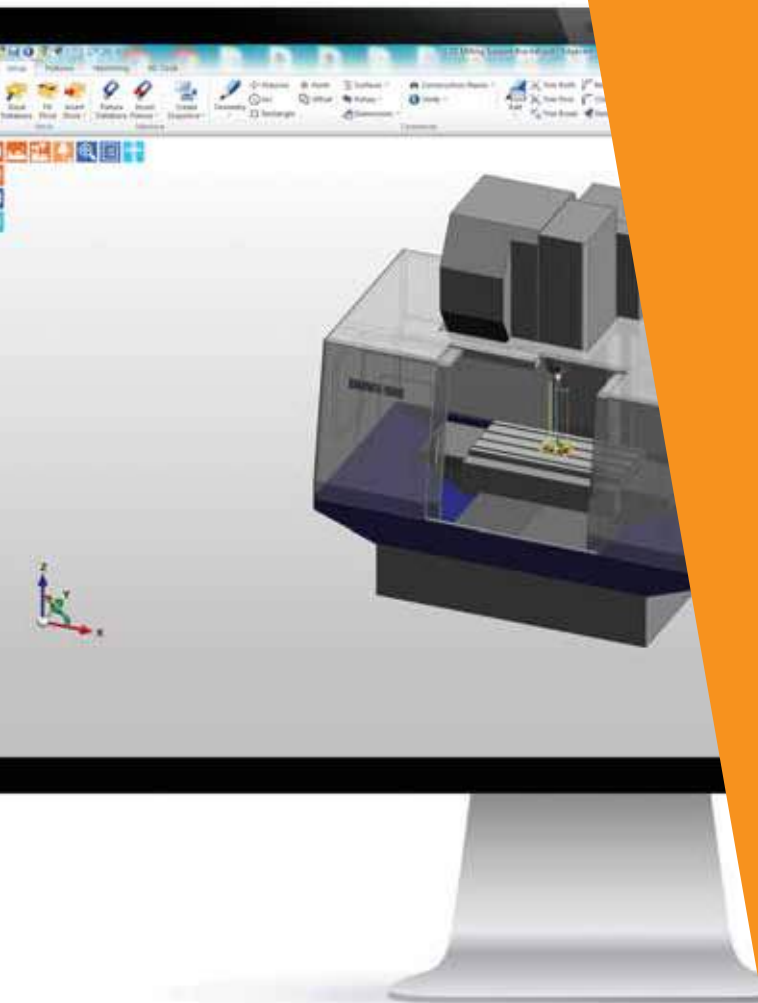


Edgecam, developed by the Hexagon-owned CAD/CAM specialist Vero Software, is a highly-regarded software product designed for manufacturers to expedite the generation of CNC code. Because Edgecam understands both component topology and the manufacturing environment, engineers are able to accelerate the toolpath generation process and therefore reduce costs, improve quality and achieve shorter lead times.

The use of Edgecam technology has given Quonset Point engineers:

- » Fast, comprehensive component setup that dynamically adds stock and fixtures
- » A list of suitable machine tools based on component geometry
- » Intelligent feature recognition to help identify commonly found manufacturing features
- » Insights about manufacturing strategies that make production more efficient
- » Optimised order of manufacture
- » Comprehensive toolpath simulation which checks for collisions, and validates machine limits
- » Proven NC code generation

Tools like Edgecam are helping Quonset Point engineers drive manufacturing efficiency by leveraging the smart capabilities the software places at their fingertips. Because all the elements of the manufacturing process are easily parsed, engineers at the facility are able to add value by using that information. Actions like toolpaths, clamping and stock size used to manufacture a part are analysed to prevent risk and optimise throughput. These features also recommend process improvements – enhancements ranging from better toolpaths to the best way to manage stock changes – making critical decisions about the organisation's manufacturing efficiencies easier and more effective. It's not surprising then, that the simulation tools and data that Edgecam provides have quickly become a key part of operations at the factory. Equipped with software that enables deeper thought and greater efficiency, the environment helps Quonset Point's engineers to work smarter. ■



THE SHAPE OF PROGRESS





““ An idea enabling precision...””

Closing the gap between ‘what is’ and ‘what should be’ – the shared goal of Hexagon and its customers. As we strive to shape smart change together, big ideas are taking shape all around us. **Accelerate!** explores the shape of progress for Hexagon Manufacturing Intelligence and manufacturers around the world.

A lot is written these days about company missions. Although some may dismiss these sentiments as mere marketing tools, having a clear vision and an understanding of why a company exists and the role it plays in society as a whole gives that business a valuable perspective. It maintains a focus on outcomes for customers and helps employees engage with both their business’ values and the needs, desires and values of their customers.

Hexagon aspires to play a leading role in the effort to solve the challenges our world is facing by providing groundbreaking information technologies that make a positive and lasting impact.

If we take a look at the state of our planet, we arrive at one indisputable conclusion: there’s work to be done. Simply put, the task looks like this: on one side we find ‘what is’, the current state of affairs. On the other we see ‘what should be.’ Hexagon and its customers share a common purpose – to narrow the chasm between the two; closing the gap between what is and what should be.

The distance between what is and what should be? CHANGE.

Hexagon customers are at the forefront of change, operating in industries essential to our existence – agriculture, power,



“ “ Allowing quality to remain at the heart of manufacturing. ” ”

safety, infrastructure, surveying and construction, aerospace, automotive, metals and mining – to name a few. Their ability to effect change critically depends on how well they leverage the explosion of data and the disruptive disciplines that make it invaluable – from private and public clouds and real-time analytics to the connectivity of virtually everything.

Hexagon is empowering its customers to harness this huge potential. And Hexagon Manufacturing Intelligence exists to help industrial manufacturers develop the disruptive technologies of today and the life-changing products of tomorrow.

Few would dispute the impact that technologies like automobiles, aircraft and medical devices have had on our day-to-day lives. Yet when the first cars, planes and medical instruments were invented, they were viewed with suspicion and scepticism. It takes great vision to break through

this resistance to change and make a difference. Every breakthrough that has shaped our modern lives started as an idea, making the journey from concept to reality. This is the big idea of Hexagon Manufacturing Intelligence – to build an idea so powerful it brings other ideas to life.

As we strive to build a better future for ourselves and our children, our metrology and manufacturing solutions are the enablers that help our customers to turn concept into reality and build a better world for us to live in. Big ideas need to be nurtured and developed strategically – many potentially world-changing concepts have failed and will continue to fail because they cannot be efficiently manufactured; the cost is too high or the tolerances too tight. As Hexagon Manufacturing Intelligence, our goal is to develop data-driven solutions that overcome these problems and allow potential to be realised – shaping smart change in manufacturing.

We've moved from our metrology heritage, when the quality assurance process was seen as an unwelcome bottleneck, to being a proactive partner of manufacturers and measuring at the point of production to make the feedback loop smaller. We aspire to close the quality loop entirely – sensing, thinking and acting in a continuous cycle so that quality drives productivity and manufacturers can make things right the first time, the ten-thousandth time, every time. Using smart, connected technologies to gather, analyse and use data within the production environment, we enable customers to work at speed and with confidence to push the boundaries of what is possible. Our solutions should not necessarily change the world. But they should help our customers to do so.

This is the idea that is taking shape, where quality drives productivity... This is the shape of progress.
This is Hexagon Manufacturing Intelligence. ■



To see how big ideas take shape when quality drives productivity, visit our website.
<http://hex.ag/10lyVs>

“...accelerating innovation.”



PROGRESS THROUGH COLLABORATION

In an age where customer relationships drive businesses to change, Hexagon Manufacturing Intelligence India's Managing Director, **Anup Verma**, and Regional Manager, **C.S. Srivatsa**, explore how the company's long relationship with Hindustan Aeronautics Limited (HAL) has left a lasting impression on both businesses.

Business success is related to finding the right combination of people, processes and tools. At Hexagon Manufacturing Intelligence, we place this knowledge right at the core of our work, taking a customer-centric approach and working smart for success. As a strategic partner to many big businesses around the world, we pride ourselves on delivering above and beyond the typical scope of work.

These characteristics have been acknowledged on many occasions during our long association with Hindustan Aeronautics Limited (HAL). The company's robust technical requirements and stringent online tendering selected us as the supplier who could match their requirements for absolute and accurate measurements, within the shortest turnaround time. Both companies have grown over the period we have worked together, and from the Hexagon side it's fair to say this association has helped us scale new heights – we have evolved from being just a supplier to a valued partner by understanding HAL's challenges and proactively suggesting solutions.

Creating a Legacy in Every Relationship

HAL has been a customer for us since 1988 and today it is one of our biggest customers in APAC, as well as a strategic collaborator. Before working with Hexagon, HAL followed first principle methods by using basic measuring instruments, profile projectors, blue matching etc. for its aircraft manufacturing activities.

Hexagon has helped develop HAL's metrology infrastructure so that quality control is integrated into every aspect of day-to-day operations. For an aircraft builder, it is vital that actual measured values, which can be used to both ensure quality and inform process decisions, are delivered every time. Chief Resident Inspectors (CRI) from the Air Force and DGQI witness every component measurement, so it's imperative for HAL to maintain robust processes that inspire customer confidence in its manufacturing capabilities.



Diverse and Collaborative Solutions

One of the key advantages that Hexagon can offer is the sheer range and diversity of the product portfolio – something that HAL has embraced fully to build customised solutions for each department and division of the company. Hexagon's GLOBAL CMMs are being used at the LCA Division, HAL Sukoi Engine Division in Koraput, HAL Engine Division in Bangalore and at the HAL ARDC Division. A DEA ALPHA gantry CMM is situated at the CMD Division and an ultra-high accuracy Leitz Cygnus CMM (a forerunner to the Leitz PMM-C model) at HAL Helicopter Division. For large-volume measurements, Leica Absolute Tracker range laser trackers are used extensively in the Aircraft, Helicopters, ARDC and LCA Divisions, while a specially-customised DEA LAMBDA with a measurement volume of 9 m x 4 m x 5 m, believed to be one of Asia's biggest CMMs, is in operation at the Aerospace Division in Bangalore.

In two particularly successful installations, Hexagon CMMs are interfaced with 5-axis machines. The components are picked up by robots from the machine, placed on the CMM and measured so that feedback can be provided to the machine for further correction or processing.

Hexagon machines are also used for inspection in HAL's Engine division where critical aero engine NGVs are machined, while HAL Aerospace utilises them after machining rocket parts for satellite launching vehicles. In one of its most prestigious projects, the Tejas light combat aircraft, HAL's LCA division uses Hexagon equipment to measure the machined body parts while the helicopter division uses it extensively for all types of gear and worm measurements for helicopters. At HAL Helicopters, the Leitz

Cygnus machine is used to take Gleason nominals and the gears are measured without using the rotary table. In what is thought to be a first for metrology in India, our CMMs are interfaced with the manufacturing machines for automatic feedback.

Interestingly, HAL utilises one of the more specialised applications of the ROMER Absolute Arm portable CMM, the ability to measure pipes and send feedback to CNC bending machines. These arms are currently used in HAL Aircrafts and the HAL Engine Division. Almost all the departments of HAL also use TESA precision measuring instruments ranging from hand tools to height gauges.

Of course, in the aerospace industry, data must be stored for a minimum period of 25 years to ensure traceability, and our software-centric solutions are designed to make this process easier for HAL. While most of the machines work with PC-DMIS CAD++ software, two of the ARDC division installations use QUINDOS software.

Partnerships Driving Change

With change being constant and markets and technologies evolving, businesses have to be agile. Our recent transition from Hexagon Metrology to Hexagon Manufacturing Intelligence reflects the growing diversity of our capabilities – all of which is driven by demanding customers like HAL. Being associated with such businesses is not only a great privilege and achievement, but also an ideal platform to develop our technology and position ourselves to help more customers. ■

CASE STUDY

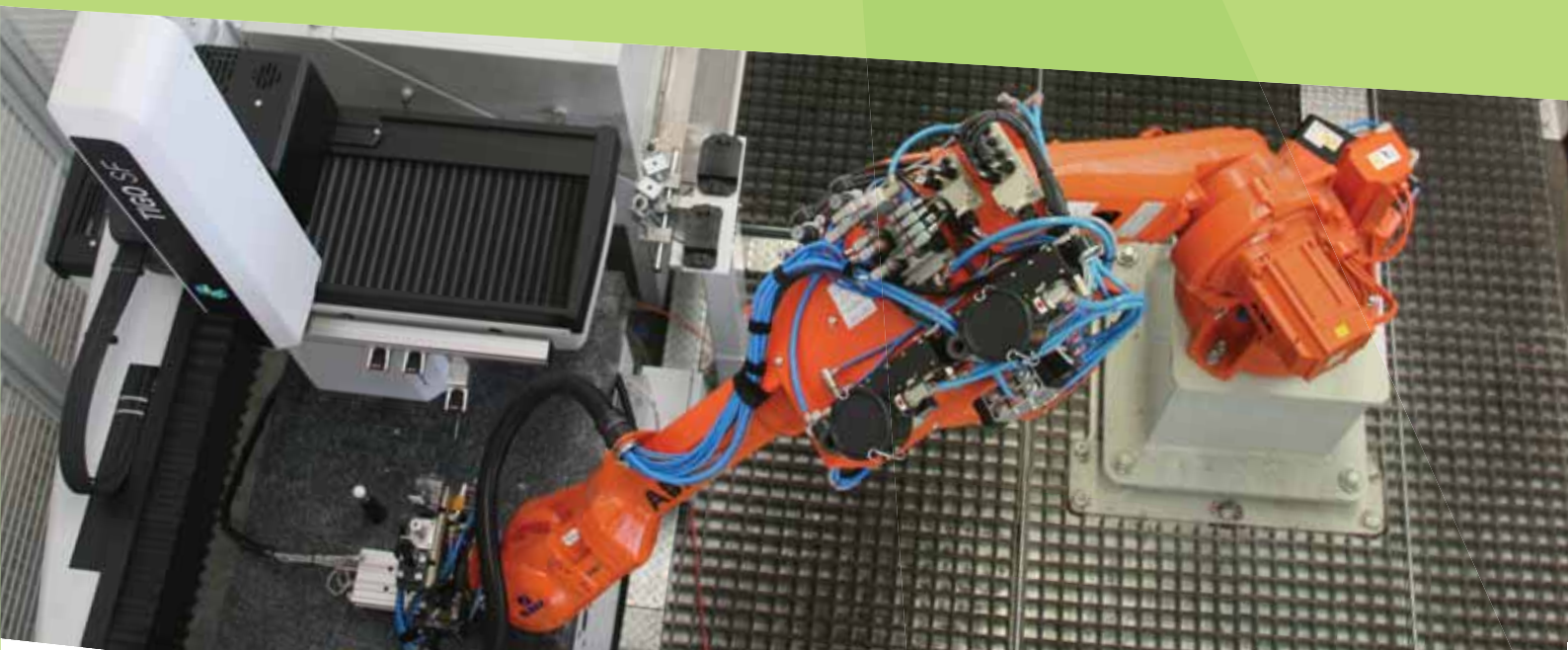
HEXAGON

FLUID DYNAMICS



Automated shop-floor inspection system from Hexagon Manufacturing Intelligence keeps Italian oil-hydraulic component supplier's production cell at full flow.

For oil-hydraulic component manufacturer 3B FLUID POWER, productivity is the key to success. Installation of a TIGO SF shop-floor coordinate measuring machine (CMM) as part of a fully-automated production and measurement cell has enabled the company to increase inspection sampling from 10% to 50% without slowing the work cycle of the machine tool. Operating to tolerances in the region of 10 microns and producing 24 hours a day, 7 days a week, the process efficiency has contributed to the company trebling its turnover in just a few years. ■



“We opted for a TIGO SF CMM because this machine has characteristics that make it suitable for operations in a shop-floor environment.”

Andrea Barani
General Manager
3B FLUID POWER

Company: 3B FLUID POWER
Location: Novellara, Italy
Industry: General manufacturing
Solution: TIGO SF with industrial robot



To find out more about how 3B FLUID POWER uses the TIGO SF, go online to read the full case study.
<http://hex.ag/10lyS0>

SOFTWARE SECRETS

Getting the best from your hardware is often dependent on knowing your software. This issue, **Accelerate!** puts your questions to Hexagon Manufacturing Intelligence software specialists.

Q As a new SpatialAnalyzer® user, I'd like to know how important temperature scale is, and what methods of scaling are best?

A: **Richard Nelson**, Senior Application Engineer at New River Kinematics, says: While metrology instruments compensate for temperature changes in their measurements, operators must still account for changes in the size of parts due to shifts in temperature. For example, a two-metre aluminium bar will grow 0.47 mm (0.019 in) as the temperature increases by 10°C (18°F). It might not sound like a huge proportion of the bar, but it is a significant shift to a metrologist and these shifts must be taken into account in order to make accurate comparisons to a design part.

Scale in SpatialAnalyzer® is applied as a property of a measurement station. As temperature changes during measurement, new stations can be added. By scaling the measurements to a consistent reference temperature, all the stations can easily be networked together for an accurate comparison to a design part.

As for what methods of inspection are best, it really depends on the situation. If an accurate delta temperature can be obtained, scaling based on Coefficient of Thermal Expansion (CTE) is ideal. The core temperature of the object must be accurately measured to ensure sound results. Alternatively, you can use the measurements themselves to establish scale, which is known as Best-Fit Scaling (7DoF fits). Allowing scale to float during a best-fit works well with a set of reference points integrated into the part; however, establishing the network at a known temperature is required.

Q I'm considering implementing a metrology simulation platform. How does the I++ Simulator differ from conventional dimensional metrology simulation software and what are the advantages?

A: **Gianni Gencarelli**, I++ Simulator Product Manager, says: The concept of the I++ Simulator approach is very different from the current simulation functions in other manufacturers' proprietary measurement software. I++ Simulator makes virtual coordinate measurement technology possible, similar to the virtual commissioning of automation systems in equipment simulation.

The virtual scenario enables 3D visualisation of the entire process, including measuring and peripheral equipment like automatic pallet systems and robots. Machines and equipment can be controlled by control and part programs, whilst users can interact with this virtual world to teach movement paths or align workpieces. Offline programming is performed just the same as on a 'real' machine, but without the process downtime normally associated with setup and programming.

The key benefits; well, simulation frees users from the stranglehold of manufacturing cycles as the physical part and measuring machine are not required. Simulated measurements make identification of errors and collisions possible. Accessibility and critical conditions can be tested and conclusions about correction parameters for the measurement process drawn and verified. Time-consuming run-in of new programs is no longer necessary, which makes complete automation of the measurement process possible.



Richard Nelson



Gianni Gencarelli



Shaun Wissner



Karin Schneider

Q What is Model Based Engineering and does PC-DMIS support it?

A: PC-DMIS expert **Shaun Wissner** says: Model Based Engineering (MBE), otherwise known as Product and Manufacturing Information (PMI) or Model Based Definition (MBD) is simply digital tolerance annotations embedded in a CAD model. The idea is to remove both the paper and the interpretation from the manufacturing and quality processes. The types of information included are geometric dimensioning and tolerancing (GD&T), component level materials, assembly level bills of materials, engineering configurations and design intent.

With Computer-Aided Design (CAD) software tools, component manufacturers are able to receive a single CAD file and complete all the necessary steps to build and inspect a given part. The ability to design tooling, machinery and processes from the CAD model has been common practice for years, however, an accompanying blueprint was always required to create an inspection plan. Now the component datum structure, GD&T, key characteristics and any other necessary dimensioning can be embedded directly into the CAD model. The only thing a quality technician needs is inspection software capable of utilising the embedded data – like PC-DMIS.

PC-DMIS can use this embedded data to create features, datum definitions and associated dimensions from a single click in the software. Another key point is the use of a feature control frame editor for the user interface. PC-DMIS all but eliminates the need to program inspection routines via messy

code and clunky text editors. Exploiting the benefits of MBE and PC-DMIS, a quality technician can create inspection plans for new components in half the normal time. It's a simple process to import the CAD model and select the feature control frames and/or other linear dimensioning from the MBD. Each dimension selected will add the correct (up-to-date) features and tolerancing to the plan based on the designer's intent with no interpretation necessary by the quality technician.

Q What changes has the continuing modification of the Geometrical Product Specification (GPS) brought for QUINDOS in the short term?

A: QUINDOS Product Manager **Karin Schneider** says: A pilot implementation of the new GPS standards in ISO 14405-1:2010 on Linear Sizes was introduced with QUINDOS Version Q710.16343, and user-friendliness was a key focus during its realisation. A visualisation is generated in the dialogue according to the inputs (feature of size, modifiers, dimensions), which corresponds with the drawing specification. This concept ensures that users can confidently apply the new norm, in particular with support from the integrated plausibility checks. The command already complies with ISO 14405-1, which will come into effect in autumn 2016.

The most recent norm developments were also considered when implementing the verification of line profiles with variable tolerance zone (UZ) according to ISO 1660. This will be available in the upcoming QUINDOS release with the same interactive dialogue concept. New developments when evaluating pitch planes according to ISO 1101 will be also available in the next release. ■

MOULDING WITH INTEGRITY

Specialist plastic flow analysis software performs a significant role for a leading UK tool and mouldings manufacturer which successfully produces over 400 pre-proven tools each year.

Company: Formaplex
Location: Hampshire, UK
Industry: Tooling, Mould and Die
Solution: VISI Flow injection simulation software

When you are running over 40 CNC machine tools and 11 injection mould presses, errors can be expensive. Using smart manufacturing software can help, which is why UK-based Formaplex uses VISI Flow from Vero Software. Formaplex designs and manufactures aluminium and steel injection mould tools for the automotive, motorsport and aerospace industries, and produces low-volume finished moulded components. VISI Flow's injection simulation enables Formaplex to achieve cost-effective and reliable designs and optimum moulding conditions as well as identifying potential manufacturing issues before they occur, avoiding downtime, repairs, wasted toolmaking and setting time, and reducing material costs. ■

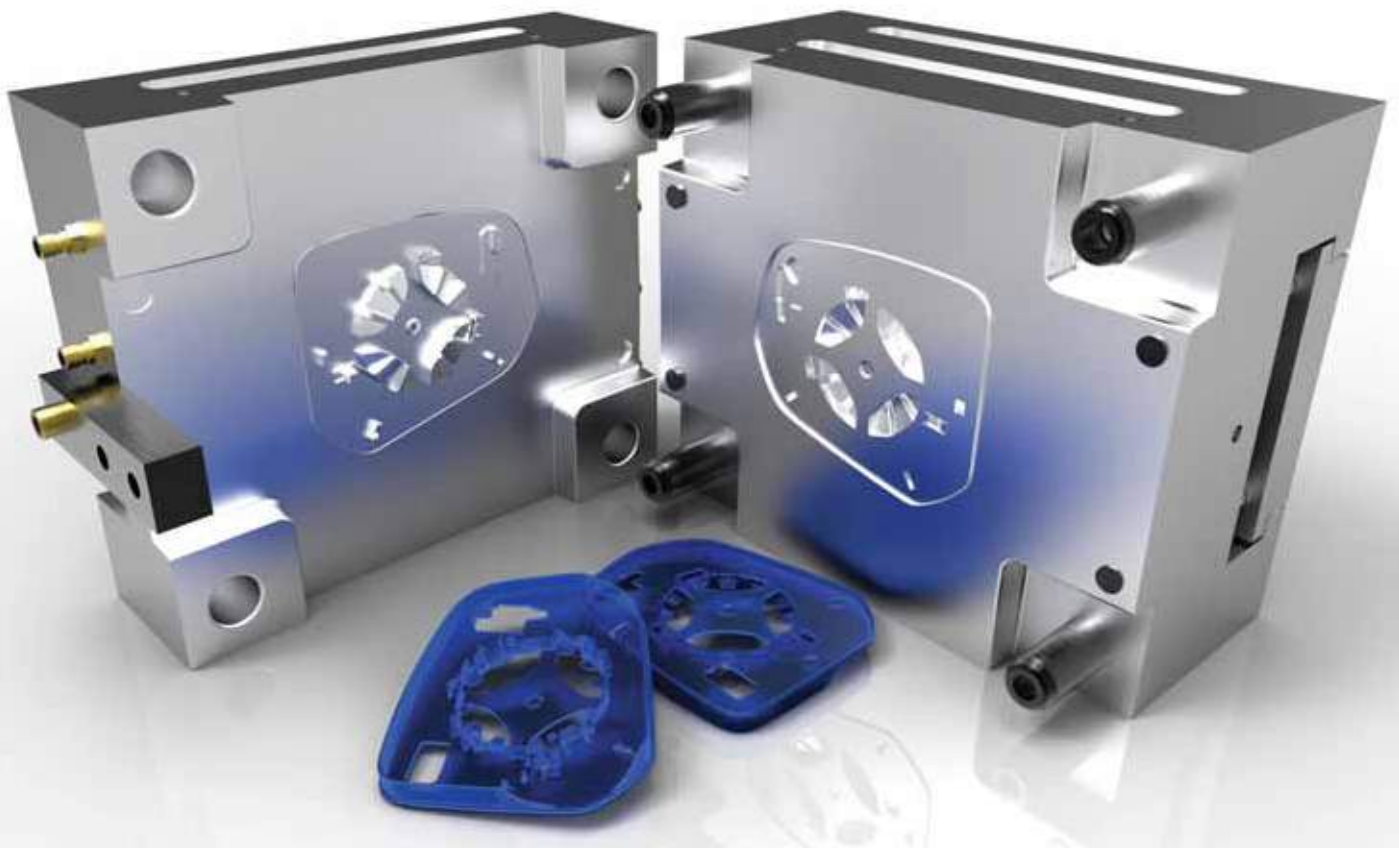


“ Within the first month of using VISI Flow to analyse the correct filling pattern and maximise our process parameters, we saved the cost of the software.”

Adrian Chapman
Technical Director, Formaplex



To find out more about how Formaplex uses VISI Flow, go online to read the full case study.
<http://hex.ag/10lyTO>



DEALING IN SUCCESS

Following an exciting 2015 that saw the company rebrand and take part in the very first HxGN LIVE Hong Kong, **Accelerate!** spoke to four Hexagon Manufacturing Intelligence dealers from the Asia Pacific region about their relationships with the company and what they made of the year's events.

Cairnhill Metrology, Singapore

Cairnhill Metrology, founded in 1983 in Singapore, is a regional distributor of industrial metrology solutions, covering the Philippines, Thailand, Malaysia, Singapore and Indonesia. The company's relationship with Hexagon dates back to early 2001, when it became a dedicated international reseller for a range of portable measuring arms that was subsequently acquired by Hexagon.



"2015 was my first attendance at HxGN LIVE, an out-of-the-box event that truly sets Hexagon apart," enthuses Lim Seng Hoo, Group Managing Director at Cairnhill Metrology. "The new name, Hexagon Manufacturing Intelligence, is innovative and bold – it succinctly sums up strategic intent, vision and mission. Overall I'd say our relationship with Hexagon is good and always evolving. The best will come and is yet to be!"

Digigate Technology, Thailand

Digigate Technology has been in business with Hexagon since 2005 and holds the honour of being the first dealer to setup a calibration room facility in Thailand. In the decade-long relationship, Digigate Technology and Hexagon have developed an excellent working relationship, and the Thai company works closely with local Hexagon contacts in the country to develop and supply the best solutions for customers.

Chiu Yew Kong, Managing Director of Digigate Technology, is quick to praise, "In all these years, Digigate Technology has had an excellent relationship with Hexagon Thailand. The team always offers support and gives us good advice, and so we will be taking more Hexagon machines to market from this year. I'd like to take this opportunity to thank APAC President Mr. Lim Boon Choon, and Hexagon Thailand's Mr. Srisuntisuk Taveesak for supporting us always. Really, we are honoured and humbled to be a part of Hexagon's network."





ATTOTECH, Korea

Founded in 1993, ATTOTECH traded in Hexagon products for some time before becoming an official distributor in 2010. Specialising in coordinate measuring machines (CMMs) from the Serein factory and ROMER Absolute Arm portable systems, the company is keen to progress its relationship with Hexagon from that of a supplier and distributor to that of a real collaborative partner.

"I attended HxGN LIVE in Hong Kong in 2015, which enabled me to see Hexagon's vision for the future," explains Chunkwon Lee, Executive Director of Technical Sales. "When I saw not only the traditional metrology applications but also the in-line systems, statistical process control, automation and so on, I could see the synergies Hexagon is building. I feel the company is really extending the business arena right now, and it's something my company wants to be part of."

"The rebrand from Hexagon Metrology to Hexagon Manufacturing Intelligence demonstrates the expansion from hardware manufacturer to software-focused information technology solution provider. Initial feedback from customers seems positive and we look to the future with optimism for our relationship."

Metrotec Corporation, Japan

Japanese distributor Metrotec Corporation can lay claim to a lengthy working relationship with Hexagon. The two companies have worked together, in various other guises, for 27 years, and Metrotec sells an extensive range of Hexagon technologies all over Japan.

"Our relationship with Hexagon is many years old, yet we feel it becomes better year by year," says Mikio Enomoto, CEO of Metrotec Corporation. "In future, we hope to provide more Hexagon products. This will enable us to respond to a complete range of customer needs and requests."





FAST-TRACK PRECISION

Speed and confidence are part of the mentality at Hexagon Manufacturing Intelligence, but for one member of the team, they mean a little more than most. **Accelerate!** caught up with **Christophe Courtet**, TESA employee and passionate car racer, to see how the high-precision measuring instruments he works with contribute to success in his sports career.

Christophe Courtet began working in 3D sensor painting at TESA in 2010 and combines his job with his great passion in life. With approximately 20 years of experience in karting, rallying and hill-climb racing, Christophe is a serious competitor in the French Hill Climb Championship. Driving his powerful Silver Car, he finished second in several competitions throughout 2015, which boosted his motivation and energy. Christophe is now fighting to maximise his points in the upcoming races to secure qualification for the Championship Final in September 2016.

Of course, precision measurement equipment comes in handy when you are preparing a car to race, so Christophe's work life and sporting career soon began to cross over. Today, Christophe has become something of an ambassador for TESA, and represents the company at competitions of the French Hill Climb Championship.

"TESA measuring instruments, such as callipers, dial gauges and the TESA IMICRO internal micrometer are essential tools in controlling the quality and setup of the car components that determine its performance during competitions," Christophe explains. "Precise measurements and subsequent fine-tuning are crucial in making your car faster. And in car racing, it is often just a few milliseconds that make the difference between a good final result and winning a race."

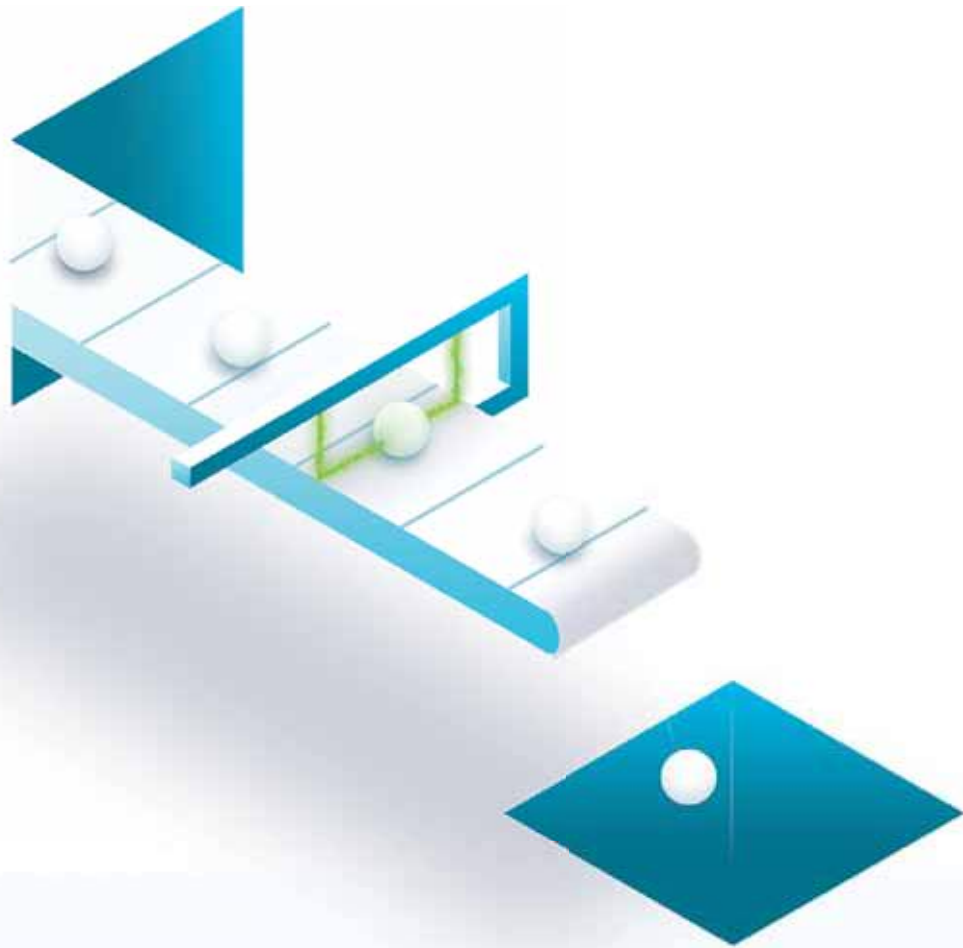
During the winter break, Christophe and his team work on making his race car more competitive, always recording adjustments with their high-precision TESA instruments.

"In a field where the smallest mistake can be decisive and which is based on metrology, quality is fundamental. I am very proud to represent TESA, and my motto during competitions is 'TESA, the extreme measure of my performances!'" ■



BIG IDEAS TAKE SHAPE.

When quality drives productivity.



We enable manufacturers to work at the speed they require with the confidence they need to make it perfect the first time, the ten-thousandth time, every time.

Shape Matters to Hexagon. Shaping Smart Change.
hexagon.com



HEXAGON

shaping smart change

VISIONARIES UNITE

This issue, **Accelerate!** celebrates innovation with some of Hexagon Manufacturing Intelligence's brightest and best – the inventors and project leaders who turn ideas into reality through groundbreaking research and development (R&D).



Name: Carsten Struve

Job: Chief Technology Officer

Length of service: 6 years

What is the biggest evolution you have seen in R&D processes in the last few years?

We implemented the Hexagon Innovation Process (HIP) worldwide. It's a stage gate project management tool to improve the workflow and visibility of our projects, and we had very positive feedback from the teams involved.

Why do we need to innovate?

Innovation is the driver for our success on the market. New innovations help our customers to be more efficient and successful and this is the service we have to deliver.

Could you give us an insight into the process of innovation?

Planning an innovation is the most exciting thing. We have an innovation wheel as part of the HIP – a process flow from idea to final product. So, we meet with the different people involved and encourage everybody to share their ideas. Once the ideas are presented, we discuss feasibility and market impact to make a first selection before further investigating the top few ideas. The final selected idea then goes through pre-project to minimise the risks, before we even consider taking it to a full project.

What is your favourite part of the innovation process?

As an engineer you are always proud to see your ideas working in reality. A perfect example is the Leica Absolute Tracker AT960, where several groundbreaking ideas were put together and became a very successful product on the market.

Does innovation change manufacturing, or does manufacturing change innovation?

Innovation is constantly changing manufacturing. Think for example about the invention of the robot, it has changed manufacturing completely. Another major step will be the Industry 4.0 or smart factory approach, which I think will change the workflow in manufacturing again.

What makes a product truly innovative?

Benchmarks against others are usually a good measure, but the only truth is the customer. If they decide to buy our products, we know we are doing something right. Hexagon is the benchmark for many products and we are fortunate that our customers give us exactly that feedback. To keep that reputation for innovation and even grow it, we have to work even smarter.



Name: Marco Massaia
Job: R&D Manager, Turin CMM
Factory
Length of service: 1 year

What is the biggest evolution you have seen in R&D processes in the last few years?

One of the biggest evolutions, which relates to R&D and beyond, is the interconnectivity that allows us to react faster by sharing information between different entities, regions and companies. Being part of a global company enables skilled people all over the world to collaborate as part of a team.

Why do we need to innovate?

Innovation refers to changing, improving or creating more effective processes, dynamic products and ideas that increase the likelihood of a business succeeding. I think innovation is the most vital factor in success – it is a catalyst for growth in a competitive world. Global economic forces and financial constraints have made innovation-driven growth more essential now than ever before. To survive in this environment, companies must constantly improve the things they do, and also come up with new, different ways of operating.

Could you give us an insight into the process of innovation?

Innovation is not a single event or activity, it is a process and outcome of creating something new and of value. It runs from opportunity identification through ideation or invention to development, prototyping, production, even marketing and sales. A typical team for us might be anywhere from five to twenty people, and they might work together for one year or five years. It just depends on the project.

What is your favourite part of the innovation process?

The conception phase is my favourite part, where people's creativity and passion are merging. In this phase, creativity is driving all the activities that make the idea real and provide the basis for the next steps involving the project team.

Does innovation change manufacturing, or does manufacturing change innovation?

Recently some manufacturing trends have emerged that drive the innovation process. Due to factors such as globalisation and outsourcing, there is an increased push to

improve organisational efficiency. I also think consumer expectations drive innovation in the market. Customers are used to products that continually improve and add features that make their life easier.

What makes a product truly innovative?

Innovations can fall into one of three categories: incremental, complementary or disruptive. Incremental innovations are small changes, additions and improvements to existing products and services. Complementary innovations are new products or services that support the existing ones. Disruptive innovations replace existing products by being significantly better than anything currently offered in the market. All these cases are innovations but only the last has a radical impact.

TEAM TALKS



Name: Laurent Desforges
Job: R&D Manager, Portable Measuring Arms
Length of service: 12 years

What is the biggest evolution you have seen in R&D processes in the last few years?

Definitely the standardisation of the processes and tools. HIP and our project management tool are now common across Hexagon, while our product lifecycle management system and intranet centralise the product and project information for simple stakeholder collaboration.

Why do we need to innovate?

World-changing innovations infiltrate daily life by increasing the standard of living and providing people with opportunities to simplify their lives. Innovation has also led to significant improvements in the way businesses operate. Companies that innovate get a jump on the competition by addressing the changing needs of customers. To survive with the constant emergence of new technologies, you need more than good products. It requires innovative processes that drive down costs yet improve quality and productivity. Today's customers are better informed and have more choice of what they buy and from whom, so you have to offer innovative solutions.

Could you give us an insight into the process of innovation?

Well, I say that to be an innovator, you don't need a crystal ball: you need a wide-angle lens! It's about gathering data and creating synergies that drive development. As it's hard to pin down the value of an idea that exists only as a concept, we use a process which evaluates the earnings/risks of our inspiring visions. That proven process guides us step by step, ensuring that each milestone has been fully studied, documented and secured.

What is your favourite part of the innovation process?

I personally like the way the innovation process challenges our organisation to look beyond its established business boundaries and mental models, and how we fuel this innovation process from R&D to other departments.

Does innovation change manufacturing, or does manufacturing change innovation?

I'm not sure there is a proper answer to that one, since I believe it's both. This is a virtuous circle where everyone contributes with the common goal of improving productivity and quality.

What makes a product truly innovative?

You don't create truly innovative products by copying what other people are doing. A product or an idea is truly innovative when it stands out from the rest and makes customers' lives easier. You have to match solutions to the needs of your customers in every industry and also engage with upcoming technologies. This approach is part of Hexagon's DNA. When there's a new trend in manufacturing, you can expect us to integrate these technologies into innovative solutions for our customers.



Name: Michael Zapp
Job: R&D Manager, Vision
Length of service: 6 years

What is the biggest evolution you have seen in R&D processes in the last few years?

The biggest evolution in R&D processes is our HIP implementation. It gives us the same understanding and standards framework. But the important thing for me is that it is not only an R&D process. All departments are involved in bringing innovations to life, and I think this gives everyone confidence and motivation.

Why do we need to innovate?

Looking into the future, the question should be 'what are we innovating for?'. We do it to offer our customers technologies that enable them to realise processes and products that make them successful on the market.

Could you give us an insight into the process of innovation?

Innovations need impulsion, realisation and bringing into market. Early contact with customers is important, you get input on

what the customer needs and actively discuss new ideas and approaches. So market pull – getting ideas from customers and market push – discussing new ideas with customers. Any new product has to be bought by customers after all. Really, innovation is not R&D only; in the early stages product management is important. During realisation, R&D is perhaps the main actor, with the support of the other departments that will build the product. In the end phase we hand over to production, and when the product is ready, sales, service and product management bring it to the customer and get feedback for the next product update. So there are a lot of people in the innovation process!

What is your favourite part of the innovation process?

There is no favourite. The most important are the challenge, the success in solving problems, and getting good feedback about customer satisfaction.

Does innovation change manufacturing, or does manufacturing change innovation?

It's both. A new idea or approach can change manufacturing (push), and a request to solve a problem can create a new manufacturing solution (pull).

What makes a product truly innovative?

The bandwidth of technologies and solutions that could be offered to customers is a cornerstone to being innovative. And of course, a broad technology and product base is one of the strengths of Hexagon.

Name: Alfons Meid

Job: Senior Project Manager,
Laser Tracker Software/
Firmware

Length of service: 26 years



What is the biggest evolution you have seen in R&D processes in the last few years?

I think the implementation of new tools and processes have made developments more agile. In particular, software development has become agile with the use of scrum development methods. But agile projects in a multi-project landscape produce so many status changes that they demand a sophisticated workflow system. There would be no chance to

do this on paper.

Why do we need to innovate?

In industrial metrology, customers look for innovations that give them convenience – like portability and cost savings – without sacrificing the high accuracy that they are used to. Even perfect products have a life cycle that ends someday; perhaps because new technologies make something better possible, or just because components cannot be built or purchased any more, forcing a replacement.

Could you give us an insight into the process of innovation?

Well, innovation projects vary hugely in scope as far as cost, duration and the number of involved people is concerned. But it is project management, carried out by cross-functional teams, that brings innovations from ideas to results. In our process, the inception phase forms targets from ideas and measures investment and benefit. Design, implementation and testing follow and eventually the outcome is delivered to the customer by production, sales, support and service.

What is your favourite part of the innovation process?

It is the part when the product moves from being just paperwork to functional components, hardware as well as software. Then expectations and wishes, doubts and scruples start to be checked against feasibility and reality. We see what can really be achieved.

Does innovation change manufacturing, or does manufacturing change innovation?

Both happen at the same time. Our innovations make customers' lives easier by improving their manufacturing processes. Vice versa, we derive our innovation ideas from the customers' ways of working. This enables us to develop the most suitable systems. This is why we are focusing on integrated, automated solutions that connect metrology with manufacturing processes.

What makes a product truly innovative?

That depends on the perspective. A customer may perceive a convenient function as a great innovation, whereas the engineer implementing it finds it boring. From a commercial point of view, this function is truly innovative. On the other hand, if we make a laser tracker twice as accurate as it is today, that would be a great technological innovation. But if no customer asks for it, is it truly innovative? Perhaps this would be judged differently in an academic environment to a commercial one. ■

The latest PC-DMIS user whitepaper from **Rob Jensen**, Dimensional Standard Compliance Manager at Hexagon Manufacturing Intelligence, looks at the role of Geometric Dimensioning & Tolerancing (GD&T) and how to capitalise on its value proposition. This issue, **Accelerate!** readers get a sneak preview.

Geometric Dimensioning and Tolerancing (GD&T) is defined in two standards, ASME Y14.5 and ISO 1101. Drawings produced according to these standards yield precise definitions for each of the 14 geometric tolerance types used to control form, size, orientation and location, resulting in a single, precise interpretation of the part specifications. This ensures parts produced globally and in conformance to the drawing specifications meet the functional requirements of the final product.

In summary, GD&T provides the tools for designers to specify the maximum tolerances required for the function of the final product in its assembled state. Geometric tolerances referencing datum reference frames (DRFs) represent how parts fit with the mating parts in the assembly, which ensures that when parts conform to their geometric tolerances they will function as designed. Drawings produced in accordance to GD&T standards (ASME and ISO) will have one precise interpretation regardless of where the parts are produced globally.

This whitepaper describes the engineering standards and benefits of GD&T, along with the supported attributes in the PC-DMIS measurement software. The document looks first at the benefits of GD&T in the manufacturing process, discussing the merits of geometric tolerances versus plus and minus tolerances and exploring the role of GD&T as an international language that provides concise specifications for suppliers globally. Differences between ASME and ISO are also covered, with examples demonstrating how terms can be different but have the same definition (features of size), and how the same geometric tolerance can have different definitions (profile). Finally, the whitepaper shows GD&T attributes in action in PC-DMIS, walking through several useful scenarios for software users around the world.



To find out more about GD&T in PC-DMIS, go online to read the full whitepaper.
<http://hex.ag/10oIFb>

INTELLIGENT INNOVATIONS

As Hexagon Manufacturing Intelligence continues to roll out its SENMATION intelligent sensor automation system, **Micha Neininger**, Product Manager – Accessories and Sensors, examines the thought processes behind the development of this new technology.

As a manufacturing technology developer and OEM, Hexagon invests heavily in research to ensure continued innovation. However, development is not always about improving the capabilities of existing systems. It can be also about the wider impact of the system for customers; so things like offering a better user experience, increasing the breadth of application potential and giving customers faster return on investment. Of course, some system improvements do drive these types of changes organically. But sometimes, it's a complementary technology or system that has a major impact for customers.

This kind of development can be seen in the SENMATION intelligent sensor automation system for Hexagon's ultra-high accuracy coordinate measuring machines (CMMs). An ultra-high accuracy system is primarily defined by the accuracy of its measuring performance. However, because of the ongoing development across the industry,

the ultra-high accuracy arena is also the place to find the most cutting-edge supporting technologies. After all, what is ultra-high accuracy today could be the standard of tomorrow if progress continues.

With SENMATION, Hexagon focused not on improving the CMM accuracy, but on applying the system accuracy in a better way to improve output. A universal sensor interface that fuses the flexibility of multiple sensor types with the convenience of automation, the SENMATION system delivers the right inspection tool at the right time within a program, ensuring every aspect of the part can be measured with the most appropriate sensor. Using an integrated probe identification system, SENMATION recognises and status checks the new sensor automatically for fast changes without the need to recalibrate.

The overall result is threefold. As an automated system it speeds up sensor exchange, minimising the time taken to

measure a part and supporting higher throughput. The ability to switch inspection method within the same program makes part programming much simpler for operators, giving a better user experience. Having the choice of different sensors extends the application potential of the CMM, enabling it to support more measurement requirements and ensure uptime to maximise return on investment.

So, where does this type of development lead in future? Although at first glance it may look like an accessory, SENMATION takes the ultra-high accuracy CMM line a step further towards 'Quality 4.0', the process-integrated, automated 'total inspection' approach to quality control that is expected to play a huge role in the establishment of the ultimate targets of Industry 4.0. It's a development that adds value for the customer in many ways, engages with key industry trends and enables manufacturers to continue their progress towards better productivity. ■

CHARGE OF HOPE

To mark one year as Hexagon Manufacturing Intelligence's global charity partner, **Hannah Bostock** from spinal cord injury research foundation Wings for Life gives **Accelerate!** an insight into the groundbreaking research and technological innovations helping people affected by spinal cord injury to sense, think and act again.

Millions of people around the world are living with a spinal cord injury. As a result of their injury many find themselves dependent on the use of a wheelchair and many have additional side effects such as no use of the bowel, bladder or sexual functions. Spinal cord injury affects people of all ages and backgrounds and is most commonly caused through road traffic accidents or falls. Spinal cord injury happens in a moment, but the impact lasts a lifetime.

The not-for-profit foundation Wings for Life funds world-class scientific research and clinical trials around the globe aimed at finding a cure for this devastating injury. One current research project sees Wings for Life co-funding a clinical trial called the Big Idea. This is the second phase in a groundbreaking study being conducted by Prof. Susan Harkema at the University of Louisville.

It all began with a single toe. Prof. Harkema remembers her patient's exact words: "Hey, Susie, look at this – I can move my toe." Rob Summers had been paralysed from the neck down following a car accident and was told he would never walk again. But within just weeks of Prof. Harkema applying an electrical stimulator to his spinal cord, the unimaginable had become possible; Rob was gradually regaining movement in his limbs. Rob was the first of four fully and chronically paralysed patients to be treated with the experimental therapy of epidural electrical stimulation and intensive rehab.

Epidural stimulation involves applying a continuous electrical current to the lower part of the spinal cord. The electrical stimulation is provided by a small electrode chip implanted over the dura, the protective coating of the spinal cord. A remote control, roughly the size of a smartphone, controls the frequency and intensity of the current. When used in combination with intensive rehab, the electrical stimulation enables paralysed patients to make certain voluntary movements.

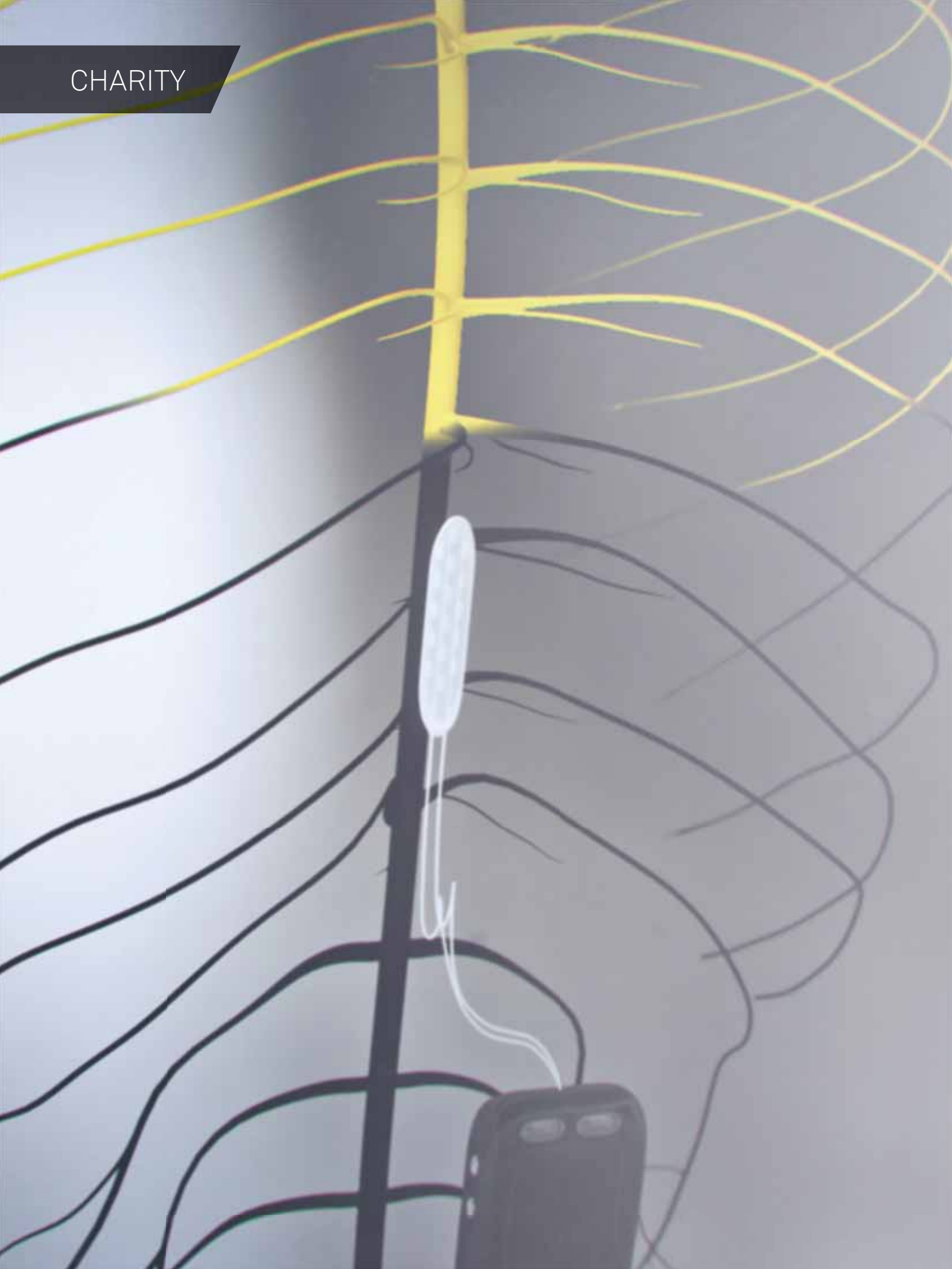
The spinal cord contains networks of nerve connections capable of performing some movements independently of the brain, like reflexes for example. Epidural stimulation taps into this ability by sending chemical impulses out from the base of the spine. The voluntary movements regained by patients are thought to occur because the impulses strengthen weak nerve signals and reactivate neural circuits.



“Hey, Susie, look at this
– I can move my toe.”

Rob Summers
Spinal Cord Research Clinical Trial Patient

CHARITY



Prof. Harkema's research project is now being extended and controlled via the Big Idea study, which will involve a larger number of paralysis patients. A special group of eight patients within the study is being financed by Wings for Life directly. There are great hopes that epidural stimulation will continue to be a success and help millions of people like Rob Summers.

How You Can Help

Wings for Life is the global charity partner of Hexagon Manufacturing Intelligence. There are a variety of ways in which you can directly support Wings for Life and its mission. From holding your own fundraising event such as a bake sale or sporting challenge, to making a direct donation to Wings for Life online, or joining Team Hexagon and thousands of other runners globally for the Foundation's flagship fundraising event, the Wings for Life World Run – the global race where the finish line chases you. What's more, when you support Wings for Life, 100% of the money you donate will go directly to spinal cord injury research as the charity's founders generously cover all of the administrative costs. ■



To find out more visit www.wingsforlife.com or www.wingsforlifeworldrun.com

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WINGTOP WONDER

Laser tracker guided automated scanning solution helps aviation industry researchers inspect jet wing surfaces in minutes.

The National Institute for Aviation Research (NIAR) at Wichita State University is a leading advanced aircraft manufacturing laboratory and a pioneer of new processes and techniques to expedite and improve aerospace production while ensuring quality and safety standards. Working with Hexagon, NIAR has developed an automated wing surface scanning solution for the aerospace industry. Using a Leica Absolute Tracker and Leica T-Mac to guide a robot carrying a Leica T-Scan 5 non-contact laser scanner, engineers cut the surface inspection time for a small business jet wing from a full day to less than four minutes. ■



Company: National Institute for Aviation
Research (NIAR)
Location: Wichita, USA
Industry: Aerospace
Solution: Leica T-Scan 5 on an industrial robot



To see the automated
inspection system in
action at NIAR, go online
to watch the video.
<http://hex.ag/10lyOC>



RETRO, BUT FIT

With new technology always in demand, businesses must balance the value of productivity improvements against the cost of equipment. In this *Shaping Smart Change* blog post from June 2015, Hexagon Manufacturing Intelligence customer services expert **Filippo Racci** explains why the best new technology may be what you have already.

Although investing in equipment involves significant outlay and is never a decision to be taken lightly, one of the major plus points of purchasing a stationary coordinate measuring machine (CMM) is that the frame – the machine's main structure – is not subject to significant wear. As a result, CMMs can remain in service for many years and customers typically have plenty of time to see return on the investment.

However, with the pace of technological progress today, the machine structure will see many other changes around it during its lifespan. Equipment, inspection techniques, production methodology and operator skillsets may all change around it. Although the frame might remain fundamentally sound, other vital elements of the CMM – like the software, electronic controllers and probing equipment – can become outdated or even obsolete long before the business is ready to purchase a replacement machine.

This is why Hexagon offers a line of dedicated retrofit controllers for CMMs. Drawing on more than 50 years of industry knowledge, we have created these controllers specifically to upgrade existing measuring machines to modern standards, offering significant savings compared to the cost of new equipment. Critically, these retrofit

solutions are not limited to just Hexagon CMMs. In fact, the state-of-the-art RC1 and B5 controllers can be fitted to equipment of practically any brand and type, and still make a huge difference to the performance. Similarly, software and probes can usually be updated to the latest versions without the need for major adjustments to the rest of the machine, breathing new life into aging equipment.

While the idea behind retrofits seems simple, and the process can completely transform old CMMs to meet the accuracy, speed, productivity and efficiency demands of modern industry, the potential benefits do not end there. Retrofits can also add functionality to a system. Our retrofit controllers support touch-trigger probing, analogue scanning, temperature compensation and dual-read functions, as well as a wide range of contact and non-contact sensors. Advanced motion control features allow rapid movement around the part and smoother, faster scanning.

Software upgrades can also make a huge difference to the usefulness of a CMM. The latest platforms enable CAD-driven programming, which provides automated inspection processes and optimised measurements with lower operating costs. Modern graphical reports add more functionality, while Hexagon's retrofit controllers also support I++-compliant software.

Of course, no retrofit solution can be effective without the support of skilled engineers to implement, calibrate and set up the CMM. But with Hexagon's global presence extending to over 70 precision centres globally, customers around the world are taking advantage of our local service and support teams. Our aim is to be where customers need us, offering services that make a difference. From calibrations, certifications and geometric compensations, through servicing, repairs and mechanical adjustments, to complete retrofit solutions, we protect equipment to protect our customers' investments. ■



To read more from the
Shaping Smart Change blog,
visit blog.hexagon.com.



MEASURABLY BETTER

INTRODUCING THE 77 SERIES – THE MOST ACCURATE ROMER ABSOLUTE ARM EVER

Offering around 20% better scanning accuracy and 15% better touch-probing accuracy than the 75 Model ROMER Absolute Arm, the 77 Series gives best-in-class performance for high-end measurement applications.



Find out more
<http://hex.ag/10lyQf>





FEATURE

LIVE FROM HONG KONG

Last November, Hexagon's international conference arrived in the Asia-Pacific region for the first time, attracting a record attendance for Hexagon Manufacturing Intelligence. **Accelerate!** gets the lowdown on HxGN LIVE Hong Kong.

The ambitious scale of HxGN LIVE is clear to any conference attendee. However, the sheer size and complexity of the Hong Kong event took this ambition to a whole new level – with spectacular results! HxGN LIVE broke records on all fronts, and its resounding success certainly made an impact on customers, partners and industry professionals in the Asia-Pacific region.

“In our planning stage, we certainly had high hopes for this event, but to see it executed so well and have our customers share the many benefits they received from being here is beyond what we anticipated. We are very pleased and believe this is a great foundation on which to build future events,” said Hexagon President and CEO Ola Rollén.



HxGN LIVE Hong Kong attracted 3 500 attendees to the event – 80% of whom were from mainland China and 20% from the rest of the world – with the promise of inspiring keynotes, unlimited networking and an 85 000-square-foot technology expo, The Zone. The Manufacturing Intelligence track represented over a third of the total attendance, as delegates enjoyed industry-focused breakout sessions, detailed technical seminars and the ‘Wonder!’ track wrap-up event.

The conference marked the first presentation of Hexagon Manufacturing Intelligence since the change of identity from Hexagon Metrology. In the main keynote, entitled ‘Change!’,

company President and CEO Norbert Hanke took the opportunity to explore the reasoning behind the rebrand. Highlighting how technology must adapt to the changing needs of industrial manufacturing customers, he outlined how the company intends to expand its offering into new areas of manufacturing and connect products to provide more integrated software-centric solutions.

“We are here to help customers make things right the first time, the ten-thousandth time, every time,” said Hanke. “The reception from the customers in Hong Kong was incredible – they embraced our message and we had some great dialogue on how we can move forward and build the future of manufacturing together.” ■

“ The HxGN LIVE global conference is an important event for all of Hexagon’s customers. Our goal in 2015 was to bring it closer to this side of the world, offering customers in China and other countries in the region a better opportunity to partake in the same engaging experiences of this unique forum. ”

Ola Rollén, Hexagon President and CEO

TESTIMONIALS



“Hexagon means for us unquestionable quality. We chose solutions from Hexagon because we wanted to guarantee the highest possible reliability for our products.”

Matthew Gorman
Premier Composite Technologies (PCT), UAE

“With Leica Absolute Tracker technology from Hexagon we have increased versatility, speed and accuracy. Now we can ensure dimensional control with different dimensions and achieve accuracy levels that were unthinkable before acquiring this equipment, allowing us to measure accurately to the hundredth of a millimetre.”

Gonçalo Inocentes
Geotrilho, Portugal



“What used to take us two whole days, between setup, measurement and evaluation, we can now accomplish with QUINDOS Wear and the new coordinate measuring machine in four to six hours, maximum. This is positively sensational!”

Martin Heuking
Salzbergen GmbH & Co. KG, Germany



IN YOUR WORDS

The latest comments and feedback from Hexagon Manufacturing Intelligence customers.



“Usually, we'd be using two different pieces of equipment. We don't need to use the tactile machine first and then switch to the optical machine any more. Thanks to the OPTIV Performance and its combination of different measuring processes on a single machine, we save a lot of time.”

Thomas Bauerfeld
Pretema GmbH, Germany



“Where the structured light scanner required us to powder the prop to get any kind of quality data, the ROMER Absolute Arm enabled us to capture all the detail without treating the surfaces at all. It was also much faster than the structured light scanner, and I'd say it provided better data too.”

Chris Barnardo
The Wand Company, UK

DID YOU KNOW?

THE ORIGINS OF METROLOGY



As Hexagon Manufacturing Intelligence looks forward to increasingly data-driven manufacturing solutions, **Accelerate!** takes a look back at the earliest forms of measurement and standards.

Extensive evidence has been found of ancient civilisations attempting to measure length, area and volume with moderate accuracy. They also measured weight or mass, but did not make a distinction between the two.

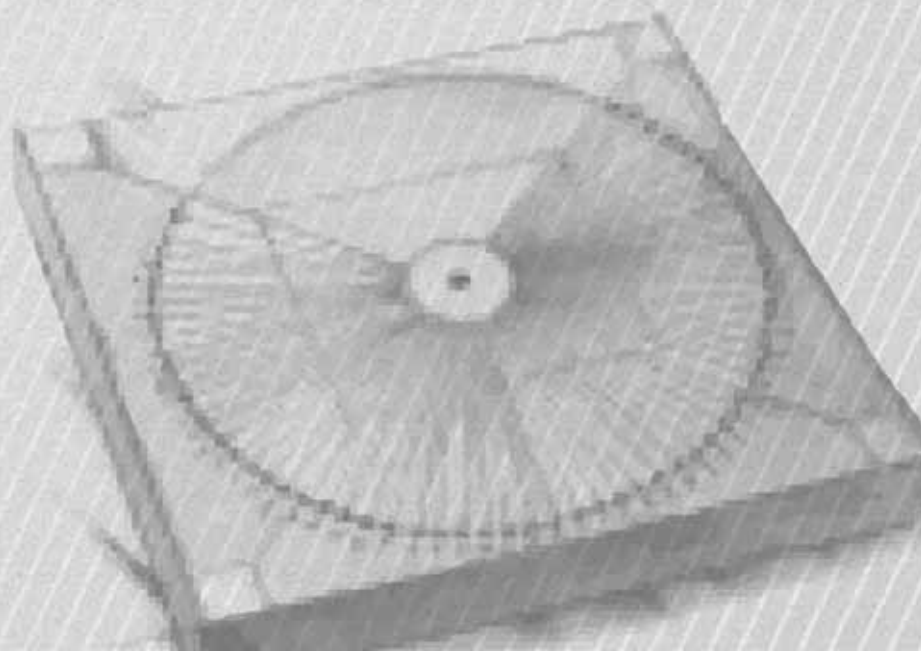
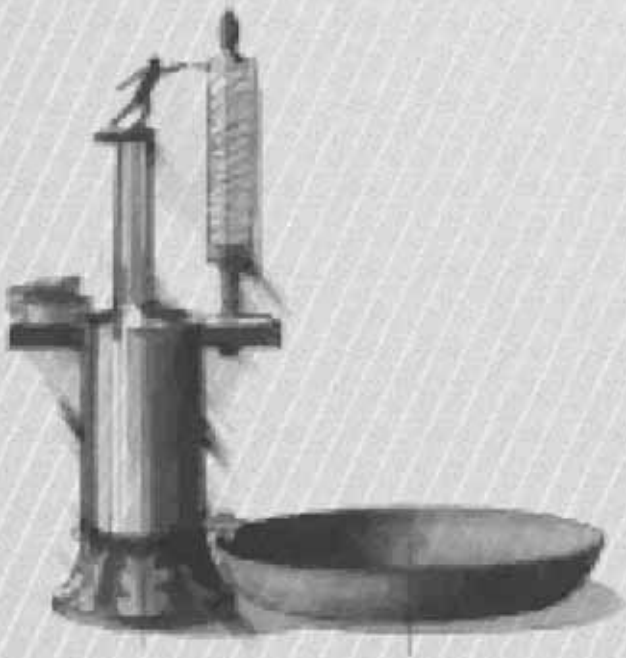
Time was once used to measure lengths and areas. Journeys were defined in hours or days. An acre was the amount of land a pair of oxen could plough in a day, and a furlong was the length of the furrow produced.

As well as the foot and the hand, many other measures were derived from the human body. The length of an inch was based on the last joint of the thumb, while a yard was the distance from the tip of the nose to the outstretched fingers of the right arm.

Taking the human body as a standard created a huge degree of inconsistency and variation. Early attempts to overcome this included defining the lengths against one individual, typically the king or another important figure.

More formal standardisation may have begun over 4 500 years ago. A broken ruler unearthed from Mohenjo-daro in Pakistan is marked at exact intervals of 0.264 inches, while weights found there also appear to be cut to central standards.

Early sundials divided day and night into 12 hours each, but an 'hour' would change with the seasons! The discrepancy was noted when water clocks came into use, and later sundials were calibrated to ensure hours were the same length all year round.



MORE THAN A CONFERENCE IT'S AN EXPERIENCE

HxGN LIVE

HEXAGON'S ANNUAL INTERNATIONAL CONFERENCE

Highlighting the latest trends in geospatial and industrial enterprise technologies, HxGN LIVE brings together Hexagon's businesses, customers and partners to exchange ideas and explore solutions that are shaping the way we work and live.



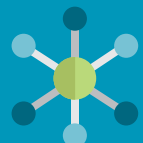
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