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Journal of the Institute of Sheet Metal Engineering

PRESIDENT'S NOTES

Hi All,

I hope all members, friends and families are keeping fit and well in these uncertain times. For those members who are business owners and/or managers, I think you will agree that most of us have never experienced anything quite like the challenges we are currently experiencing.

The war in Ukraine, coming as it does on top of the Coronavirus pandemic, has undoubtedly set in train some serious reconsiderations of the supply chains in which many of us occupy critical positions. We are clearly going to see some serious changes in the strategies of Automotive, Defence and Energy related business, along with changes in the supply sources for many of our key materials. Given that on the reverse side of every threat lies an opportunity, I'm sure Sheet Metal companies will be exercising their innovation and entrepreneurial skills to the full in the coming months and years.

Sorry to end on a sad note, but the passing of our dear friend, colleague and former President, John Davis, has to be mentioned here. For those of us lucky enough to have known John in his prime, there was no more engaging, interesting, or amusing companion. He was loved by all who knew him and will be sadly missed. Our deepest condolences to his wife Jan, and all the rest of his family.

Alan Shaw
President

CHAIRMAN'S COMMENTS

ARE YOU READY FOR INDUSTRY 4.0?

The automotive industry is facing constant changes that impact the industry, including globalisation, stricter sustainability, and regulatory requirements, along with growing consumer demand.

Some of these demands are for new innovative designs and features, this in itself increases the pressure on the time available to complete these tasks. This is coupled with that, there is constant pressure to meet production targets and stay profitable.

With a traditional approach to manufacturing, car makers and sub-contractors can struggling to keep up and deliver the parts for the current and next-generation car. Not having the necessary insight into real-time manufacturing performance and failure to identify will eventually lead to failure, slowing down production that can jeopardise their competitive position.

Companies with foresight and who are progressive now need to adopt a smart manufacturing approach to compete in today's ever fast-changing automotive landscape. This can be successfully achieved by implementing multiple solutions across the disconnected areas of their manufacturing operation.

While most automotive and sub-contract automotive suppliers recognise that there is a need to change the big question is are they ready to change to industry 4.0 solutions to compete in today's fast changing automotive sector.

Industry 4.0 transforms the manufacturing process by bridging the gap between high-level Information Technology (IT) and floor-level Operational Technology (OT), leveraging intelligent data insights to power factory-wide innovative adaptability.

Factories with Industry 4.0 capabilities can shift their operations in a very short time period, flexibly adapting to meet changing customer demands, enhance productivity, reduce waste, and accelerate production.

This is achieved primarily through a decentralized production system, in which production plants can maintain closer contact with customers and supply chain partners and achieve a flexible model for mass customisation.

Successful decentralization requires advanced data-sharing between locations which not only consolidates and provides intelligent insights into day-to-day operations across sites, but also enhances communications between people, machines, and customers.

Having a factory that can support a 'single piece flow', but then automatically adapts to a new product configuration or an entirely new product as each unit comes down the line, is game-changing.

B D Smith
Chairman ISME

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ISME MEMBERSHIPS

If you want to learn more about sheet metal and meet like minded people why not become an ISME member.

OUR MAIN AIMS:

- To promote the science and working of sheet metal.
- To provide opportunities for people to exchange ideas and information.
- To encourage the development of members.

CURRENT ANNUAL MEMBERSHIP SUBSCRIPTIONS ARE:

Company Membership	£300.00
Fellows Membership	£85.00
Individual Membership	£60.00
Corporate Individual	£40.00
Student Membership	£20.00

Full details and membership application forms are available on our website **www.isme.org.uk**
Or contact the ISME secretary at **ismesec@gmail.com**

SECRETARY'S NOTES

With the welcome return to more normal conditions the Institute has been able to start planning a resumption of its events. We will be participating in the MACH 2022 exhibition at the NEC in April and the Skills Competition will be held in June hosted by Amada, Kidderminster. The Institutes AGM will be held in May. Details of the date and location will be sent to members by email.

Although we have a number of works visits lined up, we are finding that companies are still not ready to accept visitors until they are certain that covid dangers have been suitably reduced.

It seems that the Government has recognised the need to tackle the skills shortages in numerous occupations with the launch of a number of training initiatives. Council members are involved in discussions producing requirements for new vocational training courses and promoting engineering as a good career option to school leavers.

Bill Pinfold
ISME Hon Secretary

KEEP YOUR BUSINESS RUNNING WITH MPPS' PROACTIVE MAINTENANCE STRATEGY

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75TH ANNIVERSARY
GOLD MEDAL DINNER

The Institute was delighted to be able to hold its first social event since the start of the pandemic with its Gold Medal Awards Dinner at the Fairlawns Hotel Aldridge.

This well attended event enabled friends old and new to meet up and chat in an informal but safe environment.

The ISME Gold Medal for a "Major Contribution to the UK Sheet Metal Industry" was awarded to Professor Jianguo Lin, Imperial College. Professor Lin led the team responsible for the development of the HFQ sheet aluminium forming method.

With two spin-out companies, over 300 publications, 19 patents and having authored two books, Professor Lin is a world-leading academic, engineer, entrepreneur, and educator. His contribution to the development of metal forming technologies over the past three decades has resulted in new factories, new jobs, and new global opportunities for the UK sheet metal sector.

The ISME Davy Udal award for "Services to the Sheet Metal Industry" was awarded to Dave Gilbert, Managing Director, Skillcraft Products Ltd. Dave has a very well-rounded background in sheet metal from craftsman to director.

In 2016 he set up a fabrication sub contract company DG Fabs and later, in addition, set up Skillcraft Products to produce and market his own range of products. Dave has provided high quality training and employment whilst providing excellent service to his sheet metal customers.

Professor Jianguo Lin receives the ISME Gold Medal from ISME President Alan Shaw

Dave Gilbert receives the ISME Davy Udal Award fro ISME Chairman Barry Smith.

CBM HEALTH AND SAFETY MEETING FEBRUARY 2022

HSE Inspector Martin Giles reported that the concentration in the metal fabrication industry on metal working fluids and weld fume extraction in the last 12 months had resulted if around 1450 visits with approx. 1/3 OK, 1/3 issued with letters and 1/3 getting improvement notices. Most of the problems had been found with metal working fluids with an improving situation with weld fumes. This campaign will continue to the end of March 2022. Plans for the following 12 months have not yet been finalised but are likely to see a continuation of the metal working fluids and weld fume visits but visiting premises not previously seen. There will also be action on Silica induced disease in quarries but also including processes using sand particles for cutting.

Covid was still around but it was up to companies to do their own risk assessment. The HSE website has updated ventilation recommendations.

The HSE were also looking at stress and mental health at work and again there is updated guidance on their website.

Mike Harris of Alcumus Sypol gave a presentation on COSHH during which he gave the following recently published figures for the last 12 months.

Fatal Injuries 142 representing a small increase.

Deaths from industrial lung disease 12,000, broadly flat.

Of which some 2,369 were Mesothelioma, asbestos related, down 100.

Incidents of work-related ill health shot up to 850,000, many of them Covid related in education, health care and defence industries.

Bill Pinfold
February 2022

JOHN B DAVIS

1938 - 2022

The Institute is sad to announce the death of its Past President and Chairman, John B Davies at the age of 84. John passed away in Beech Hill Grange Care Home have been unwell in the last couple of years.

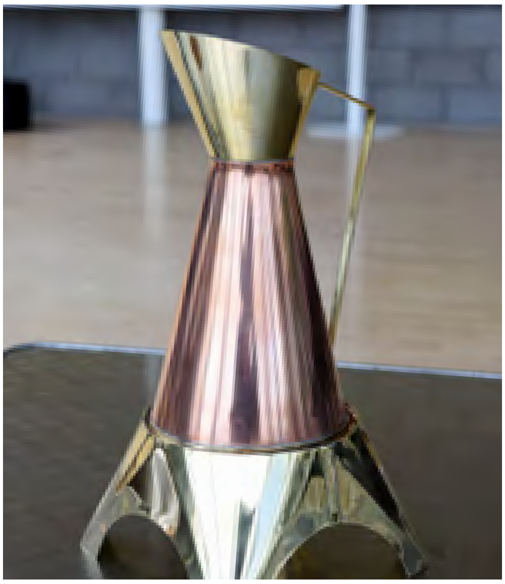
John led a full and interesting life and was an enthusiastic supported of ISME for many years.

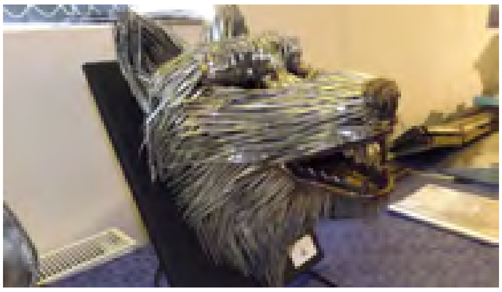
A full obituary to John will be included in the next Oracle.

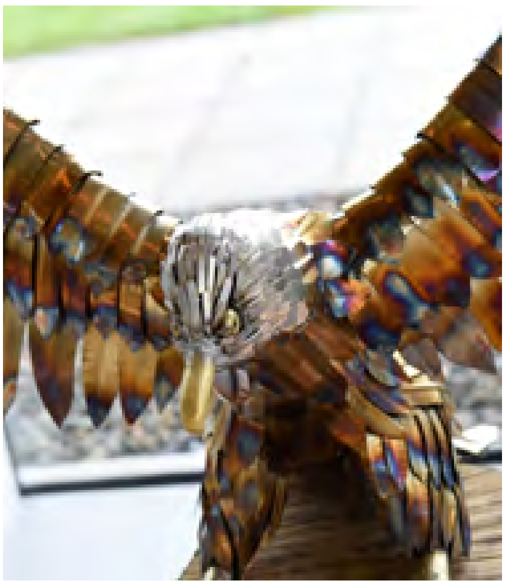
Our condolences go to Janet and the family.

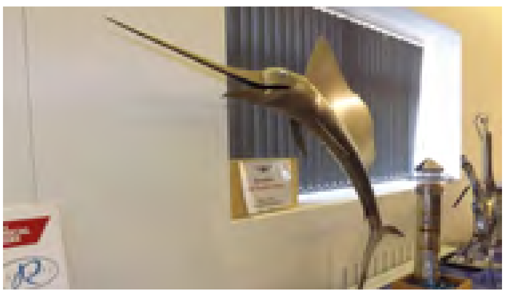
2022 SKILLS COMPETITION IS NOW OPEN FOR ENTRIES

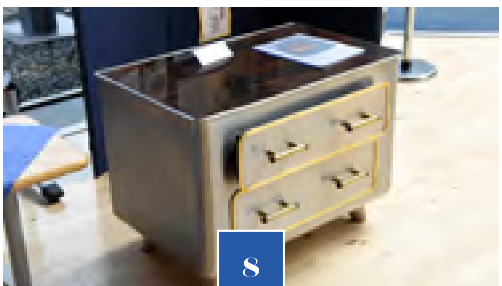
FOR DETAILS ON THIS YEAR'S EVENT VISIT ISME.ORG.UK/ISME-SKILLS-COMPETITION-2022











The Metalforming Machinery Makers Association

WHAT IT MEANS TO BE A MMMA MEMBER

- Association dedicated to the metalworking industry and allied sectors
- Major reduction in stand cost at the UK's major metalworking exhibition
- Networking opportunities across the UK's Manufacturing sector
- Social Media platforms that work for you
- Banner advert on the MMMA website home page
- Funding and business support guidance
- Your own dedicated Members page on the MMMA website
- Access to advice and information on Training, Apprenticeships and Up-skilling
- Access to preferential, cost effective recruitment
- Access to free advice on HR and employment law
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The Metalforming Machinery Makers Association

AT THE HEART OF THE METAL FORMING INDUSTRY

THE MMMA IS GROWING ITS MEMBERSHIP DESPITE A DIFFICULT PERIOD DUE TO THE COVID-19 PANDEMIC AND WILL SHOWCASE EVERYTHING IT OFFERS IN ITS LARGEST EVER METALWORKING VILLAGE AT MACH 2022 IN APRIL

The Metalforming Machinery Makers Association (MMMA) has been representing the UK's power press makers since 1949 and is the only UK association solely dedicated to the sheet metal forming industry.

The association's membership has been growing strongly after it changed the membership criteria three years ago to include ancillary equipment manufacturers and British-based importers, adding to previously evolving to also include roll forming and sheet metal machine manufacturing companies.

The MMMA can now count on 41 members, with more than 20 added since the rebrand that now even features recruitment firm Glen Callum Associates, training company In-Comm Training and Business Services and a safety expert.

The last couple of years have been challenging, as key trade show MACH 2020, which is a critical event, was postponed due to the Covid-19 pandemic, but the MMMA has used the time to help members and plan for MACH 2022 in April this year, where it will host its biggest-ever Metalworking Village.

KEY TO THE RECOVERY

Since the outbreak of Covid-19, the sheet metal forming industry has like many industries suffered, especially as it is heavily reliant on the automotive sector. However, the MMMA is positive about the prospects for the industry and its members in 2022 and believes there will be a strong recovery.

Chairman Adrian Haller, managing director (MD) of Bruderer UK, a key supplier of high speed presses of 10-to-1000-ton capacity in the UK, says it has been a challenging period on different levels but business has proven to be resilient. "It's been dif cult, no question, and a double whammy with both Covid-19 and Brexit challenges, but on the whole very promising. Our industry is used to ever-changing environments with one thing and another.

"Another difficulty has been trying to get engineers into our customers and most of our industry has an ageing workforce so they have had to shield, which has proven to be another big challenge, as during the first lockdown, no hotels or amenities were open so working on site was very difficult."

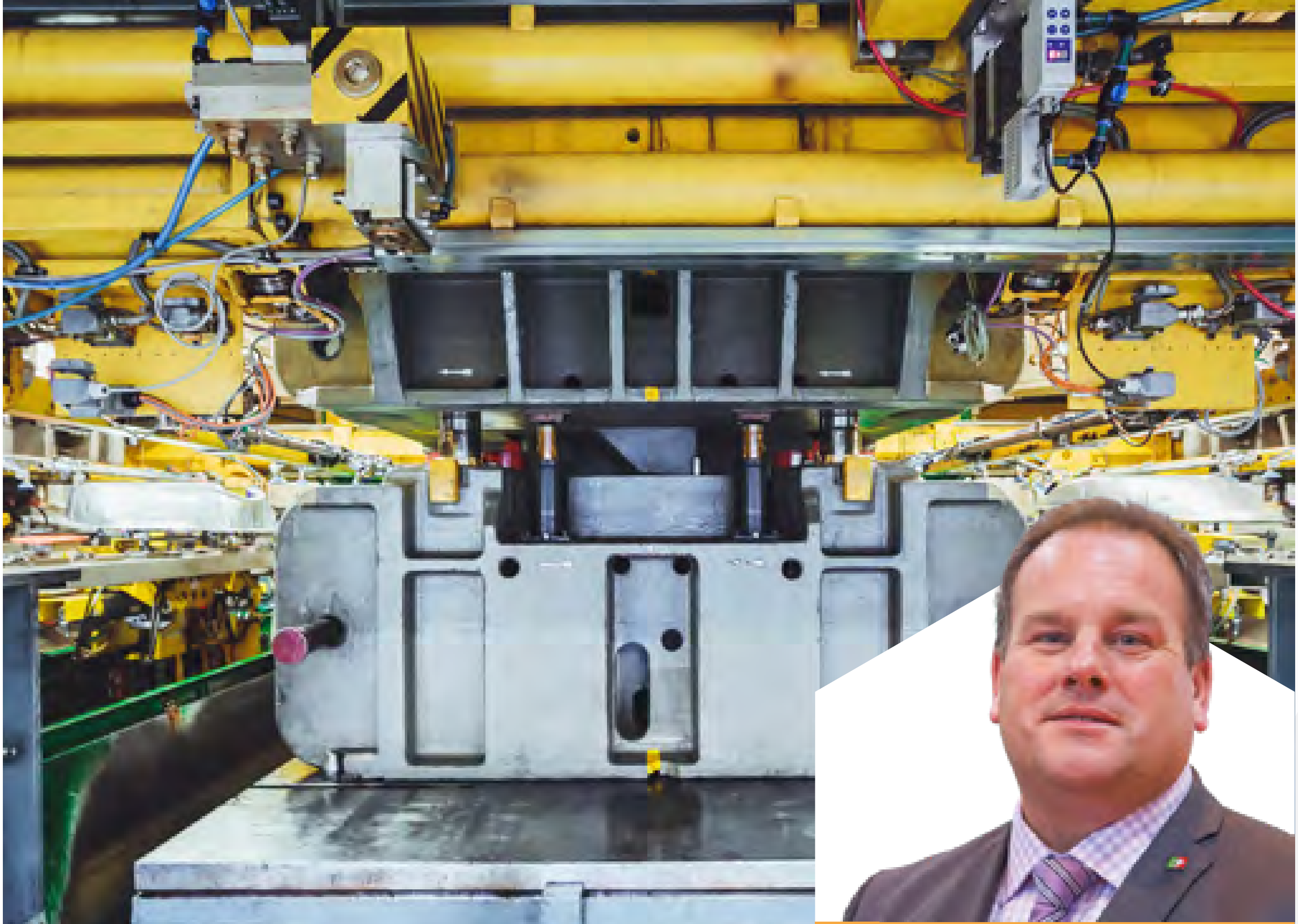
Haller believes that manufacturing and engineering hold the key to the UK recovery and is the only way to get the country "back up and running" at full capacity, forecasting a V-shaped recovery. He is very positive about the year ahead and for the future of the sheet metal forming industry.

Vice chairman Phil Leath-Dawson, MD of Schuler UK, a provider of mechanical and hydraulic presses, feels the biggest challenge now is the continued uncertainty.

He explains that due to being a heavily automotive-based industry, many power press makers have faced strong headwinds, although there is a drive to diversify away from being too reliant on the sector.

"It has been really difficult as we have been fully-booked for periods, but then there have been these huge voids of nothing in between," says Leath-Dawson. "That is the biggest problem we face, as before we could plan things, but there is no consistent business and we do not know what it will be from week to week.

Bruderer BSTA 410-110 stamping press



MMMA Chairman - Adrian Haller

"The majority of our members have said at our meetings that they are ticking over and surviving. Much of this is down to the government furlough scheme supporting them – but it is challenging."

He forecasts that due to the UK's dependence on the automotive sector, the economy will recover to pre-pandemic levels in two years, rather than by the end of the year as predicted by some.

The sheet metal forming industry has traditionally been quite dependent on the automotive sector, but is looking to diversify into other sectors and there are major opportunities on the horizon, notably in the electric vehicles (EV) and medical sectors.

Leath-Dawson believes things will naturally diversify to sectors, such as e-mobility and EV which is an ever-growing market, as every electric motor has to have several metal stampings, while are also other applications that many would not think metal forming plays a key role.

"The UK is leading EV technology globally at the moment and there is a lot of innovation going on and taking place with several new start-ups for passenger and commercial vehicles. There is a great opportunity and as these innovations come forward it will naturally diversify as these opportunities are created."

BREXIT AND RESHORING

The UK left the European Union (EU) at the end of 2020 when the transition period ended, but will this move have an impact on the sheet metal forming industry?

Leath-Dawson is sure that leaving the bloc will provide a positive boost to the industry. "We go back to the 1970s slogan 'Buy British' and things start to be more nationally produced which will be good for manufacturing and our economy. I think it will have a stronger local focus that will be great for our industry."

Haller concurs, and feels the reduced bureaucracy will help boost trade to other markets so leaving the EU allows the UK to spread its wings, opening up new opportunities across the globe.

Due to the Covid-19 pandemic a Reshoring UK programme was launched to bring back more manufacturing and engineering home along with some concerns over the UK's reliance on global supply chains. This initiative is being firmly backed by the association.

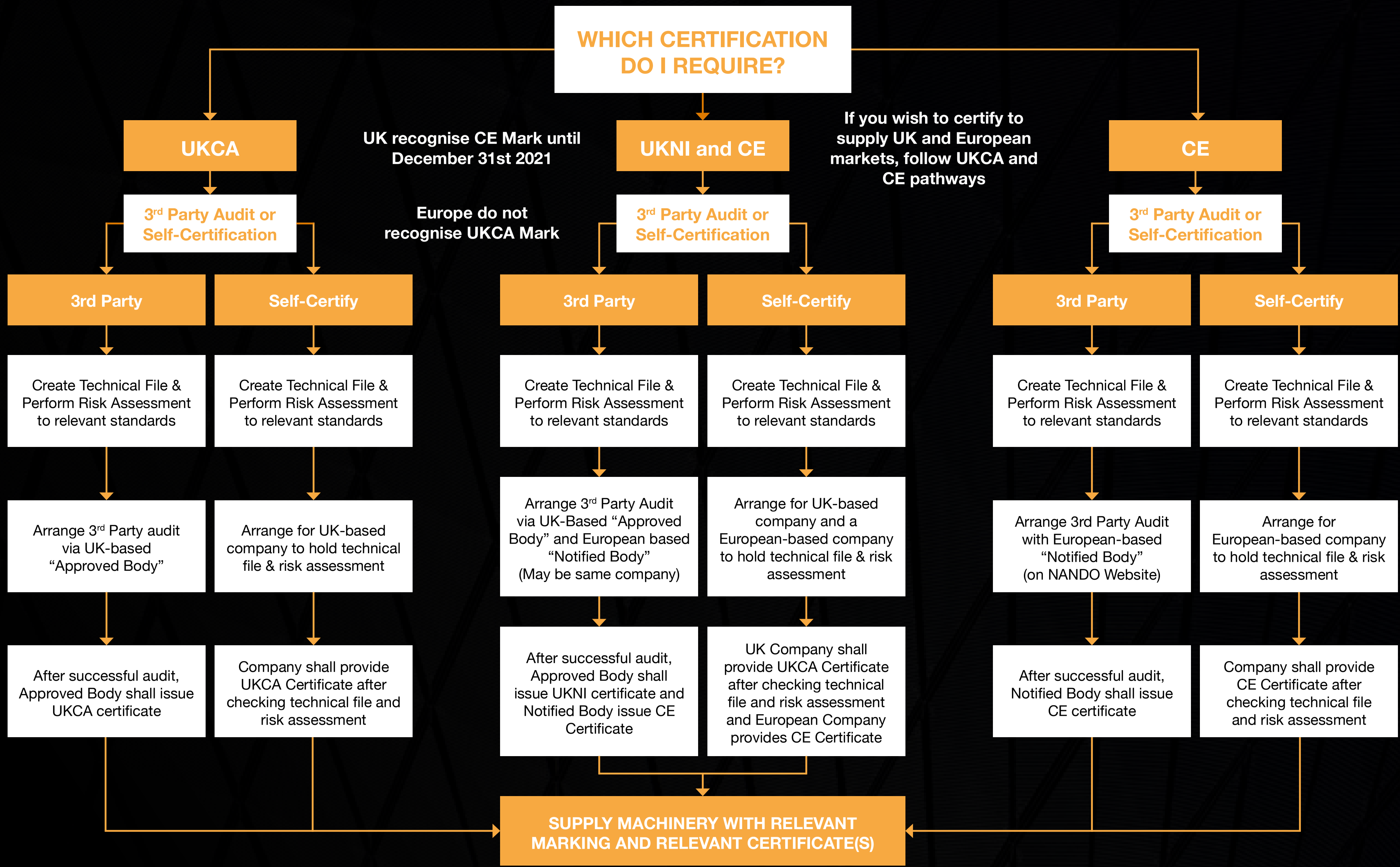
Haller feels the programme is "absolutely essential" and is much needed by the UK's power press makers, providing an opportunity to pull together to grow business and help MMMA members grow their business.

Reshoring UK will also prove an invaluable tool for the MMMA to grow its membership. Marketing coordinator Bill Neal explains:

"It is up to us to keep our members up-to date about what opportunities are out there for them, as certainly, the indications are there in some industries that companies are looking to bring production back into the UK.

"When they do that, these companies will need to employ the latest production techniques and technology in order to compete, and many of our members are in the right position to deliver that."

CE - CA MARKING DECISION TREE



Member
The Metalforming Machinery Makers Association

A few members have asked questions regarding certifications and which ones they require due to the confusion in the marketplace and our sector. As a result, the MMMA have put together a working party to discuss the topic and have produced the above 'Decision Making Tree' to help advise members. **Source - Ray Pearson**

BRANDAUER | BRUDERER

BRANDAUER TAPS INTO BRUDERER TECHNOLOGY TO DELIVER MIDDLE EAST CONTRACT

A significant £1.5m investment in a new high-speed production cell is helping a 159-year-old metal stamping specialist deliver a major contract to the Middle East.

Brandauer, which employs 63 people at its Birmingham factory, has strengthened its long-term partnership with Bruderer by installing a BSTA410-100, which is capable of up to 41 tonnes, 1600 strokes per minute and features a large 1110mm bed.

The machine will be used to manufacture stainless steel substrate frames for a male grooming product that is exported all the way to Israel and was chosen for its ability to achieve repeatable quality and parts in their millions.

Secured against intense international competition, the project underlined Brandauer's ability to take the customer through the entire journey, from developing the complex tooling to producing these parts in extremely high volumes.

"We needed technology that could give us the tolerances and speed required by the customer to meet the order quantities, quantities that have more than doubled since winning the work," explained Rowan Crozier, CEO of Queen's Award-winning Brandauer.

"The Bruderer was our 26th press of theirs. We know the level of performance and reliability it can deliver and we knew we could work with their engineers to spec the machine so that it not only gave us the control we wanted for this project, but could also be deployed to pick up other high volume contracts we might be managing in the future."

> *THE BSTA410-100 IS CAPABLE OF UP TO 41 TONNES, 1600 STROKES PER MINUTE!*


BRANDAUER
BRUDERER
BRUDERER

He continued: "We haven't been disappointed. The control technology provides automatic ram shut height adjustment while the press is under acceleration and deceleration load for guaranteed process stability and pinpoint repeatability.

"This is essential when you are working with high tensile stainless steel that is just 0.15mm thick and utilising a progression tool that cost in excess of £100,000 to manufacture."

The Bruderer BSTA 410-110 B2 was selected, customised and commissioned in a uniquely competitive eight-month window to meet the stringent delivery requirements of the global client.

Teams from both companies worked closely together to make this happen and to also ensure the machine was set-up to be fully automated to include post-production cleaning and re-reeling.

This means the press, alongside another Bruderer BSTA 510-110 B2, can produce up to 100 million parts for the customer every year.

"You just can't beat the precision and speed of this technology and the £1.5m dedicated cell we've created for this is one of the best-performing in the business," added Rowan.

Adrian Haller, Managing Director of Bruderer UK, concluded: "We've been helping Brandauer produce precision parts since 1976, so it's great that the firm has once again turned to our presses for its latest product introduction.

"The tri-modular progression tool has more than twenty different stages and is one of the most complex the company has ever created. Our ram guidance system – exclusively at strip level, helps eliminate displacement between the punch and the lower die giving engineers the ultimate control over the quality of the component.

"It also plays a big role in reducing tool wear, which I know Rowan and the team were very keen on."

For further information, please visit www.brandauer.co.uk or www.bruderer.co.uk

CONNECTING SOME DESIGN TECHNIQUES WITH THE SHOP FLOOR, THE FAMOUS REAL-WORLD.

Whether you are a Product Engineer, it does not mean you need to only stay at the office, besides, having such behaviour you are simply losing many opportunities to easily learn lots of things, to see how YOUR products come to life.

So, whenever possible, go to the shop floor - as much as you can - even during the initial development phases, enjoy it, walk around the lines, talk to operators, see how the real-world works, and use this time to learn more about real product engineering.

And more importantly, never create a barrier between the product and manufacturing engineering environments, in the end everyone needs to work together to deliver the same task - the product.

YES, IT'S QUITE IMPORTANT FOR BODY STRUCTURES ENGINEERS TO UNDERSTAND THE METAL STAMPING PROCESS, FOR REAL.

For me, it's highly necessary, and this is always my first advice for fresh engineers. I'm not saying that you need to be a stamping expert, what would be great and helpful if you are, but it's really necessary having some knowledge about the forming process, sheetmetal methods and mainly about the manufacturing constraints.

My point is, to drive and lead a sheet metal part design you have to at least understand how it's made and on top of this, you'll face issues during development phases that demand major design changes. You need to be able to analyse and provide feasible solutions.

Do you know what springback is? How to control and fix it using design or process? Believe me, this is just one constraint whilst designing a sheetmetal part, and YOU need to be able to drive the issue resolution, with or without support from stamping mates and toolmakers.

Bear in mind that the cool CAD models on your computer screen is just the beginning. The parts have to be manufactured, and all upcoming steps related to process and manufacturing is also part of product design. Yes, the product engineering workstream ends up only at the shop floor.

What's the main differences among progressive, tandem and transfer die processes? Stamping and roll forming? Cold and hot forming? How does the process affect the design? The stamping process also affects your part costs and quality. It sometimes drives the product design and you need to understand how to provide a proper solution and deliver a feasible design - since the first sketch.

> MY FIRST ADVICE FOR FRESH ENGINEERS IS TO UNDERSTAND THE METAL STAMPING PROCESS

DESIGN-UNFOLD CROSS CHECK, NEVER FORGET THAT THE METAL STAMPING PROCESS STARTS FROM SOME POINT.

During the engineering development phases, there is one thing we can never stay away from, the pressure. The clock never stops, same as the design change requests. Well, let's say that THIS is normal business, but needs high attention during all this process to not waste an important resource - engineering time.

So, always keep the stamping process in mind whilst designing a sheetmetal part, this is quite important as this will help you save time. Adding features into a design impossible

to be manufactured doesn't help right? Not at all. It's just time wasting.

Here is a tip for you: Always think that all sheetmetal stamped part 'borns' from a flat sheet. We call this blank and this is what you have to deliver your design (volume and area). So, all the flanges, draw, pockets, embossment, side walls were flat sheet at some point and that's why you need to unfold the design to ensure you're not overlaying any surface or getting away from blank limits. Believe me, it will happen a lot if you don't pay attention, mainly for complex shapes with several formings.

The main point is, the stamping feasibility analysis will be performed at some point using proper CAE Software and right skills. However when we get on this point, this means all related system interfaces surrounding the parts are already considering that design is possible or feasible. For example, the interior trim engineer is counting on you to deliver that flange you drew to hang their part, so YES the product engineer is responsible to ensure the design walking goes the right way - feasible.

Besides unfolding and checking faces overlaying, there are much more to consider, such: trim edges and holes distances, size of features, die-tip (negative faces), but if you start by not adding any flange overlaying, it's already a good start.

Bear in mind that designing a sheetmetal part without considering the stamping process is the same as having a tire without a wheel, both need walking and riding together. Stay close to the stamping process - the real world.

VEHICLE SURFACES CLASSES, WHEN THE SHEET METAL STAMPING PROCESS AND QUALITY SPEAKS LOUDER.

We can say that something is common during all engineering and manufacturing workloads, the severity levels definition. We often use this strategy to properly manage the product development, adding efforts with meaning and money in the right pocket. Don't waste time with activities and expensive processes that won't return real benefits for the vehicle.

Based on that, we work with some severity criteria for the complete vehicle structure, defining the surface finishing level of parts based on vehicle appearance. It is important to point out that this same strategy is also applied for some other systems, like interior and exterior ornamentation systems but for now on, we'll talk only about body structure parts.

So, considering the complete BIW Structures, including closures, we basically manage the surfaces finishing quality and appearance criteria considering three different surface classes:

Class 1 or A - In a simple way, all exposed sheetmetal surfaces that the customers can simply see. Remember that deep look when you go shopping for a vehicle? That's it. Before you open some doors and get inside the vehicle, every exterior sheetmetal part is considered Class 1 surface. For these parts, NONE scratches, marks, metal slivers, indentation, die recoil markings, wrinkles, or irregularity is accepted. These are the 'golden parts' of Body Structures.

Class 2 or B - Considered as the second layer, these are all surfaces the customers can see AFTER open the closures. We can say that we consider this surface class about the same as Class 1 – the customers will see – but the main difference is the concessions. Let's say that depending on the situation we can be friendly and sign some deviation, mainly when we need to go for some cost reduction, or we're facing some major feasibility issues, but only as a last option.

Class 3 or C - The Ugly Duckling of BIW, basically are all remaining parts out of previous classes but it doesn't mean we don't look for quality too. This definition is only based on appearance criteria which means the parts must be delivered with the right quality, as designed.

All these classes are managed considering the stamping parts before and mainly after the painting process, including welding process, which means, nothing out of spec will go in or out the production lines without proper approval.

In the end, we can also correlate cost and complexity based on these levels, starting from Class 1 as the most expensive. High quality often means high tooling, process and material costs. But, as everything around the BIW is always tricky, sometimes this is not that true.

HOW TO SELECT THE RIGHT RAW MATERIAL FOR EACH PART DURING DESIGN PHASES.

That's another good point with no simple answer. Sorry, but the body structure world is really tricky, there is never a simple answer even for an easy question.

But, let's say we use some 'tips' to start the work. We know that the vehicle structures must have high tensile strength as well as high stiffness bending, torsional, dynamic and static, besides good crash-worthiness performance. On top of that, it needs to be lightweight to achieve the vehicle efficiency performance, corrosion resistant, and will need to pack all these attributes in a profitable business case. Besides, we already know all material grades and gauges available at market, which means we know what we have on the shelf. What a 'tip' isn't?

Based on that, to define the right material of each part we use the most important deliverable of any system, the FUNCTION. Bring it into a simple way. Do you need to jump from an airplane? Pick a parachute. Do you need to dive into the ocean? Pick a diving mask, fins and snorkel. Do you need to jump from an airplane straight to the ocean? Pick a parachute, diving mask, fins and snorkel. Simple like this. Depending on your needs, you pick the right device, this is how we often select the proper raw material, including grade and gage.

The main point is, the material selection is about the parts function considering the overall body structures deliverables, vehicle performance and all other systems interfaces, rather than the raw material itself. Let's say that the raw material is the device, we pick each one based on performance needs.

To simplify the raw material selection we often use a kind of pick list. We've been designing vehicles for years so we need to use all the information and lessons learned we have to at least start to deliver the mission. But, here is when it becomes tricky.

The main drive for a sheetmetal part is the shape and the stamping process, and when we add these inputs, the material selection gets some challenges. Sometimes we need to improve the part Strength selecting a higher grade material, but we can not get stamping feasibility. So we need to work with gauge, shape and sometimes balancing the surrounding parts design to deliver the expected system function. In the end, the complete body structures need to achieve the overall vehicle target.

Bear in mind that besides function, the stamping or forming process must always be part of raw material selection - for each part - and NEVER forget that at some point you will also need to weld or rivet it, even more if you're using boron steel, remember to always check the stack-up.

So never jump from an airplane wearing a snorkel expecting a happy landing. I'm not sure but I believe it won't work.

LAST BUT NOT LEAST, NEVER CARRY AN UNFEASIBLE DESIGN, IT JUST DOES NOT EXIST IN THE REAL-WORD.

Whilst in the virtual phase, not all the sheetmetal stamping issues can be solved by increasing radii, opening flanges or adding notches. Sometimes the hard points don't allow major changes and even after exhausting all possible fixing's related to product and process, we still need to find a solution.

The last thing we want during development phases is going back to the studio team asking for major changes but if required, we have to and sometimes we do. Same as all other systems, the stamping process has some limits too and having good quality parts at line should also be part of the design concept.

The point is - mainly for skin panels - being complex often means high stylish, but still need be feasible. Challenging the shapes and trying the best in class design is what we do. Everytime we challenge the stamping process we end up with amazing results.

That's why it is quite important having the engineering and manufacturing teams onboard since initial design phases, not for road blocking the ideas but for being part of the dream, challenging the constraints and helping finding solutions to push the design to state of art, even those that seem 'impossible'.

Who is Daniel Perez

Just a guy who loves the sheetmetal world, mainly related to vehicle BIW Structures, always looking for new techniques, Software and processes that challenge the status-quo.

CONTINUOUSLY EXPANDING SERVICE TO INDUSTRY

For nearly 40 years Midland Power Press Services Limited (MPPS) has been supporting press users with an increasing range of services. Over the years the company has grown from a one man operation into the company that UK industry calls when presses develop a fault. As the nature and demands of manufacturing industry has changed so has MPPS with continuous investment in people, facilities, machinery and equipment.

Well known as the company to call when presses develop a fault the MPPS emergency power press repair service guarantees a rapid response with an engineer on site the same day. However, the move to Lean Manufacturing in recent years means that OEM manufacturers have minimised production stock and require "Just in Time" deliveries which in turn puts the pressure on suppliers to maintain production and deliveries that can be costly when unexpected breakdowns occur. To minimise unplanned machine downtime MPPS offers press users an annual contract service for **Planned Preventive Maintenance**

Preventive Maintenance, provides a proactive maintenance strategy that involves regular and routine servicing of presses and equipment to reduce the likelihood of failure leading to unplanned downtime. Repairs to machines can then be planned well in advance enabling users to plan and schedule their production capacities.

MPPS has developed **Planned Maintenance Programmes** to check and inspect all mechanical, electrical, pneumatic and hydraulic equipment for correct operation and function. Where possible, MPPS service engineers will make adjustments to correct any minor faults during their visit.

A detailed report will advise on the condition of the machine, detail the repair work required (if any) and the actions required to maintaining continued production. This service is available for power presses, hydraulic presses, forging machines and auxiliary equipment

The advantages of a Planned Maintenance contract with MPPS include:

- Reduced unplanned downtime
- Fewer breakdowns of presses and machines that are essential for production
- Improved reliability of presses and equipment
- Fewer expensive corrective and emergency repairs

The frequency of the scheduled Planned Maintenance inspections, either 6 monthly or 12 monthly, is dependent on the machine use – single or double shift – and will be agreed with the customer as part of an annual service contract.

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Rob Friberg – Email: rob@mpps.co.uk or
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ADVANCED INCREMENTAL SHEET FORMING FOR LIGHT WEIGHTING

Ahmed Elsayed, Giribaskar Sivaswamy, Diego Gonzalez, Evgenia Yakushina

INCREMENTAL SHEET FORMING

Incremental sheet forming (ISF) is a flexible and cost effective forming process which involves a localized deformation of the sheet metal induced by a rigid hemispherical tool the movement of which is precisely controlled during the forming process. Different variants and improvements have been developed for ISF in the last decades, such as Single Point Incremental Forming (SPIF), Double Point Incremental Forming (DPIF), Laser Assisted ISF, Electrical resistance ISF and Friction ISF. SPIF and DPIF are the most commonly used technologies since they have a simpler setup and lower cost.

Different works can be found in the literature analysing from a numeral point of view the ISF process with the aim of understanding the complex forming mechanisms occurring in the process. A material deformation mode consisting of a combination of stretching, bending, compression, cyclic loading and shearing (in plane and through thickness) was confirmed experimentally and through FE (finite element) simulations. The main merit in ISF is the ability to form complex and / or deep shapes that exceeds the normal strain limits obtained by Nakajima test (see Figure 2).

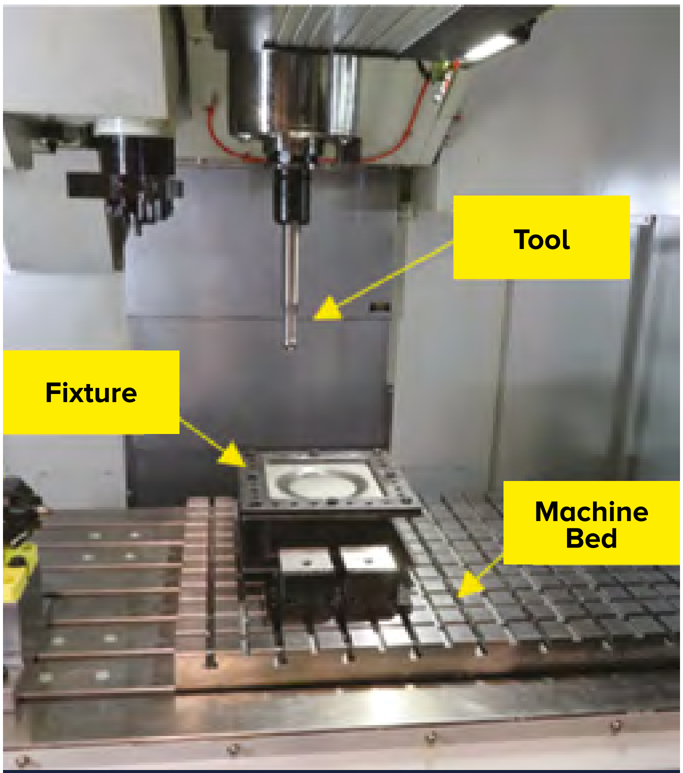

Figure 1 ISF (SPIF) setup at AFRC

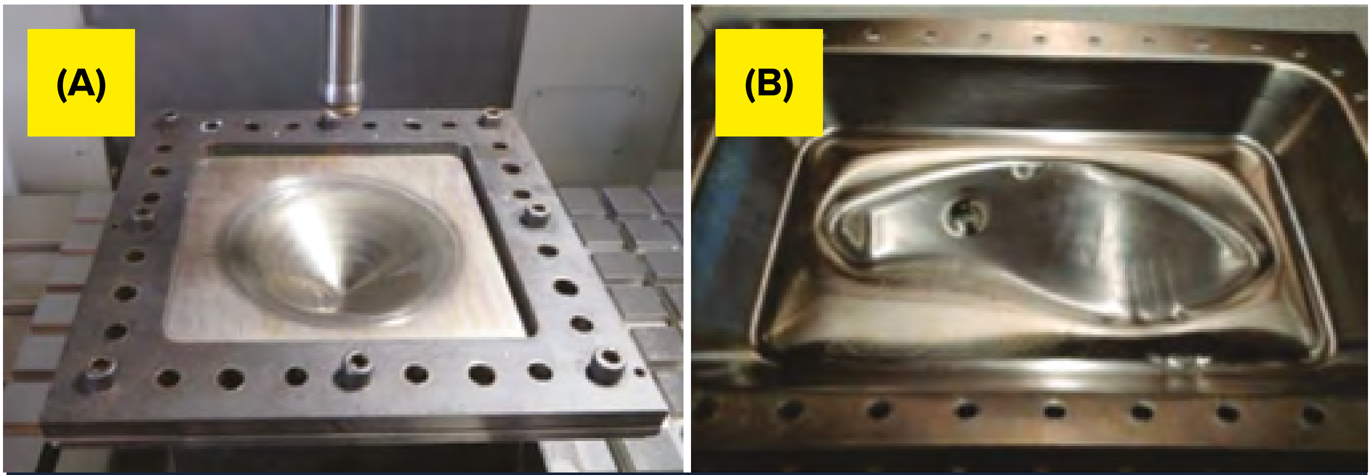

Figure 2 Forming of (A) Titanium alloy and (B) Aluminium alloy using ISF

ISF CASE STUDY DEVELOPED BY THE AFRC

The AFRC has investigated the die assisted DPIF process applied to the forming of AA7075 with thickness of 1 mm via modelling; where commercial software PAM-STAMP has been used. The numerical work has been validated through experimental forming trials. GOM ARGUS analysis was carried out to compare the thickness distribution of the formed part with the outcomes of the simulation. Good agreement was observed between the FE simulation results and the scanned outputs.

ISF PROCESS SETUP

In this investigation, a 3-axis CNC machine with a 25 mm diameter forming tool tip (hemispherical shape) was used. A rotational speed of 150 rpm was selected for the tool. The movements of the tool and the CNC bed were controlled by the CNC machine. A pitch value (size of the vertical step down of the forming tool per revolution) of 0.2 mm was chosen.

FE MODEL SETUP

The tools were considered as surface rigid bodies in the model (see Figure 3). Both the punch and the clamping are moving in the Z (depth) direction with the same velocity. The friction coefficient was assumed to be 0.08 for the contact between the punch and the blank since the continuous use of the lubrication during forming process.

In order to define an accurate material model, the tensile tests were carried out at three directions to the rolling direction (0° RD, 45° RD and 90° RD). A Hollomon law was used to characterise the hardening of the material, and a Hill 90 plasticity model was employed for the AA7075 alloy in O condition.

Belytschko-Wong-Chiang fully integrated elements were used, with an initial element size of 20 mm. Automatic refinement of the mesh was allowed during the simulation, achieving a minimum element size of around 1.25 mm at the end of the simulation which should be below the initial thickness of the sheet.

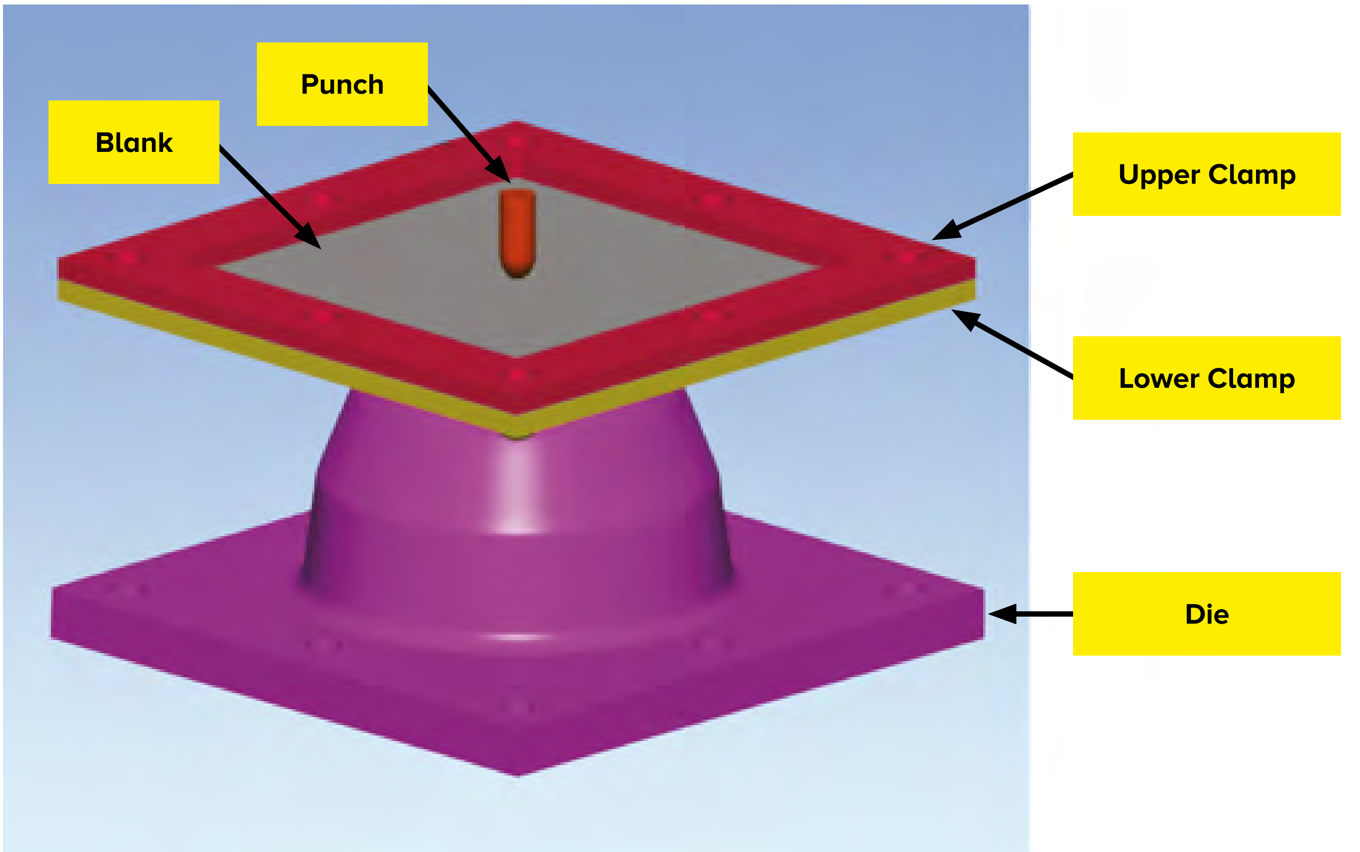

Figure 3 ISF- die assisted FE model setup

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RESULTS THICKNESS COMPARISON

Figure 4 highlights the outcomes of the comparative analysis performed for the FE simulation results and the data generated for the scanned part with the same forming depth (102 mm). A minimum thickness value of 0.32 mm was found in the scanned part, whereas the FE part shown a value of 0.29 mm. As the reader can see in Figure 4, a good agreement can be observed between the two parts.

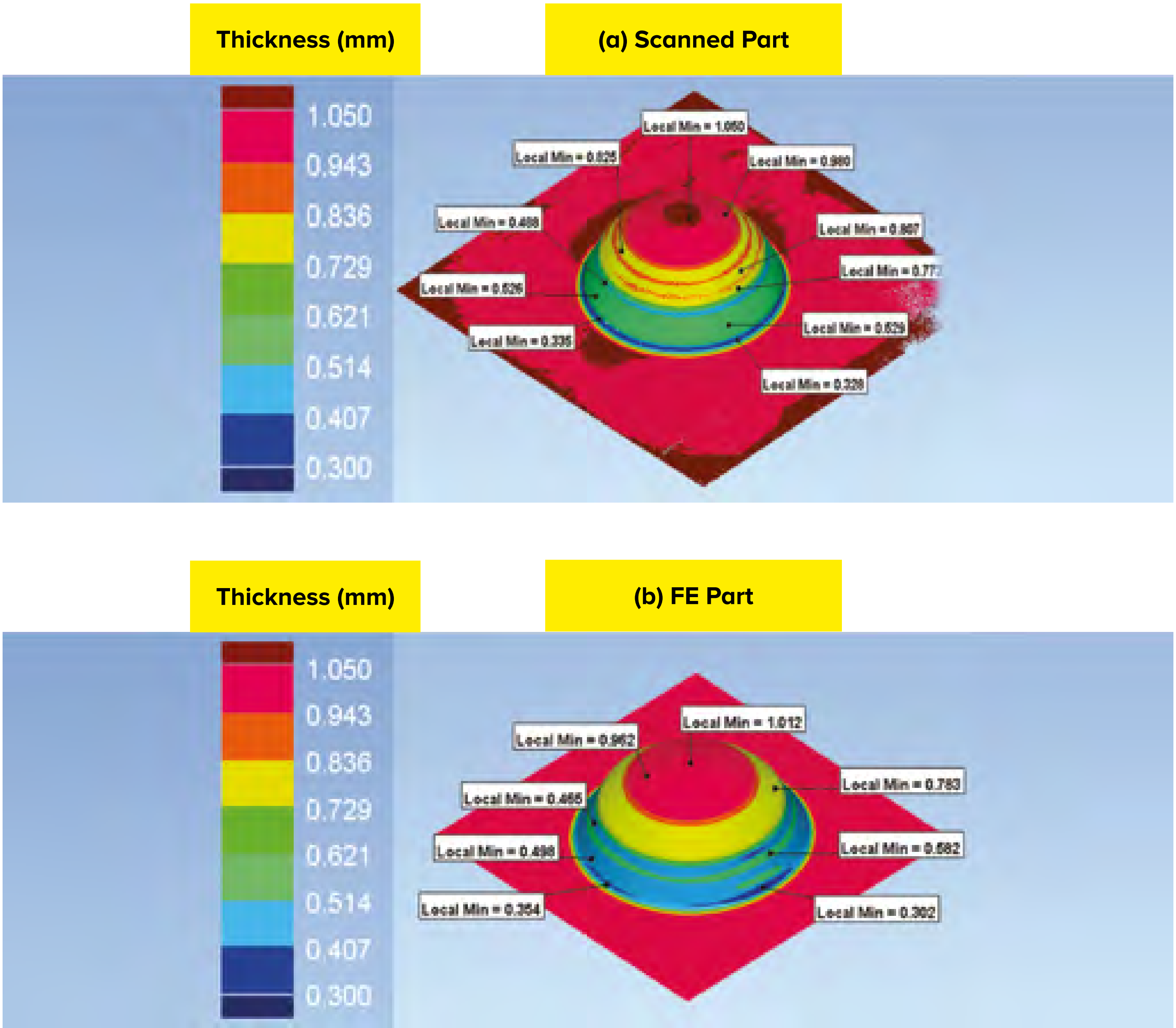

Figure 4 thickness distribution of (a) scanned part, (b) FE part

THE ANALYSIS OF THE SURFACED STRAIN DISTRIBUTION (FLD).

One of the great advantages of using ISF is the ability to form parts introducing the large strains in the material. As shown in Figure 5, a maximum value of the major strain of 1.15 was found in the FLD diagram under the plane strain condition. These values are much higher than those shown in the failure limits of the material obtained from the Nakajima test. Different research works have indicated that this higher limits are due to the complex forming mechanism occurring during the ISF process (tension, bending, and shear) when it is compared to the simple stretching phenomenon occurring in the Nakajima test.

The AFRC has investigated forming a wide range of Aluminium and Titanium alloys using ISF. The research confirmed the ability to form complex 3D shapes successfully at room temperature maintaining low production cost, energy saving and shorten time to market. ISF could be used as very flexible low volume manufacturing technology with a broad application in prototyping.

NMIS
National Manufacturing Institute Scotland

The National Manufacturing Institute Scotland (NMIS) is a group of industry-led manufacturing R&D, innovation and skills facilities supported by a network of Partners across Scotland, all working together to transform the future of manufacturing. It is where industry, academia and the public sector work together on ground-breaking manufacturing research to transform productivity levels, make companies more competitive and boost the skills of our current and future workforce.

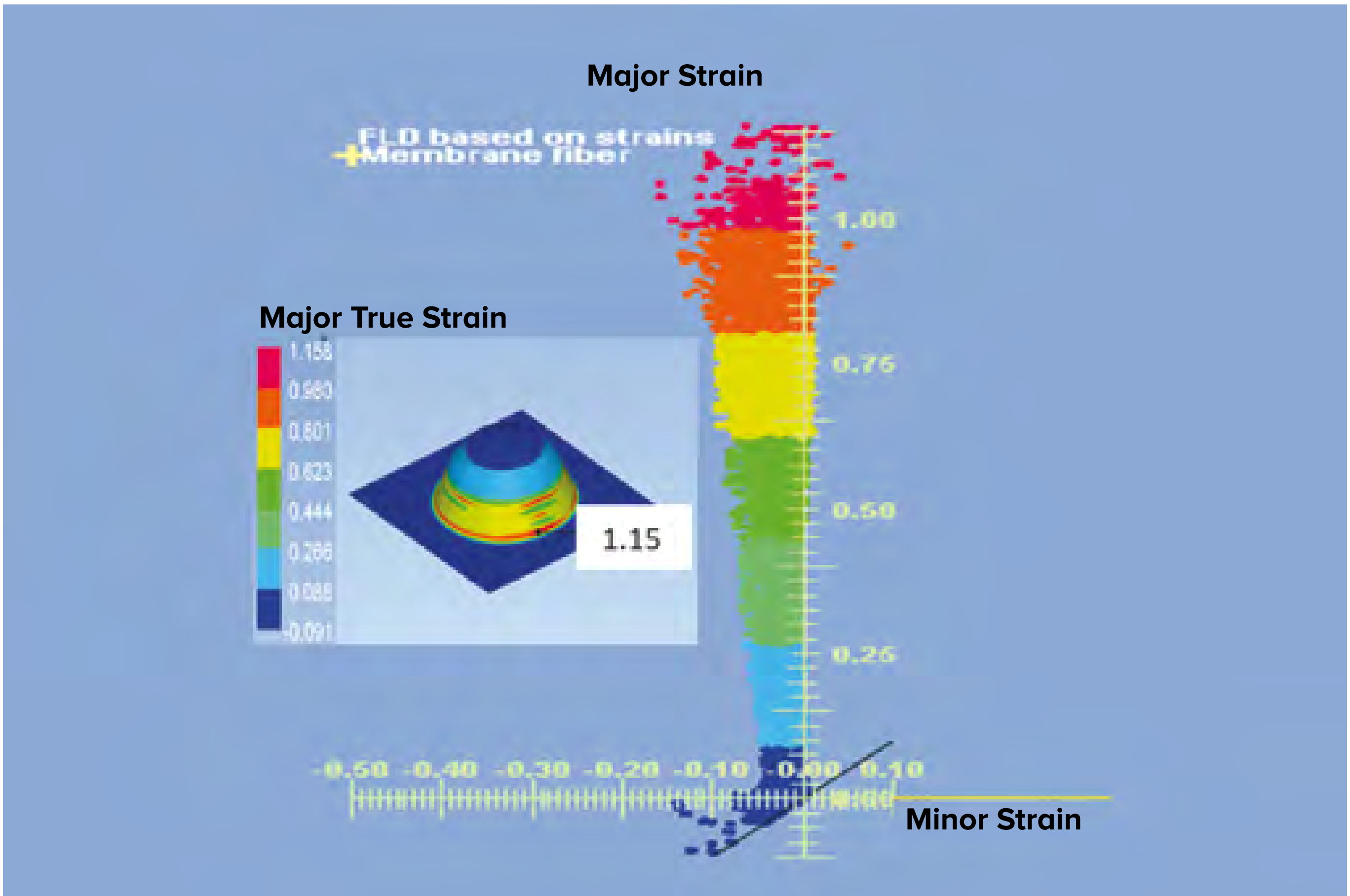

Figure 5 FLD Diagram for the Simulated formed part with the major strain distribution

MORE CAPACITY AND ORDERS AS BRUDERER UK HELPS CHILWELL PRODUCTS INTRODUCE A 4-DAY WORKING WEEK

The UK's leading manufacturer of scaffold board end bands has posted an impressive 12% increase in volumes, thanks to a timely investment in ancillary equipment and a switch to a 4-day working week.

Chilwell Products, which is now under third generation family ownership, has invested nearly £100,000 into equipping eleven of its power presses with the latest servo feed technology from Bruderer UK.

> **CHILWELL PRODUCTS SHOWED A 12% INCREASE IN VOLUMES WHEN MOVING TO A 4 DAY WORKING WEEK**

Located at its factory on Lows Lane in Stanton by Dale, the company was originally looking to continue using air feeds, but were convinced by experts from the high speed press specialist to trial its MF-2P servo feeders and the results have been astonishing.

Volumes have gone from 15.6million to 17.5million over the last twelve months and, better still, the firm has managed to achieve this in just four days, making Friday a permanent day off as a thank you (whilst all staff still maintain full pay).

"We always thought that using servo feeds would mean the material would slip when oily, but these initial concerns were quickly blown away once we put the equipment through a supported trial," explained Laura Clarke, Managing Director of Chilwell Products and the granddaughter of founder Derrick Telford.

"Through experience we found set up times were far quicker and they run the material significantly more efficiently than our incumbent air feeds; less jams, less downtime, less material rejected and wasted. All making for a much more efficient production."

She continued: "With this in mind, we began to roll-out the feeders across every press in our factory and are now up to eleven, with a twelfth on order.

"Working 39 hours per week and overtime during multiple points throughout the year is now a thing of the past. We always worried that we'd have to move to a larger premises and buy additional presses, but we've even eliminated one of the lines as it proved to be surplus! Thanks to Bruderer UK, the outlook and future for the company really has been totally transformed."

Laura, who took over the reins from her mother and now Company Secretary and Director Lorraine Clarke in 2019, is a firm believer in work/rest balance and ensuring Chilwell Products looks after the heart of its operation - its people.

Boosted by the new technology and changes on the shopfloor, the 30-year-old business leader has written into employee contracts that they'll never have to work on Fridays or weekends again.

It's also worth noting that annual salaries are remaining the same, despite staff working five hours less every week.

"We've made the changes and have still achieved a 45% increase in capacity, helping us increase turnover and giving us the chance to go after new opportunities," continued Laura.

"Everyone at Bruderer has been brilliant. From the start, they understood our issues and our concerns and quickly came up with a solution that eased our fears and, instead, opened our eyes to up the opportunity.

> ***VOLUMES HAVE GONE FROM 15.6MILLION TO 17.5 MILLION OVER THE LAST TWELVE MONTHS***

"The eleven servo feeds are all high quality and installed in a time frame that suited our business, with the added bonus of having full support of an account manager on hand if we had any small issues in the early days."

Adrian Haller, Managing Director of Bruderer UK, added: "We're very used to our technology and equipment having a really positive impact on the shopfloor, but it is even better to hear we have helped introduce a new culture that has transformed Chilwell Products."

He concluded: "This is definitely a story we are going to tell people when they visit us at MACH 2022 in April – it really underlines what a difference you can make to production and capacity if you explore different processes. Better still we'll guide you through the entire process."

Bruderer UK is set to take its largest ever presence at MACH 2022 next month as it aims to build on a record-breaking start to the year.

The high-speed press specialist has seen demand for its presses and associated portfolio grow rapidly from the automotive, medical, aerospace, construction and electrification sectors and is hoping to cement its position as the leading authority in its field by showcasing its latest technology.

Headlining the firm's 100sq metre stand (20-602) in the MMMA's Metalworking Village will be the latest BSTA 510-150 B2, which will be fitted with a state-of-the-art 300mm wide precision high-speed servo feeder.

For further information, please visit www.bruderer.co.uk or www.chilwellproducts.com

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WHAT CAN IMPACT THE ACCURACY OF SIMULATIONS?

Mohamed Mohamed, Damian Szegda, Yogendra Joshi, Alistair Foster

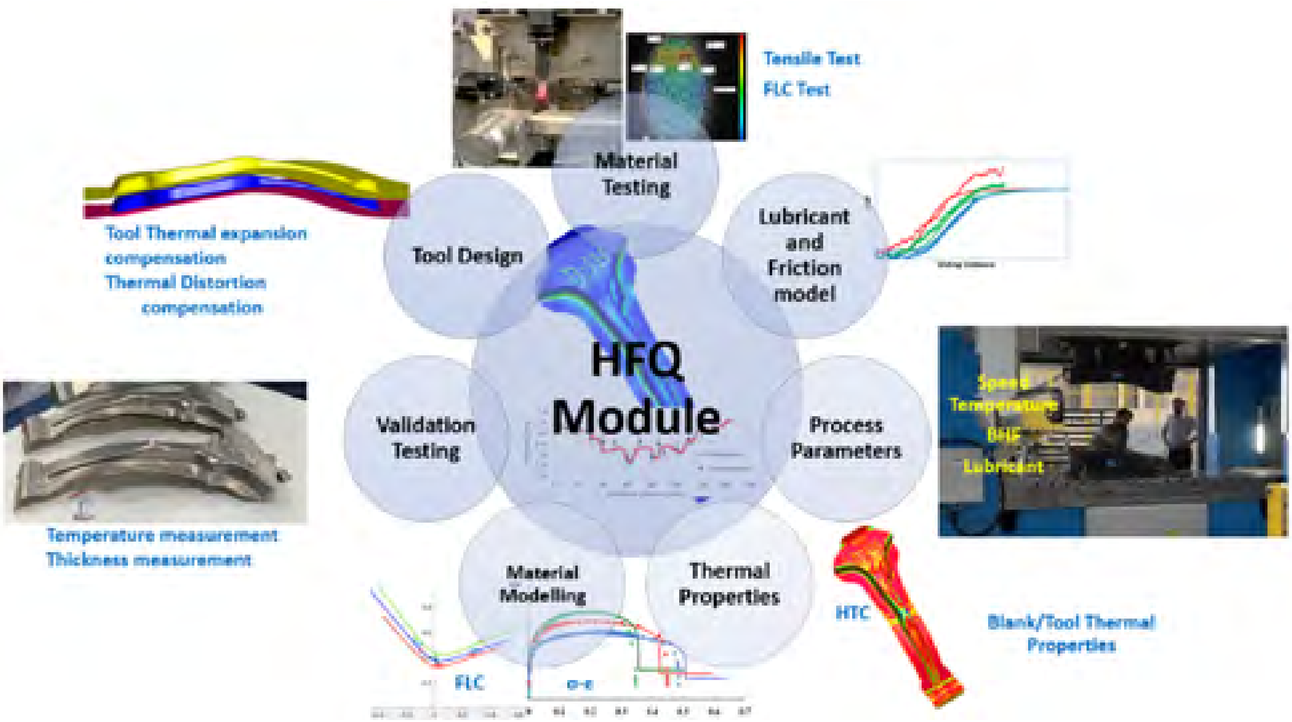
Hot forming processes such as HFQ® are considered complex as strain rates and temperatures change dynamically during the forming stroke. The accurate modelling of material behaviour during forming is crucial to achieving accurate simulations. Dr Mohamed Mohamed, Principal Technical Specialist, has developed a modern damage model to predict the failure limit during HFQ forming. With Dr Damian Szegda, Director of Technology and our prime software partner (ESI Group), Dr Mohamed is collaborating to release the new model into commercially available FE software.

The modern damage model requires calibration and validation to achieve accurate simulation. This calibration process requires a high-quality and extensive data set including uniaxial tensile and Forming Limit Curves (FLC), captured at multiple temperatures and strain rates. ITL's material testing and modelling facility includes Digital Image Correlation (DIC) to accurately track strain during hot material testing, and optimisation codes used to efficiently calibrate the modern continuum damage model. Validation of the model needs to be relevant to the actual process as realised in the production environment. Key parameters are i) forming process window (Forming speed, temperature, forming force and blank holder force, quenching time, and quenching force), (ii) Tool design, (iii) Temperature control and (iv) Lubrication. The harmonic integration and optimization of all process parameters relies upon good calibration and validation of the model.

HFQ MODULE

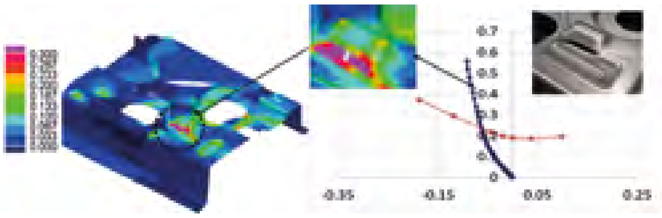
Impression technologies developed a dedicated HFQ module as a knowledge-based multiple function module, which is built from calibrated and validated independent model building blocks to enable various features of the HFQ process to be accurately predicted. The HFQ module contains a modern continuum damage mechanics material model, friction model, thermal model, thermal distortion model and microstructure model.

The HFQ Material Mechanical Model has been developed to account for the effect of stress-state on damage accumulation and failure for different aluminium series. The stress-based HFQ Material Mechanical Model has the capability to predict the shape of the FLCs at any different combination of temperatures and strain rates. The model was implemented via user-defined subroutine into PAM-STAMP, a commercial FE software package from ESI Group. This enables the capability to predict the formability of sheet metal components through the use of FE simulation. The underlying viscoplastic model equations, take the mechanisms of dislocation-driven evolution processes such as hardening, dynamic and static recovery into account.



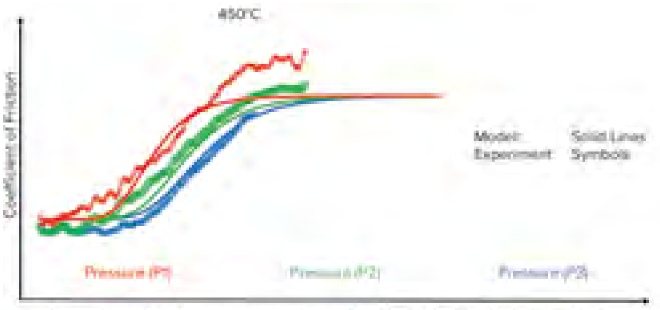
a) Modern continuum damage mechanics material model

IMPRESSIONTECHNOLOGIES



b) Tribology in hot forming of aluminium alloys

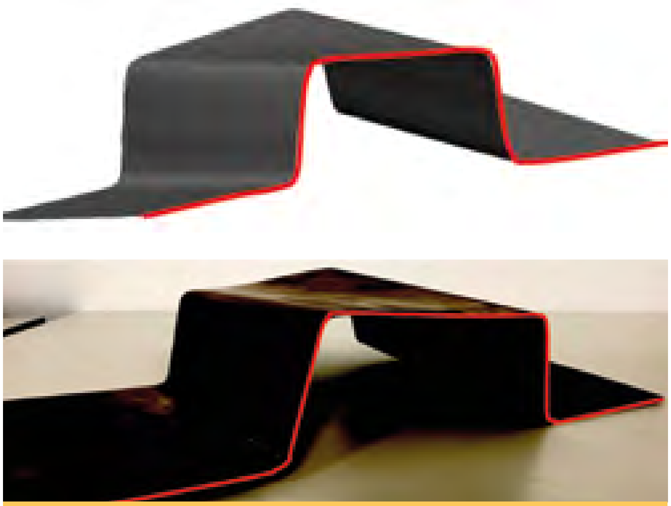
In hot sheet metal forming, lubrication and coefficient of friction representation in FE analyses is a key enabler in harnessing the advantages offered by patented technologies such as HFQ®. Tribological systems that offer consistent and stable friction simultaneously minimising die wear are of paramount significance. However, as illustrated in Figure 1, the tribological interactions at micro-scale in lubricated contacts at elevated temperatures are immensely complex. The mechanical, chemical and topographical properties of the aluminium blank and tool, lubricant viscosity and additives evolve as the hot blank is being formed and cooled simultaneously. This not only makes it challenging to design experiments for lubricant evaluation but also results in poor repeatability of friction data. A friction model has been developed to include the effect of temperature, sliding velocity, sliding distance, contact pressure and lubricant amount. The model is calibrated using the tribological experiments which carried out were carried out using a hot strip drawing tribometer.



Comparison of modelling and experiment result of coeffiecient of friction evolution under various loading conditions

c) Thermal distortion model

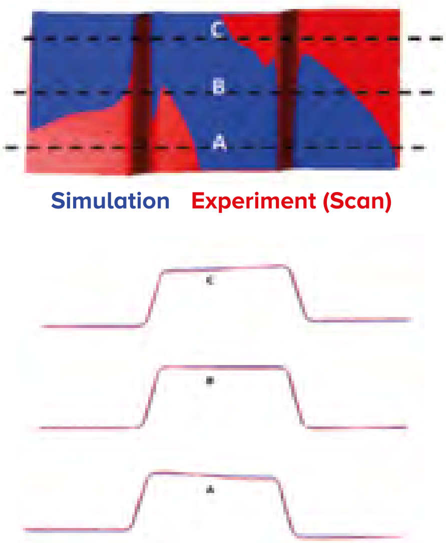
In hot stamping, the shape distortion issue proved to be more complex than in cold forming. At elevated temperatures the material response becomes viscoplastic, i.e., rate-dependent, whilst the process is inherently non-isothermal due to contact with cold tools and ambient air. Moreover, the quenching phase is defined by mechanical boundary conditions applied through contact which is characterised by contact pressure distribution leading to non-uniform cooling and, hence,



Overlay of Scan physical part and FEM predicted model (high forming speed and long-time quench).

non-uniform thermal contraction. The complex interactions between the thermal and mechanical conditions can often lead to difficulties in accurate simulation of the process leading to inaccuracies in the prediction of the thermo-mechanical distortion. Without accurate distortion prediction, effective tool compensation is impossible.

A dedicated modelling approach was developed for the prediction of the complex thermo-mechanical distortion for the HFQ process which enables effective design methodology for tool compensation.



Overlay of Scan physical part and FEM predicted model (high forming speed and long-time quench).

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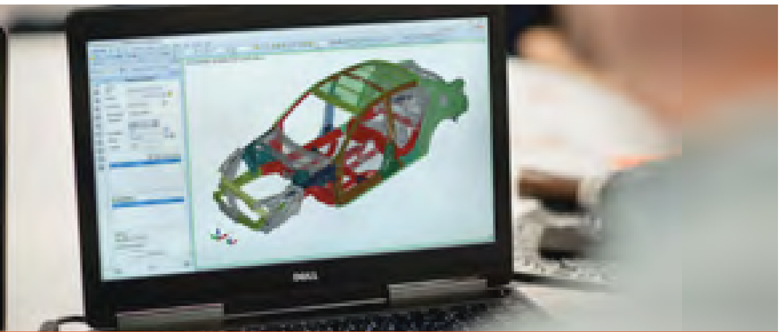
EMPOWER AUTOMAKERS TO ENGINEER AND MANUFACTURE MULTI-MATERIAL ASSEMBLIES WITH CONFIDENCE

Matthieu Niess, Industry Program Leader, ESI Group

Automotive companies strive to develop disruptive and sustainable mobility devices. Their carbon reduction objectives mostly translate into weight reduction targets - which conveniently fits the bill for increasing EV range. Introducing new materials and processes can be very tricky with regards to feasibility, as much as for final product performance that no one is ready to jeopardize. Not to mention cost – product development involving new materials and processes over which you have no experience is inevitably risky and full of surprises. Read on to learn about feasibility assessments, assembly process prediction, performance validation – all-virtual, cost-effective and "first time right".

Driven by the need to reduce CO2 emission and by the new e-mobility trend, automotive OEMs and suppliers have been on a journey towards developing lightweight, disruptive, individual and sustainable products that can be manufactured in scale and a 'lot size 1' factory architecture.

Lightweight has become the new must have in body and chassis design, shifting from 100% steel body and chassis manufacturing to multi-material strategies that mainly now combine steel with aluminium and composites. Finding the right material mix, applying the right material at the right place, optimizing geometries and thicknesses and selecting the optimal joining technologies, for their strength and also their manufacturing feasibility and cost – early clarity and confidence in predicting these problematics are key to efficiently managing the increased complexity in the manufacturing of those advanced assemblies and to achieving the vehicle mass targets.



Numerical simulation is state of the art to evaluate manufacturing feasibility, assess and validate a design's performance

In addition, with regards to the electrification challenge, multi-material assemblies are key to producing vehicle bodies with the best cost / lightweight ratio and increasing energy efficiency during production. However, currently higher investments on the powertrain side translate into more conservative investments on the body and chassis side. This increases the pressure to achieve better cost efficiency in engineering and manufacturing for those vehicles.

SHIFTING FROM SINGLE-POINT NUMERICAL SIMULATION TO END-TO-END VIRTUAL PROTOTYPING

Over the past decades, numerical simulation has been instrumental in allowing OEMs to evaluate manufacturing feasibility and to assess and validate a design's performance. However, body manufacturing decisions are made relatively late in the process, after the design freeze, and automakers still rely heavily on physical testing. Often, engineers detect body assembly distortions too late in the process. Late design changes and iteration loops risk extra cost and delays to start of production.

The ambition to frontload manufacturing decisions is not new. But the design-to-cost requirement brings an additional push. Indeed, best practice is to find an optimal design as early as possible and to validate it in the engineering phases, and this in a highly predictive manner, to avoid costly prototypes and late design changes during manufacturing pre-production validation.

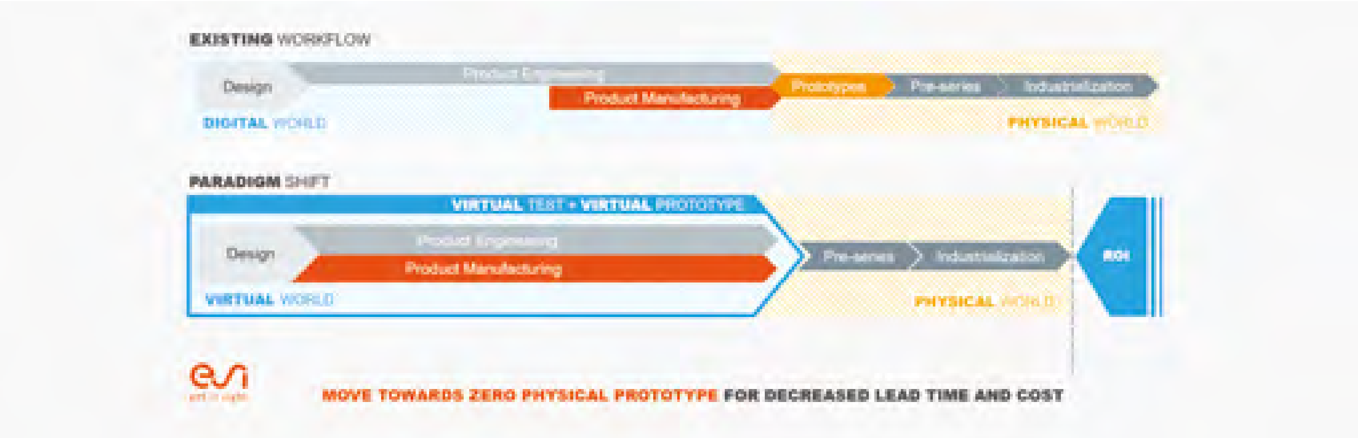


Image 2: end-to-end chaining of BiW processes with Virtual Prototyping

Achieving such an optimal design through a pure digital approach is not straightforward. Two main aspects need to be accounted for to ensure a fluid journey until serial production (image 2):

- **Single Parts Manufacturing**: Detailed simulation of single- part manufacturing has been established in the industry for many years. However, typically it comes later in the workflow because engineers need to define various tool environments first. With the rise of advanced mix-materials, automakers, need early confidence to make the right decisions about which material works best at which place. Thus, it is very important to be able to estimate the manufacturing feasibility since the beginning, when the first CAD data and bill of material (BOM) are generated. Virtual Prototyping allows engineers to consider all this information in early development phases and therewith improving the predictivity of the function and performance validation as well as the assembly process simulation – even prior to process tools and dies definitions.

The main benefits of having manufacturing data available at the earliest stages include:

  - early optimization of the part design for feasibility and therefore drastically reduce the number of iterations on part changes afterwards
  - estimate material cost based on realistic blank outlines, accounting for scrap material
  - predict manufacturing effects introduced during the actual manufacturing process (strength, thinning, strains) and use the data to improve the overall crash performance and NVH/durability prediction
  - get realistic predictions for final component shape (including springback) and define the assembly process accounting for realistic part geometry

- **Joining Process:** The possibilities to join multi-material assemblies are numerous. To find the right match, it is crucial to accurately model and simulate the joining process in order to transfer the connection strength into crash and durability optimization. In addition, engineers need to account for the impact of the joining process on the parts' geometries in order to predict assemblies' quality.

  The final target is always to have best predictivity as early as possible, with minimum computation time.

In the later pre-production validation phase, first physical parts would be sent over typically from different suppliers and locations to OEM assembly plants in order to check final assembly tolerances and quality. To overcome these costly logistics, Virtual Prototyping allows engineers to use instead 3D scans of the single parts plus the joining process impact as input for their assembly simulation. Consequently, parts and assembly tolerances deviations can be anticipated and costly trial-and-error phases avoided.

Furthermore, 3D scans can even be replaced now by digital results of manufacturing processes, like stamping. As a consequence, distortions and tolerances in body and chassis as well as perceived quality in class A panels assemblies can be analyzed and predicted already in early development phases, ensuring the end product can be produced and assembled at highest quality standard within the specified tolerance range.

Let's look at two examples of leading automakers that nicely visualize the benefit of this approach:

CUSTOMER STORY 1 |
NISSAN REDUCED ENGINEERING LEAD TIMES FOR NEW LIGHTWEIGHT MATERIAL BY AS MUCH AS 50%

To address the weight reduction objectives of Nissan's Green Program, the Japanese OEM has been investigating mixed material use (aluminium, steel, and composites assemblies). Nissan engineers used ESI simulation solution for composites manufacturing to develop a new process method of injection molding and compressed molding, bringing significant efficiency gains for their production lines. By trading the usually long and costly trial-and-error period for developing a new manufacturing process with numerical simulation, Nissan's engineers managed to make early decisions on lightweight material types, while securing design requirements and production goals. By their estimation they succeeded in reducing engineering lead time by as much as 50%.

In terms of manufacturing results: In November 2020, Nissan publicly announced their breakthrough in carbon fiber parts production. They went from producing a Carbon-Fiber Reinforced part in two hours down to 2 minutes, reducing production time for a single molding by 80%. This technological agility also allows Nissan to produce complex part shapes enabling an average weight reduction of 80kg per vehicle.

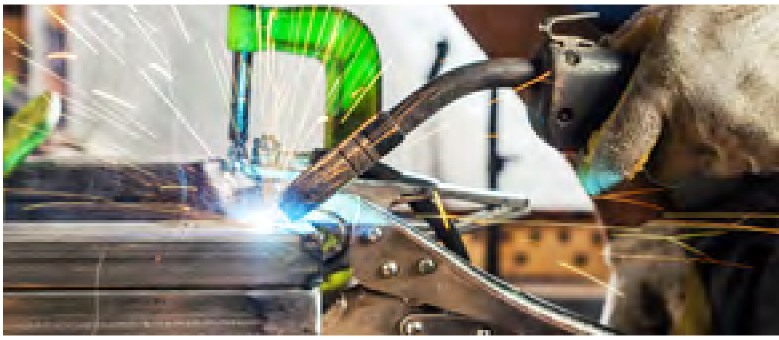
Such an achievement became possible not at least thanks to the ability of confident decision-making and early optimization and thanks to synchronized activities in both design and manufacturing engineering for forming, heat treatment, joining and assembly processes.

CUSTOMER STORY 2 | FORD LEVERAGES VIRTUAL PROTOTYPING TO PROPEL LIGHTWEIGHTING CAPABILITIES TO THE NEXT LEVEL (IMAGE 3)

As new government regulations related to emissions policies emerge, auto manufacturers are forced to shift away from their legacy knowledge and start thinking creatively. The most popular shift has been towards lightweight materials, which, naturally, come with their own unique set of challenges. For example, if an OEM was historically using traditional steel for their bumper but is now using ultra-high-strength steel, they must assimilate new methods allowing them to work within the parameters of that new lightweight material and adapt their processes to its behaviour.

But the job doesn't end there. How will the vehicle perform once it is on the road? How safe are these new materials once they are manipulated, joined, and welded?

With this Spot Weld Rupture Solution, it is realizable to accurately simulate the resistance spot welding process and seamlessly transfer the manufacturing effects to performance models. In doing so, spot weld rupture properties can be characterized, in one single environment, instead of using different software for each. During spot welding of high-strength steel, such as boron steel, the nugget is fully martensitic. The heat-affected zone undergoes softening due to the transformation of existing martensite to tempered



martensite (image 3). ESI's Spot Weld Rupture solution captures the phase information after welding and changes to mechanical properties around the weld, seamlessly, to predict the rupture force-deflection curves for lap shear, cross tension coupons.

LONG-TERM VISION – EVOLVE TOWARDS ZERO PHYSICAL PROTOTYPES IN AUTO MANUFACTURING

Virtual Prototyping represents an end-to-end approach, for early validation of material and design choices, manufacturing, and assembly process strategy, with significant benefits over the complete body development cycle. It empowers automakers to effectively validate all the leading lightweighting material candidates for vehicle structures safety-critical components and to associate the optimum joining processes to achieve assemblies at best performance/cost/quality ratio.

This robust foundation brings early confidence before moving to physical world with clarity about the right production strategy, which is finally virtually validated prior to production with a constant link to function and performance validation. This paves the way for a digital Body factory in which automakers can progress towards zero physical prototype, ultimately shortening the overall product development cycle and minimizing its cost and time to start of production (SOP).

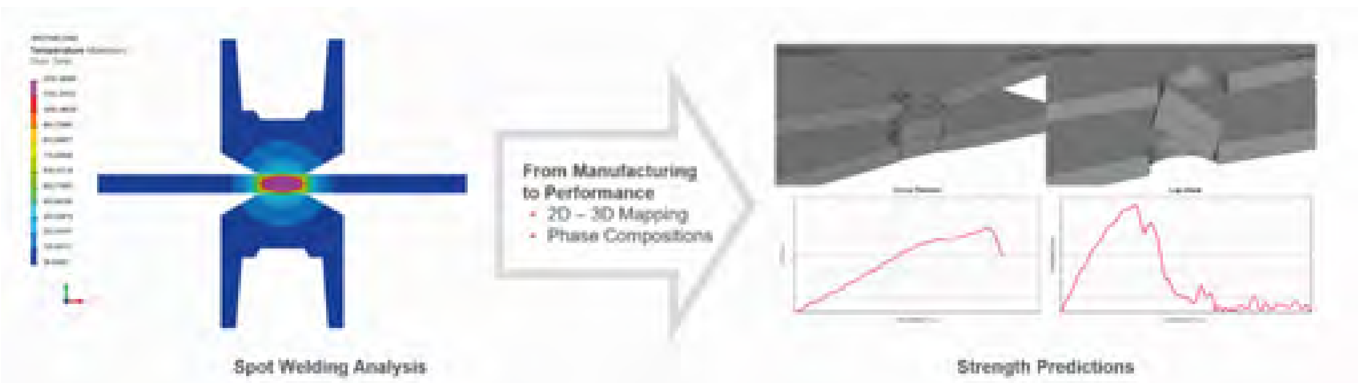


Image 3: ESI's spot weld rupture solution predicts force-displacement curves for various nugget rupture modes