Hot Press Simulation with PAM-STAMP

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Dear Reader,

I am excited to introduce this issue of ESI’s magazine, with its specific focus on Virtual Manufacturing.

Before we touch on the topic, I would like to point out how deeply rooted Virtual Manufacturing is in ESI’s history and strategic vision for Virtual Prototyping.

Here at ESI, we strongly believe that it is impossible to build an accurate Virtual Prototype without correctly accounting for material properties and the processes by which parts and components are fabricated and assembled. This is the essential foundation for fast and accurate virtual tests that reduce the need for physical prototypes and physical tests.

ESI’s ability to chain manufacturing history with virtual tests — and to couple different physics — enables our clients to build multi-domain optimization strategies. We challenge the practice of engineers working in domain silos and instead offer integrated solutions that help industrials gain in process efficiency. Used from the earliest stages of product development, ESI’s virtual prototyping solutions enable companies to avoid heavy financial investments in physical prototyping and testing. Our mission is to enable our customers to pre-certify their products, and their means of production, before anything is built.

Our Special Report (page 4) will show you how our simulation solutions for die making and stamping enable the seamless design and development of cutting-edge tooling and machinery. Our leading sheet metal forming solutions are no secret and only keep getting better and faster…

We will also show you how ESI goes the extra mile by enabling early customer experience thanks to Virtual Reality solutions which offer an unprecedented immersive experience, with real-time interactions, before any physical prototype even exists.

Our customer AP&T in Sweden, leader in sheet metal forming production lines, explains how our combined technologies represent a true competitive advantage for their business (page 8).

In this issue, we celebrate the 25 years of our flagship casting simulation solution, ESI’s ProCAST (page 18) as the latest version of the software was presented last month at GIFA, the world’s most important trade show for casting technologies.

We inform you about latest product releases and acquisitions — including Ciespace (page 21) — that increase the value proposition of ESI’s Virtual Prototyping solutions and set the stage for democratization of CAE.

Enjoy the read!

Peter Schmitt
Executive Vice President Sales & Marketing,
ESI Group
Automotive trends and tight CAFÉ fuel economy regulations are driving lighter weight design every design cycle. As we reduce the weight of our cars, there is a risk of decreasing vehicle safety. Many manufacturers have opted to reduce weight using plastics and composites. However, hot formed steel can also ensure a thin, lightweight and strong design. In fact, the recent use of hot formed steel has seen small Group-A cars, like the Fiat 500, in range of 5 star EURO-NCAP crash test ratings.

“You want to have a section that is hard to protect you from a side impact, or from the cage crashing down,” said Harald Porzner Director of Virtual Manufacturing at ESI Group. “You will also want an area that is ductile to absorb the energy of the crash keeping the driver and passengers safe. Hot forming allows for light weight strong, complex shapes, and close to nominal structures needed for the rigid structure.”

In fact, Porzner expanded that the complex shapes needed in the design of today’s car parts is due to optimized strength characteristics and the reduction of space under a car’s hood. These complex shapes are possible to produce with hot forming but would be difficult to make with cold formed high strength material. Furthermore, these hot formed shapes are typically closer to nominal allowing for easier car assembly.
Porzner applies this knowledge in his responsibilities managing ESI's PAM-STAMP, a program able to model and simulate a hot forming process of a part defined in CAD drawings. Despite the design challenges associated in reducing a car's weight, the automotive development time has reduced considerably. A tool like PAM-STAMP which can model, simulate, and virtually prototype the whole hot forming process is a considerable design cycle advantage.

"With PAM-STAMP, you can perform up to 40 simulations a day in the early feasibility phase. As each simulation is specialized for the hot forming field, you don’t have to spend as much time setting up the problem as you would with other FEA software,” explained Porzner.

The Science Behind Hot Forming Steel

The hot forming process is designed to freeze the crystalline structure of steel to ensure the strongest possible properties. The part is heated to about 800°C (~1500°F) where the atomic structure will transition from a body centric cubic lattice into face centric cubic austenite steel. If the steel is quenched fast enough, the steel will become martensite. The strained crystalline structure produced is responsible for the desired structural properties.

“The blank will go through the furnace for about 5 minutes to produce the desired microstructure. The blank is then transported to the die where it is formed into the part. This part is then quenched by a cooling rate above 50°C/s (122°F/s). This new microstructure structure will be hard to stretch and compress,” said Porzner.

The PAM-STAMP Workflow Simplifies Die Tool Creation

Geometry Processing

The first step to design the hot forming process is to ensure that the geometry is safe to use. Much like using CAD in other CAE software, engineers need to check the topology of the part and clean up the design. Users then define the part’s material and thickness.

Both surface and solid models can be imported as PAM-STAMP geometry. The program will be able to determine the top and bottom surface of the solid, as well as generate the mid-surface. These calculations are necessary to assess the flattening of the part.

Material Cost Feasibility

For quoting purposes, engineers can next determine the feasibility of the material costs.

PAM-STAMP determines an optimized flattened blank outline based on the 3D model, restraining force, material, and other inputs. To develop the blank outline further, nesting techniques are used. These will smooth, supplement, and offset regions in an attempt to reduce scrap. PAM-STAMP supports various nesting layouts such as one-up, two-up, mirror, and transfer die.

“Nesting is when you lay out the shape of your blanks over a coil. The program helps place the blank within the coil to get the most out of the material and reduce the scrap,” said Porzner.

To complete the quote, PAM-STAMP can auto-generate a report, which includes data on fall off, coil width, blank area, utilization, and images of the nesting and blank outline.
Die Face Definitions

After the material costing is completed, engineers can start designing the tool faces of the die. The faces are determined based on the part B-Spline geometry and the hot forming process. Much of these design iterations can be done within a CAD environment.

The die face should be optimized for performance and simulation accuracy throughout the design cycle. PAM-STAMP also ensures the die is compliant to automotive standards.

“All die face design solutions from ESI include automated interfaces to simulation. This saves 90% of the time forming, setting up and simulating the model.”

Harald Porzner,
Director of Virtual Manufacturing
ESI Group

The die face definition constitutes a large challenge in today’s automotive industry. Typically, a part is designed by engineers based on functionality and aesthetics. Manufacturability cannot be an afterthought. PAM-STAMP assists in the die’s design and simulations for optimum costs and manufacturability.

Validation and Manufacturing Feasibility Studies

The next step of the PAM-STAMP workflow is to assess the feasibility and to validate the transport, gravity stamping, and quenching of the part.

The gravity stamp and transport simulations will assess the wrinkling, cracks and thinning while forming the part. The process parameters in the transport and gravity stamping simulation are updated iteratively until an optimum setup is created. This tends to be when the thinning is no less than 20% and there are no cracks, with no wrinkles.

Porzner explained, “You don’t need a lot of pressure to form the part; gravity on the tool is theoretically good enough. But during the quench you need to press down on the part to make sure you get the correct heat transfer during the quench.”

Continuing with the work flow, the engineer then moves onto the simulation of the quenching process. This simulation will determine the cooling rates, hardness, and temperature of the part. Porzner mentioned that to ensure a proper heat transfer during the quench, over 90% of the surfaces should be in contact with the part at 10 MPa, 99% of the part should be in contact with the die at 1MPa.

“If you are not achieving the surface contact or pressure needed then you must spot the die. This is when you grind down the die until the part has the contact needed to get the heat out. This optimization process can take weeks,” warned Porzner.

If the part is cooled properly, then the fully hardened part will not deform much as it cools. Porzner said, “If you take the part out with a max temperature of 150°C (~300 °F) then you have the required properties from the microstructure, and you will not have any distortions affecting your assembly.”
“However, you don't want this final temperature to be so cold that it takes too long. Typical cycle times for a sheet of metal 2mm thick is about 10-12 seconds. This is key not only for the microstructure of the steel but also for the production cycles in the automotive industry. If you can't make the part fast and cheap then nobody wants it.”

Harald Porzner, Director of Virtual Manufacturing ESI Group

**Cooling Channel Analysis**

Porzner mentioned that if you are going to produce one part then you don't typically need to cool the die. The die’s temperature will be cool enough to quench the part. However, when producing many parts in an assembly line, as is the way in the automotive industry, water based liquids are used to keep the die cool.

PAM-STAMP is able to perform cooling channel analysis (including 3D heat transfer and determination of contact heat transfer properties from forming) to ensure that the cooling channels will be able to handle the production load of the system. ESI's Computational Fluid Dynamics software ACE+ Suite, part of the hot forming solution, will allow the engineer to determine a conjugate heat transfer model to identify flow characteristics and the coolant temperature.

**Bringing it all together with Virtual Reality**

Now that the simulation data for the whole process is completed, the data can all be culminated into one virtual reality simulation. This simulation can be used in a Virtual Reality cave for training, or a system wide simulation to ensure just in time production.

Overall, with the completed simulation and die face design, the engineer can now sign off on the part manufacturing at a fraction of the time that it would have taken when relying on a physical trial and error process.
AP&T, which stands for Automation, Presses & Tooling, is a Swedish company specialized in the development and manufacture of complete production systems for manufacturers of formed metal parts. AP&T is one of the few players who are delivering turnkey solutions especially for the hotforming process. We supply both to global automotive OEMs, such as Volvo, and also to many Tier-1 suppliers all over the world.

AP&T offers a vast product range: we are world leaders in complete press hardening lines, and one of the largest supplier in air duct lines, all sorts of press lines, roof drainage lines, heat exchanger lines – and we even offer to ‘retrofit’, which means to automate and rebuild existing presses. In this respect, we have established ourselves as technical leaders and innovation is therefore central in keeping our competitive advantage.

Today, equipment for hotforming processes represent about two thirds of our business. It’s a complex and challenging process that requires know-how of the whole process. AP&T has in-house expertise in all areas for the manufacturing of hotforming lines – from heating over handling of the hot material to presses and the water-cooled tools. For the simulation of the tools, AP&T has been using ESI’s Sheet Metal Forming simulation software, PAM-STAMP, since 2008. For the 3D-visualisation of the whole production line, we have IC.IDO in use since 2013.

Finally, we use ESI’s Virtual Reality solution IC.IDO for marketing purposes. The technology enables us to interactively share our design proposals with customers at trade shows and customer presentations. It’s much more exciting to experience a full functioning manufacturing line in 3D, compared to the previously used 2D models.

In a market aiming at reducing weight whilst gaining strength, there’s a clear trend towards advanced parts with tailored properties – different weight, strength or thickness in different regions, and using different material grades, all aimed at the optimization of material usage. This is a big challenge in the manufacturing of parts, where simulation will be a great help.
Today, a broader spectrum of patients – including athletes – need hip surgery at an increasingly younger age; and with growing life expectancies, prostheses must last longer. These requirements for increased longevity and comfort raise several new challenges for doctors as well as for prosthesis manufacturers. ESI, partner of numerous R&D projects in the biomedical sector for many years, has recently conducted a study in France to help understand the issues related to the manufacturing, placement and in-vivo mechanical behavior of such prostheses.

For manufacturers, new materials, including ceramics and metal alloys, must be evaluated and prosthesis design must take into account various issues related to breakage, wear and noise. Doctors, on the other hand, try to mitigate the possible consequences of a micro separation between the prosthesis’ femoral head and the cavity in which it is inserted (the ‘cup’). This separation can cause micro impacts during daily use and result in premature wear.

A study was conducted to accurately simulate the kinematics and the various stresses applied on a hip prosthesis in order to understand the physics taking place in cases of extreme load, experienced in accidental cases. The teams used ESI’s integrated CAE platform, Visual-Environment to build models from geometry and material description provided by the manufacturer. They then switched to ESI’s Virtual Performance Solution to study an impact equivalent to 9K Newton in 9ms, which is representative of a severe shock, such as a patient heavily falling down the stairs.

Subsequently a study was conducted on behalf of a prosthesis manufacturer, Science et Médecine (SEM), based in Créteil, near Paris, France. The aim was to compare three different designs of modular prostheses fabricated from vanadium alloys, to determine which one was the most resistant in accidental cases. The precise simulation of the fitting process of the prostheses has helped SEM to accurately determine their future positioning, as well as the structural damage expected when regulatory tests are performed.

“Numerical simulation is commonly used by SEM to achieve reliable design and ensure the safe use of our medical devices. We are very sensitive to software improvements, especially those incorporating dynamic simulation. The study conducted in partnership with ESI has improved our understanding of the mechanical behavior of our prostheses, for each tested design. The recent developments of simulation tools help us in increasing the reliability of medical devices including those requiring assemblies.”

Mr. Bréard, 
Research and Development Director
Science et Médecine

“As explained by Fouad El-Khaldi, Industrial Strategy and Innovation Director for ESI Group, this study in the health sector is part of ESI’s diversification strategy:

“ESI has already proven its value in helping companies in the automotive, aerospace, energy and electronics domains. Now many other industries are turning to Virtual Prototyping as they see the benefits of being able to pre-certify products and anticipate product issues. Obviously, the health sector represents a huge potential market because simulation can solve customization issues and help manufacturers deliver the best solution for each and every patient, in less time and at an affordable cost.”

About Science et Médecine

SCIENCE ET MEDECINE, created in 1970 is specialized in the development and the manufacturing of prostheses for hips, knees and spine. Focused on innovation, SEM patents many models every year and is becoming a major stakeholder in traumatic and orthopedic surgery in France and in other countries all over the world.

for more information
www.esi-group.com/visual-environment
www.esi-group.com/VPS
www.science-et-medecine.fr
Based in Ottawa, Canada, the Eclipse Foundation is a not-for-profit organization dedicated to the promotion of Open Source solutions via their collaborative platform. The many projects hosted by Eclipse focus on building and strengthening this platform, while providing a range of services including IT infrastructure management, intellectual property management and software development support. Eclipse also nurtures the Open Source community by the organization of events, training and other networking opportunities.

“Today, Eclipse counts no less than 230 member companies: software editors, hardware manufacturers, and chip makers have joined forces as well as an increasing number of industrial manufacturers, who are seeking their way out of software dependency, or rather, technological dependency,” explains Gaël Blondelle, Director, European Ecosystem Development at Eclipse Foundation.

Airbus, Thales, BMW, Ericson, or Audi to only name a few, have chosen Eclipse’s Open Source platform as a base to support some of their longest product development cycles. For software editors including ESI, one of the benefits gained from contributing to the Eclipse platform is that it can then be embedded into their own product developments.

ESI is a member of the PolarSys Project

“After joining the Eclipse open community, we became an active member of the PolarSys Project a year ago,” comments Serge Laverdure, Virtual Systems & Controls Director at ESI Group.

Eclipse project PolarSys is an industrial working group dedicated to open source tools for embedded systems development. It addresses the full range of system engineering activities including Modeling, Requirement Engineering, Simulation, Coding and Debugging, Testing and Verification. The project is led by large organizations such as Airbus, CEA, Ericsson and Thales. It represents a stimulating ecosystem of users, vendors, service providers and researchers.

Laverdure explains: “ESI’s main target in the field of Virtual Systems & Controls is to provide a seamless software solution to build, test and qualify a complex electronic system thanks to a virtual functional prototype. Challenges can be numerous. In the automotive sector for instance, the electronic system is composed of around 60 sub-electronic systems interacting together, relying on information coming from smart sensors, GPS, and in a near future, from car-to-car communication or car-to-infrastructure communication.

Participating in PolarSys will undoubtedly help us rise to this challenge, by letting us inherit from mature technologies so we can focus on our main objective, which is to provide an open platform for systems engineering.”

The project VIPES, detailed in the opposite page, will use some of the technologies developed by industrial manufacturers to the benefit of other industrial manufacturers, as part of PolarSys.

“The starting point of PolarSys was TopCased, a project completed by Airbus ten years ago and then deployed within the A350 development”, Laverdure recalls. The last major project milestone was provided by Thales this year with Capella, which is a model-based engineering solution developed and successfully deployed at Thales and now transferred into the PolarSys Project. Based on a graphical modeling workbench, Capella provides rich methodological guidance, high productivity and quality assurance gains for engineers developing systems. “This new tool could be a very interesting candidate in our electronics system simulation solution,” Serge Laverdure concludes.
ESI Leads VIPES

A project dedicated to fostering a Virtual Integrated Platform for Embedded Systems

The French Ministry of Economy, Industry and Digital Industries has chosen to fund “VIPES” following its 19th FUI call for projects (Common Inter-ministry Fund). The total funding for the 62 R&D projects selected will amount for 47.6 M€. For VIPES like for all other candidate projects, the two criteria assessed for awarding funding are the strong potential for innovation, and the expected generated revenue in the next 5 years. Aiming to increase France’s competitiveness, VIPES is supported by three competitiveness clusters (Pole Systematic, ID4Car, Capenergies) and the Brittany region.

To foster innovation, the VIPES project proposes to look closely at embedded real-time systems, which are critical to increase performance in the automotive, aerospace and rail industries. For these three industries, embedded systems have similar performance requirements: integration, reliability and safety.

The technical challenges arising can again be compared across the three industries. Today, manufacturers must find solutions to:

- Manage a growing number of real-time embedded systems, which are given increasingly critical functions for passive and active safety such as airbag ignition, braking systems and Advanced Driver Assistance Systems (ADAS);
- Shorten design and validation loops to decrease costs and lead times;
- Manage increasingly complex software environments for product development;
- Standardize simulation tools to connect different CAD and simulation tools for electronic systems.

The VIPES project intends to meet these expectations by offering a real-time simulation environment dedicated to the development of embedded systems and compatible with standard FMI 2.0 (Functional Mock-up Interface), a standard format to exchange models and use multiple simulation tools concurrently (co-simulation). The new environment will enable manufacturers to virtualize the testing of their embedded software while taking into account future electronic components – and to do this early in the development cycle.

The project consortium around ESI consists of two complementary partners:

- Scaleo Chip, a “fabless” semiconductor company that designs, develops and markets complete solutions with high added value combining Systems-on-Chip (SoC) and embedded software.
- CEA-List, an R&D institute part of the Atomic and Alternative Energies Commission, whose areas of expertise range from the nuclear industry to biological sciences. CEA-List is primarily concerned with the development of a combination of software and hardware technologies for the development of highly complex integrated systems.

“The VIPES project will support the development of ESI’s activities in the field of Systems Engineering, and more specifically Embedded Systems. Two major development axes brought by the project are the modeling of embedded systems using Command & Control, and the Virtual Prototyping of Electronic Control Units (ECUs) to support test and integration phases.”

Jean-Sébastien Berthy,
Complex Systems Platform Manager
ESI Group

for more information
www.competitivite.gouv.fr
www.systematic-paris-region.org
www.capenergies.fr
www.id4car.org
www.scaleochip.com
www.list.cea.fr
New Version of VA One

The only solution on the market providing a complete simulation environment for vibro-acoustics analysis and design across the full frequency range.

Vibro-acoustic engineers need the right model at the right time, and there are as many model requirements as there are milestones in a project. The new VA One seamlessly combines key vibro-acoustic modeling methods in a single model and includes add-ons and enhancements, providing increased flexibility for daily use:

• Automatic coupling with the open source Computational Fluid Dynamics (CFD) software OpenFOAM® enables vibro-acoustic engineers to make quick predictions of the performance of their designs in the presence of steady flow conditions.

• A new automatic model checking minimizes the danger that computations will fail because of some missing parameter.

• The new Distributed Memory Processing (DMP) solver for Boundary Element Method (BEM) delivers superior performance on High Performance Computing architectures, reducing computational times by a factor of 10 for large cases.

• Significant advances in SEA modeling of complex plates allow accurate and quick calculation of the vibro-acoustic response of structures manufactured with the newer materials that are increasingly used in the aerospace industry.

• Automated user assistance is provided when setting up a large number of load cases, reducing import time from several hours to only a few seconds.

“The introduction of flow effects into FEA acoustics models enables GLSV to evaluate the installed performance of engine silencing systems more accurately and with a higher level of confidence. Because the CFD is integrated into the workflow, it allows us to perform multiple design iterations, including flow effects, in a short time frame. ESI’s VA One 2014.5 provides a significant capability increase with the added functionality of flow effects.”

Steven G. Mattson,
President of Great Lakes Sound & Vibration (GLSV), USA

Simulation of an automotive muffler: CFD streamlines (left) and acoustic response (right).

for more information
www.esi-group.com/VAOne

Upcoming ESI User Conferences
Latest Version of Virtual Performance Solution

ESI’s end-to-end solution for Virtual Prototyping increases efficiency by supporting modular assembly

A benchmark in the automotive industry, ESI’s Virtual Performance Solution empowers manufacturers to evaluate and optimize product performance across multiple domains, so they can develop higher performance products at lower cost and in less time.

By using a ‘single-core model’ that can integrate all manufacturing properties and multi-domain simulation data, companies using Virtual Performance Solution can efficiently assess trade-offs between different engineering domains.

The latest version of ESI’s Virtual Performance Solution includes numerous improvements:

• The introduction of a brand new modular input methodology enables manufacturers to align the structure of Computer-Aided Engineering (CAE) models with their Computer-Aided Design (CAD) or Product Data Management (PDM) tools.
• New automated simulation processes can be easily customized by the user in the domain of Noise, Vibration and Harshness (NVH).
• Virtual Performance Solution’s Graphical User Interface (Visual-Environment and associated processes) now fully supports modular assembly and the common ESI Result File format across all domains. Based on user feedback, model converters now cover most industrial standard third-party programs. The graphical performance has been improved for handling larger models, which underlines usability in industrial development projects.

The latest version of ESI’s Virtual Performance Solution truly empowers companies to embrace collaborative engineering processes.
Three Leading Composites Manufacturing Applications in One Single Package with ESI’s Composites Simulation Solution 2015

The only software solution allowing for the virtual simulation of the complete manufacturing chain

DISTORTION
Residual Stresses & Shape Distortion

FORM
Preforming & Thermoforming

RTM
Liquid Composites Molding & Curing

PRODUCTION

“Definitely, simulation is the capability we need to reduce our global costs. [...] But to reduce industrial costs, we also need to dig into the processes and all the manufacturing activities, which is now the trend.”

Jean-Luc Macret,
Senior Manager Research and Technology Projects
Airbus

ESI’s Composites Simulation Solution 2015 represents a key asset for all manufacturers using composite materials, whether in the automotive, aerospace or energy sectors. The solution empowers industrial clients to deliver on quality and deadlines, while controlling their costs.

For the first time, ESI’s Composites Simulation Solution 2015 includes three leading composites manufacturing applications - PAM-FORM, PAM-RTM and PAM-DISTORTION.

The single package exposed in ESI’s Visual-Environment, allows for the definition and optimization of process parameters that minimize manufacturing defects and increase final product quality, taking into account each step of the manufacturing chain.

The solution’s product/process design approach ensures that every manufacturing result can be transferred into the structural analysis so the model reflects the product ‘as built’ and not only ‘as designed’. This aspect is crucial as it enables manufacturers to truly rely on Virtual Prototyping to minimize design margins and reduce weight.

The applications can also be used individually:

• PAM-FORM is used to simulate the preforming process of dry textiles or the thermoforming of pre-pregs made of thermostet or thermoplastic resins. All results are available at ply level instead of only laminate level, and therefore include, for instance, the prediction of internal wrinkles.

• PAM-RTM is used to simulate the injection or the infusion of a resin in a preform and can also assist in analyzing the curing of thermostet composites parts. It can deal with extremely large numerical models using shell or solid elements, such as required in the wind industry, and also with the extreme detail of small components typical of the automotive industry.

• PAM-DISTORTION is used to compute residual stresses and geometrical deformations, such as spring-in and warping, induced by the manufacturing process. It is also used to generate a compensated mold based on computed distortions, in order to obtain a final part geometry within the specified tolerance.

Watch the video of ESI at JEC Europe 2015, the world’s biggest trade show for Composites.

for more information www.esi-group.com/composites
ESI Joins the British Manufacturing Technology Centre in Coventry

ESI, with its UK base in Cannock, Staffordshire, has been providing its Virtual Reality solution IC.IDO to the Manufacturing Technology Centre (MTC) for some time. In January 2015, ESI has formally joined the MTC as a Tier Two member, becoming the latest company to join the fast-growing MTC in Coventry.

ESI Virtual Reality experts are working hand in hand with MTC engineers and technicians from other member companies to further develop ESI’s world-leading simulation software for manufacturing companies of all sizes.

Maurice Linscott, head of ESI’s UK operations, says “ESI is delighted to be joining the MTC as a Tier Two member. This enables the MTC and ESI to further the support for UK Small and Medium Enterprises and larger engineering organisations. It allows us to bring benefits of engineering and manufacturing simulation to Members and other UK companies, by assisting them in accelerating their capability to deliver world class products.”

He adds, “ESI’s virtual reality solution, IC.IDO, running in an immersive CAVE at the MTC, brings further capabilities to organisations including more efficient communication and decision-making during product design and development, and early evaluation of manufacturing and maintenance operations. The systems now in place at the MTC offer real life experience and real-time interactions, in a digital environment. IC.IDO enables high value decisions to be made in advance of expensive physical prototypes. ESI sees its involvement with the MTC as a key enabler, bringing best-in-class simulation to the UK engineering sector.”

MTC chief executive Dr Clive Hickman is delighted to welcome ESI as the latest member of the MTC.

“ESI’s immersive virtual reality programmes have been used in the MTC’s Virtual Reality suite for some time, helping manufacturers plan production processes and layouts in an environment which brings designs and plans to life. It was a natural progression for ESI to become a full member of the MTC and we look forward to helping our other members make the right decisions throughout the product development phase.”

Dr. Clive Hickman, MTC chief executive

About MTC

The Manufacturing Technology Centre (MTC) has been established to prove innovative manufacturing processes and technologies in an agile environment in partnership with industry, academia and other institutions. The MTC houses some of the most advanced manufacturing equipment in the world, creating a high quality environment for the development and demonstration of new technologies on an industrial scale. The areas of MTC’s expertise are appropriate to both large and small companies and are applicable across varied industry sectors.
ESI’s ProCAST: 25 Years of Excellence in Casting Simulation

ProCAST was first released in 1990, and it just keeps getting better.

This year, ESI’s ProCAST proudly celebrates 25 years of industry-leading casting simulation software. Casting process modeling has come a long way since the early to mid-1980s when the casting designer using simulation was limited to deciphering a full casting through primitive two-dimensional sections. In the early days, the focus was on the simple quest of identifying hot spots in the casting. As Computer Aided Design (CAD) and numerical simulation software packages evolved, foundry engineer became able to make quick changes to the feeding design, fixing potential defects with relative ease.

Today, ESI’s ProCAST allows for a full coupling of thermal-flow-stress analyses and evaluations of all casting processes, for all castable alloys, including defect detection, residual stresses, part distortion, microstructure and mechanical properties prediction. The solution also addresses other casting-relevant manufacturing processes such as core blowing and heat treatment.

ProCAST is considered the most powerful, comprehensive and accurate casting simulation solution in the industry today. Not only are its first users - like General Electric, PCC Airfoils, Rolls Royce, Amcast Automotive (now General Aluminum) and Howmet (now a division of Alcoa) - who embraced ProCAST at its inception, still valued customers today, nearly 1000 more have adopted ProCAST since then!

In 1990, one of the first customers to adopt ProCAST was the USA-based PCC Airfoils LLC, a producer of high-precision investment casting parts for turbine engines primarily for aircraft and power generation. Kathy Bell, Simulation Engineering Manager, was an early adopter of casting simulation and selected ProCAST as PCC’s primary casting analysis tool. 25 years later, she is certain this was and continues to be the right choice.

Inseparably linked to the development of ESI’s ProCAST is software founder Dr. Mark Samonds. During the late 1980s, Mark started the development of ProCAST at the Processing Sciences Division of UES Inc. Like many high tech startups at the time, ProCAST originated in Dr. Samonds’ basement. In the next three years, Mark’s basement operation, joined by 4 other colleagues, quickly developed a global footprint. One of ProCAST’s major milestones included adding dedicated modules to address a variety of physics involved in the casting process. Key fundamental additions in the 1990s included radiation, stress analysis, deterministic micro-modeling and grain structure. These developments were considered forward thinking at the time and remain unique functionalities today.

In 1994, UES Inc. signed an agreement with Calcom SA Lausanne, the developers of casting simulation software Calcosoft, for the exclusive distribution of ProCAST in Europe. Calcom went much further than distributing the software and teamed with EPFL (Swiss Federal Institute of Technology), taking part in international, European and Swiss research projects all aimed at bridging the gap between theoretical and industrial requirements.

“PCC Airfoils has experienced numerous direct benefits from the use of ESI’s ProCAST, such as resolving defects in production parts, and decreasing time and dollars for new part introductions. One of the largest benefits has been the reputation we’ve developed with our customers as being a leader in the use of simulation technology.”

Kathy Bell,
Simulation Engineering Manager
PCC Airfoils LLC
macroscopic entities and metallurgical aspects occurring during solidification. This collaboration resulted in the creation of two new ProCAST modules including the CAFE (Cellular Automaton and Finite Elements) module for the prediction of grain structures.

In December 2002, ESI Group acquired ProCAST and Calcom SA. This was a perfect fit as ESI Group is a world-leading provider of Virtual Prototyping solutions for the most challenging product development and manufacturing applications. The acquisition quickly accelerated the expansion of the ProCAST brand name and team, now encompassing over 100 dedicated casting employees in 40 countries. This partnership integrates casting process modeling into the manufacturing process and lifecycle history so that customers can make the right decisions throughout the product development cycle. Kathy Bell from PCC states: “We enjoy an open line of communication and work with ESI as partners in our effort to have a useful, accurate, and dependable tool in our analytical toolbox. This helps us better simulate and analyze the physics needed to produce cast shapes of ever-increasing complexity.”

Taking advantage of more powerful, faster computers, ESI’s ProCAST analyses can span across multiple cores, processors and even computers, cutting weeks and days of simulation time down to hours and minutes. In 2012, ProCAST migrated to ESI’s Virtual-Environment, with its state of the art graphical user interface. Dr. Antton Melendez, a ProCAST user for over 20 years who now acts as Foundry and Steelmaking Project Manager at Technalia in Spain, notes that of all of the developments in the last two decades, one of the biggest and most beneficial improvements has been the move to Virtual-Environment. The platform enables users to gain efficiency by enjoying a common platform for all their CAE needs from pre- to post-treatment, meshing and results visualization.

Loic Calba, Product Manager of Casting Solutions at ESI Group, believes casting process modeling will continue to evolve in the next 25 years: “We passionately work to enhance the physics in our product, extending its functionality, quality and performance. One major topic for the future is a closer interaction with CAD: the current launch of integrated optimization and design tools is an initial step.”

In 2006, ESI’s ProCAST received the Frost & Sullivan Technology Leadership Award in digital simulation for its contribution to streamlining casting process design. Humbled by this recognition for excellence, ESI’s focus remains steadfast: helping each and every customer create unparalleled products. If you have flown in a jet, driven a car, heated your home, washed your hands or even spent a lazy Sunday watching motorsports, then you have probably benefitted from a quality product engineered with the help of ESI’s ProCAST.

for more information
www.esi-group.com/casting
Acquisition of CIVITEC to Support Active Safety

ESI has entered the fast-growing Advanced Driver Assistance System (ADAS) market driven by increased requirements in terms of safety standards

Founded in 2009, CIVITEC is a spin-off of IFSTTAR, the French Institute of Science, Transport Technology and Network Development which until recently was its main shareholder.

CIVITEC has capitalized on years of R&D by IFSTTAR and its know-how in perception sensors simulation and algorithmic development. This breakthrough technology is commercially available via its flagship platform, Pro-SIVIC™.

This acquisition represents a unique opportunity for ESI Group to integrate new offerings in its solutions delivered through its worldwide commercial network. Pro-SIVIC™ enables industrial players to develop perception assistance systems from the design phase to the final testing. Implementation of such modules is highly complex, as it requires the 3D modelling of ultra-realistic environment conditions, digitally transcribed using sensors simulation and wrapped in an optimized interface that improves operators’ perception. Perception assistance systems are critical to the deployment of active safety systems, today considered as crucial for the automotive and aeronautic industries.

“This new expertise in assistance to human perception, coupled with the excellent IFSTTAR partnership, provides the opportunity to take into account the interactions of a vehicle, or any other industrial product, with its scalable immersive environment, states Alain de Rouvray, ESI Group’s Chairman and CEO. “Once integrated into digital 3D modeling, it will enable dramatically accelerated design and prototyping of embedded control and security systems and thereby strengthen the value of our global solutions in virtual prototyping. For ESI Group’s industrial partners, ADAS present a major technological challenge as efficiency must be built upon the quality of interaction between digital modeling and human perception”, he adds.

Active safety is increasingly included in the Euro NCAP certification test for the whole pre-crash phase so the demand from constructors will be strong and driven by the continuous requirement for integration of related technology and connectivity in cars. Pro-SIVIC™, simulates a 3D environment as seen by the sensors and thereby, allows the creation of ADAS with substantially reduced development costs. The ADAS market is expected to show a 20% average annual growth over the 2015-2019 period. This trend will accelerate as automated systems have an increased influence on safety until, as expected by 2025, vehicles can be fully autonomous.

“We look forward to the industrialization stage proposed by ESI on the technology developed by CIVITEC in collaboration with IFSTTAR. This approach will allow us to amplify the integration of this valuable technology in Valeo’s solution in terms of innovation, especially in the context of our intuitive driving program integrating the intensification of active safety.”

Guillaume Devauchelle, Vice President of Innovation
Valeo

for more information
www.civitec.com
www.ifsttar.fr/en
www.esi.co.jp

A snapshot of Pro-SIVIC™’s graphical user interface for realistic simulations in 3D virtual environments including infrastructures, road users, vehicle dynamics and multi-technology perception sensors.
ESI Dives into Big Data Analysis with the Acquisition of Picviz Labs

Specialist in big-data-based predictive analysis through advanced visualization to detect unknown operational problems

The French Company Picviz Labs was founded in 2010 and has since built and delivered a solution “to detect the unknown” through massive data inspection. Capitalizing on big data’s potential, Picviz Labs offers a new conception of operational intelligence by reversing the methodology vs. classical analytic tools based on Query Engines. “Picviz Labs’ technology constitutes a remarkable and exceptionally clever innovation which strengthens operational intelligence by visually identifying important and hidden issues”, stated Alain de Rouvray, ESI Group’s Chairman and CEO. He added: “Beyond the highly-promising cyber-security market, energized by SaaS/Cloud deployments and the surge of hacker attacks, Picviz Labs is poised to accelerate ESI Group’s expansion into a large number of new verticals. This movement is expected to include addressing interests of non-industrial companies and health sciences by identifying previously invisible correlations that could help improve predictability and thereby reinforce the innovative potential of numerical modeling”.

For ESI Group’s core market, Picviz Labs visual solutions add a powerful capability to smartly navigate the ocean of data generated by increasingly large and complex digital models, and to reveal the wealth of knowledge deeply buried and consequentially often undetected and wasted.”

Alain de Rouvray, Chairman and CEO of ESI Group

Access to a green field market

Visual analytics and scientific data visualization market is predicted to considerably expand in the coming years, reaching a market potential of several billion dollars. Such tremendous demand is notably linked to the arrival of the smart and digital factory with the new approach that revolutionizes the methodology of all product development processes by dematerializing the physical prototype and boosting process flexibility to reduce development timeframes. Adapting to this new framework, all engineers and technicians will be able to detect and anticipate any operational issues or inefficiencies while the product is under development.

Roll-out opportunity on multiple sectors where big data is key

Picviz Labs’ technology aims to meet the exponential demand that could emerge from all verticals where big data can generate strong added value for security intelligence. Already collaborating with prestigious international groups such as BNP PARIBAS, La Poste, BULL (ATOS) or Thales, and also with government agencies, Picviz Labs has established in many fields a solid and acknowledged reputation for its data visualization offering.

ESI acquired all assets of the Company, facilitating its entry into the cyber-security market as companies seek to protect their data, prevent cyber-attacks and data theft attempts. Looking ahead, this will help ESI roll-out its virtual prototyping offering beyond the traditional industrial verticals.

Technological foundation to develop efficient machine-learning solutions

With the intention of offering industrialists the opportunity to improve the artificial intelligence of machines by learning from past data and automatically improving algorithms, the ESI Group’s strategy is to deliver strong value-added services such as predictive maintenance, quality-assurance, component-replacement planning or supply chain management and logistics.

“Like ESI we are convinced that the digital factory success will rely on industrial ability to implement collaborative processes based on efficient visual interfaces more likely to support better human decision,” says Philippe Saadé, Chairman and CEO, Picviz Labs

for more information

www.picviz.com
As the International Maritime Organization (IMO) takes firm measures for controlling on-board noise and vibration levels in the interest of passengers and seafarers' health, ESI has worked towards the development of technologies that help tackle specific challenges related to noise and vibration in the marine sector for both on board noise and underwater radiation.

To meet toughening regulations and avoid costly retrofits and modifications in the marine sector, ESI puts an emphasis on the prediction of noise levels right from the design stage. ESI's vibro-acoustic simulation solution VA One enables users to perform computationally efficient analysis across the full frequency range, resulting in accurate cost effective results.

To exchange specifically on these topics, ESI created dedicated Vibro-Acoustic events for the marine sector. Following the success of the two first Marine Special Interest Group (SIG) meetings, held on customer sites at Damen Shipyards (Holland) in 2013, and RINA Services (Italy) in 2014, ESI Group conducted its third international event in January 2015 in Mumbai (India) and a fourth one in April 2015 in Madrid (Spain).

VA Marine SIG in Mumbai
The Asian edition took place early in January 2015 at the Head Office of the Indian Register of Shipping (IRClass) in Mumbai. IRClass, having successfully developed empirical methods for onboard noise prediction, has been contributing research papers to the Vibro-Acoustics Marine Special Interest Group (SIG) seminar since 2012.

The participants included representatives and senior officials from shipyards, design companies, government bodies, classifications organisms, research institutes, and ship management companies. With twice as many participants as the previous year, the Asian SIG was deemed highly successful and confirmed the interest in noise prediction solutions in Asia.

VA Marine SIG in Madrid
The European edition took place in the building of sponsor CEHIPAR, a center for research, technological development and technical services in hydrodynamics involved in the construction of military, merchant, fishing and recreational sea vessels. Técnicas y Servicios de Ingeniería (TSI), a Spanish firm specialized in Noise & Vibration Engineering solutions, and BUREAU VERITAS, the world leader in Testing, Inspection and Certification (TIC), also sponsored the event.

During the two-days conference, sponsors and others speakers such as Damen Shipyards, RINA and TNO, presented papers on the latest advances and techniques dedicated to the study and mitigation of noise and vibration on ships and brought interesting technical contributions to the conference. Opportunities for unstructured discussion outside the conference room added value to the event.

Participants also had a chance to visit CEHIPAR facilities, founded in 1928 by the Spanish Navy and now spreading on over 4.5 hectares to include three main laboratories, a calm water towing tank, a laboratory for ship dynamics, and a cavitation tunnel where propellers are tested.

for more information
www.tsil.es
www.cehipar.es
www.veristar.com
www.irclass.org
Acquisition of Ciespace’s Technology Assets

The Ciespace platform, resulting from many years of pioneering development and addressing critical technical challenges, is the first commercially available CAE Cloud solution with modeling capabilities built entirely on an open, web services platform.

The acquisition of 100% of Ciespace’s assets, integrating its high profile engineering team, also brings to ESI a new way to develop and deliver cost effective and reliable digital modeling for CAE solutions. Ciespace’s technology and its collaborative approach will accelerate the democratization of CAE to all engineers and designers and gradually to non-technical users in both small and large enterprises.

Combining Ciespace’s Cloud technology with ESI Group end-to-end ‘Art of CAE Modeling’ enables a new disruptive paradigm to transform how products are developed and manufactured in the engineering world. It also allows ESI Group to easily and rapidly roll out all its offering on a Cloud platform accessible through the web on mobile and desktop devices.

Alain de Rouvray, ESI Group’s Chairman and CEO comments on the democratization of CAE via the cloud: “The flexibility and affordability of the Cloud/SaaS business model is expected to progressively attract new types of technical SME users, beyond the traditional community of CAE specialists.” He adds “Furthermore Ciespace’s high caliber engineering team will bring to ESI its advanced knowledge and proven experience in both CAE and Cloud technologies. The operation is well aligned with ESI’s strategy to “enable Virtual Prototyping for all”. After an initial integration phase, this acquisition should strongly accelerate the generation of new customers with an offer at minimal transactional costs.”

“Our team is very proud to be joining ESI Group as we share the same passion for innovation and technological excellence through the “Art of digital Modeling”. By leveraging ESI’s worldwide distribution and development network, Ciespace’s technology will be expanded and spread worldwide and in many new industrial sectors. We are confident numerous customers and prospects will appreciate the tremendous added value that will come from this combination of best in class physics, modeling and Cloud platform.”

Dr. Sanjay Choudhry, CTO, Ciespace

ESI strengthens Its Distribution Network in India

ESI India was founded in 2003 to address the needs of Indian customers directly. The business has grown substantially since and is expected to expand strongly thanks to recent distribution partnerships, allowing to extend ESI’s footprint in the region.
Save the Date!

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<thead>
<tr>
<th>Date</th>
<th>Event Name</th>
<th>Description</th>
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<tbody>
<tr>
<td>Jul 22-23, 2015</td>
<td><strong>Daimler EDM CAE Forum 2015</strong></td>
<td>Special focus on “Global Engineering - Unique Products”</td>
<td>Stuttgart, Germany</td>
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<td>Aug 09-12, 2015</td>
<td><strong>Internoise 2015</strong></td>
<td>44th Inter-Noise Congress &amp; Exposition on Noise Control Engineering</td>
<td>San Francisco, California, United States</td>
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<td>Sept 9, 2015</td>
<td><strong>ESI India User Forum</strong></td>
<td>Dedicated to ESI users and their experiences with Virtual Prototyping</td>
<td>Pune, India</td>
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<td>Sept 29-30, 2015</td>
<td><strong>VPS User Forum 2015</strong></td>
<td>Two days user meeting based on the release of Virtual Performance Solution 2015</td>
<td>Břasy, Czech Republic</td>
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<td>Sept 29-Oct 01, 2015</td>
<td><strong>SAE Thermal Management Systems Symposium</strong></td>
<td>Conference and tradeshow on Thermal Management</td>
<td>Troy, Michigan, United States</td>
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<td>Oct 07-08, 2015</td>
<td><strong>ESI DACH Forum 2015</strong></td>
<td>The expert platform for Virtual Product Engineering</td>
<td>Bamberg, Germany</td>
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<tr>
<td>Oct 26-29, 2015</td>
<td><strong>CAMX ACMA Composites</strong></td>
<td>The Composites and Advanced Materials Expo</td>
<td>Dallas, Texas, United States</td>
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<td>Oct 28-31, 2015</td>
<td><strong>SAMPE Korea 2015 &amp; KOREA Composite Show</strong></td>
<td>New advanced Composite in Korea</td>
<td>Goyang, South Korea</td>
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<td>Nov 4-5, 2015</td>
<td><strong>Composite Spain</strong></td>
<td>Trade Show dedicated to the Composite Materials Industry</td>
<td>Madrid, Spain</td>
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<td>Nov 10-11, 2015</td>
<td><strong>Digital Factory @ Production</strong></td>
<td>Expert conference for Virtual Reality</td>
<td>Hamburg, Germany</td>
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<td>Nov 19-20, 2015</td>
<td><strong>PUCA 2015</strong></td>
<td>ESI's Japanese User Conference on Virtual Product Engineering</td>
<td>Tokyo, Japan</td>
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<tr>
<td>Dec 7, 2015</td>
<td><strong>ESI India GT-SUITE Conference 2015</strong></td>
<td>One day conference on GT-Suite followed by two days of training</td>
<td>Pune, India</td>
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**Call for Papers!**

**OpenFOAM® User Conference 2015**

Oct 19-21, 2015 | **Bringing together users and developers of OpenFOAM®** | Stuttgart, Germany |

ESI invites worldwide OpenFOAM® users to submit abstracts based on research or industrial work with OpenFOAM® and become part of this exciting & ever growing community! All student submissions will participate in our Academic best paper award and the winner will get his/her travel and accommodation funded by ESI.

Deadline is July 31, 2015.

for more information
www.esi-group.com/events
2014 Annual Results

2014 annual sales totaled €111.0 million, up 2.5% at constant currency and up slightly by 1.6% on the previous year in actual terms. There was a negative currency effect of €1.0 million over the period, mainly due to the fall in value of the Japanese Yen.

Adoption of ESI Group’s solutions by industry leaders and their subcontractors reflects the success of the immersive virtual reality offering and builds on the evident value proposition of Virtual Prototyping to address societal priorities such as air quality and renewable energies.

Solid licensing activity and re-focusing of Services resulting in an improved gross margin

Licensing activity was solid, representing 75.0% of 2014 sales, compared with 73.3% in 2013. The Services activity was down 3.3% in actual terms following the former strategic decision to focus on projects with higher added value.

The Gross Margin was 71.3% of sales compared with 68.6% in 2013. This improvement is due to the favorable development of the product mix. The licensing margin was sustained at a high level and there was significant improvement in the Services margin consequent to the strategic refocusing of the business.

Improvement in profitability

In actual terms, EBITDA grew 5.8% to €10.1 million, i.e. a margin of 9.1% compared with 8.7% in 2013. This growth was even greater +13.6% when reported at constant rates (for an equivalent of €10.8 million, or a 9.7% margin).

Positive business momentum for 2015

Alain de Rouvray, ESI Group’s Chairman and CEO, comments:

“The significant improvement in our economic results over this fiscal year reflects the success of our profitability improvement and cost control policies, both to be continued over 2015. Our management team reinforcement and recent developments and acquisition advances have increased ESI solid assets to strengthen strategic relationships with OEMs and their Tier 1 suppliers and partners, and to amplify the use of our virtual prototyping solutions in their eco-system. The increasing use of our solutions by all stakeholders collaborating on the digital model via proprietary Cloud computing technologies, and our presence in new areas such as embedded systems and the life sciences, will strengthen and expand ESI market positioning. ESI Group is fully aware of how crucial sustaining competitive innovation is to keeping our leadership position in helping our industrial clients work towards e.g. smart digital factories. This explains why we plan to maintain our investment momentum as well as our targeted acquisition strategy in 2015, while pursuing growth and increasing economic performance.”

Reinforcement of The Management Team

The promotion of Mike Salari, as Executive Vice President of Engineering Services and the arrival of Peter Schmitt, PhD., as Executive Vice President of Sales and Operational Marketing, are expected to enhance our ability to deploy global strategies and implement actions with major industrial actors, including new clients.

Mike Salari holds a Bachelor and Master’s Degree of Sciences in Mechanical Engineering from The University of Oklahoma. He joined ESI in December 2008 upon the acquisition of Mindware Engineering, a high-end CFD engineering service provider with offices in the United States, Germany and India.

Mike started his career in virtual engineering in the early 1990s. He worked very closely with OEMs in automotive, aerospace, and power generation industries to develop and implement CFD based processes and customized solutions. He was one of the partners and VP of Operations at ICEM CFD Engineering, when the company was acquired by ANSYS in 2000.

Dr. Peter Schmitt has recently joined ESI to contribute to the Group’s international distribution and Go-to-Market strategy. Peter Schmitt has over 20 years experience on the PLM software market including Delta Industrie Informatik GmbH and Dassault Systèmes, substantial expertise in sales strategies among industrial leaders and an international profile and in-depth knowledge of the Americas.

“I am eager to contribute to the development of ESI, which I see as the leader and visionary in the virtual prototyping market. The transformational nature of ESI solutions, together with the culture of technological innovation that strongly permeates the company rapidly convinced me to join. I am confident that my 20 years of experience, gained notably in the PLM market, equip me to contribute substantially to the execution of ESIs ambitious and exciting plans.”

Dr. Peter Schmitt, Executive Vice President of Sales & Marketing, ESI Group