esi talk

The Virtual Prototyping Magazine

2018
Issue 52

Enhancing Productivity with Immersive Human-Centric Engineering

Addressing the challenges that New Products and Processes Bring to the Factory of the Future

special report

FINGERTRACKING2

in ESI IC.IDO now with tactile feedback!

- Realistic interaction by precise Fingertracking
- Tactile feedback when touching virtual objects

ART

ar-tracking.de

Accurate. Reliable. Trusted.

Contents

ESItalk is issued bi-annually by ESI Group
Executive Editor: Amy de Rouvray
amy.derouvray@esi-group.com
Editor-in-Chief: Rita Tronel
rita.tronel@esi-group.com
Copy-Editor: Natasha Petrous
natasha.petrous@esi-group.com
ESI Group Marketing
Parc d'Affaires SILIC
99, rue des Solets - BP 80112
94513 Rungis Cedex - FRANCE
Tel: +33 (0) 1 41 73 58 00
Fax: +33 (0) 1 46 87 72 02
www.esi-group.com
Design: www.lavallart.com
ISSN 12105-1739
Print: GELATO
Dépôt légal: novembre 2018

All PAM - and SYS - product names as well as other products belonging to ESI's portfolio, including OpenFOAM® and SimulationX are tradenames or trademarks of ESI Group, unless specifically mentioned. All other trademarks are the property of their respective owners.

All text and images included in the articles are the copyright of the companies presenting their applications and simulation tasks.

Photo credits: ARRK Shapers, CRRC Zhuzhou Locomotive, CVUT, Diota, FCA Brazil, Gazelle Tech, Hwaseung R&A, JSC "Zelenodolsk Design Bureau", Mazda, Nissin Kogyo, Renault, Siemens Minerals, Space Structures, Vitirover, Volum-e, Volkswagen.

G-OM-18-72-A

Editorial

Dear Reader,

The mobility industry as we know it, looks to begin a whole new era. Electric mobility, autonomous driving, Hyperloop, urban air-taxis, and even space are among the next-big-things. What these have in common is the general lack of well distributed industrial experience in the design, manufacture, and maintenance of these new products. Engineering guidelines and standards are not yet agreed upon. We must couple that with the current shifts toward Industry 4.0 and Smart Factories for that little bit of added complexity, and we also know that the products we build in the factories of tomorrow will not follow the rules that served well in the past.

This editorial space is often dedicated to furthering the use of numerical modeling in design and engineering to reduce or eliminate reliance on physical prototypes. However, I will open a controversial topic by asking you to consider what has been lost in product and process development with the elimination of physical prototypes.

In the past, prototype planes, trains, or automobiles would be physically constructed throughout the engineering and design process. From concept to production, physical builds would let us experience our product—its building and unbuilding. Throughout these operations, we could discover that critical components were unreachable, inaccessible, or simply not visible. Building prototypes gave engineers, designers, and tradespeople valuable process experience with their new products, well before release.

Success in reducing physical prototypes has deprived us of these rich experiences. In the worst case, this means that plants find several hundred "no build" issues during pilot assemblies; unanticipated maintenance procedures immobilize global fleets as service methods have to be created on the spot; or, local conditions prevent installation of industrial equipment as engineered.

The act of experiencing our products true-to-life in physically reliable Virtual Reality recreates the opportunity to discover how to build and maintain our latest product designs, digitally. In a virtual environment faced with the product in a realistic assembly or service context, we can again raise the questions: "Does this look right?", "Can we position our tools on that?", "Would I be able to complete this process?".

In our special report, we will read how the use of Virtual Reality powered solution ESI IC.IDO to perform Human-Centric Assembly Validation brings back hands-on experiential discovery using Virtual Prototypes. And in our 3 Questions, we ask an automotive OEM how they were able to, without pre-production prototypes and pilot assembly, launch a new vehicle's assembly operations on-time for start of production.

Enjoy reading!

Eric Kam

Enhancing Productivity with Immersive Human-Centric Engineering

Addressing the challenges that New Products and Processes Bring to the Factory of the Future

Experience assembly & capture process with Digital Human Model(s). Model data is Courtesy of Volkswagen

What does a Program Manager do when faced with a start of production pulled ahead by four months for the product to launch ahead of competition, and a Design & Validation budget slashed at the 11th hour to match the competitor's offer? There is neither time nor resources available to work according to standard processes anymore: activities must be rushed, reduced and/or bypassed and risk mitigation becomes pivotal.

Keeping up with market disruptions

Every day, new disruptive companies emerge and challenge the established organizations with lower structural costs, more nimble processes, and a simpler approach. Smart, dynamic entrepreneurs devise clever strategies leveraging new technologies and new mentalities to overrun the slower, historical processes of larger corporations. Existing companies must align to the new market conditions or dwindle.

To cut costs and hope to reduce lead times, Program Managers can no longer afford to design iteratively based on physical prototype trial and error. Design, validation, and manufacturing teams must be involved from the start to reach a common understanding of the design without constructing a prototype. They have to understand and experience the product before it exists. This is as true for manufacture and assembly on the factory floor as it is for the engineering design of the product.

Recognizing the interactions of people with proposed products and processes

In an experiential discovery mode, an immersed engineer performing a virtual build or service task might conclude that, while a process is "feasible" to be accomplished in the space provided with the proposed tools, the process is sub optimal for comfort or ease. In contrast to a deterministic simulation that might compute that a motion path is plausible for the installation of a component, a human operator will observe that, without super-human powers, they won't be able to see the workspace clearly enough to complete the task. Computer animations that demonstrate a process can take hours to prepare as they require specialized skills to manipulate a digital human model in a puppeteering manner. Working in a Virtual Reality (VR)-enabled Virtual Build, an engineer can, within seconds, evaluate, perform, and optimize an assembly sequence and tooling manipulation intuitively, just like they would in a pilot production facility.

First-person exploration only gets you so far because the circumstances are unique to the individual. However, the ability to record and playback object animation

sequences coupled with advance anthropometric digital human models, allows Virtual Build users to apply their first-person actions to “manikins” reflecting any number of regionalities, gender, and proportions. It becomes easy to explore, in the virtual environment, the build of a new product, and directly arrive at objective analytics for a diverse range of potential workers. Thereby it is possible, for example, to learn that, a 95% European male who performed an assembly action with ease could assign that same action to a 5% Asian female manikin and discover that she would find the same task uncomfortable or even unfeasible.

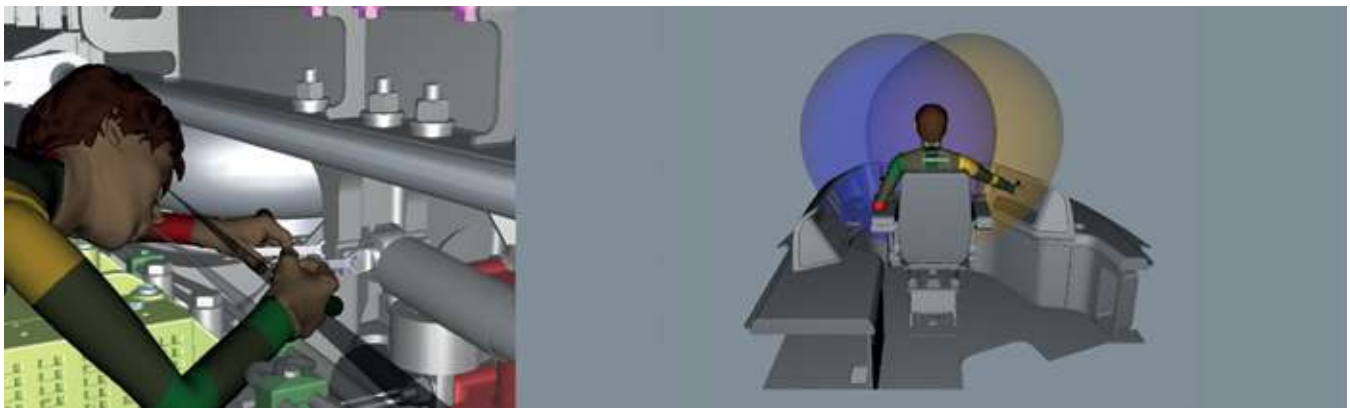
Augmented Reality and Virtual Reality

Assembly sequences are also required for creation of documentation and deployment of work instructions. Recent technology advances in the factory of the future point to a range of digitally guided assembly processes. Augmented Reality (AR) is one hot topic in this area, wherein digital model data can be overlaid with the real product to indicate the required sequence of operations. In a Virtual Reality Build environment, one can validate assembly sequences using only digital data. The findings from Virtual Builds can then be captured and exported as the basis for Augmented Reality digital guided assembly operations. It is not a question of VR versus AR, but instead that Virtual Reality can be used to validate what will eventually be deployed on Augmented Reality, before the physical products are ready.

Validating the production process across multi-disciplinary teams

Bringing in more competences for a product evaluation is always beneficial. That is why modern design processes usually call for a “multi-disciplinary approach” or simultaneous engineering in design reviews and risk assessments. Different sets of eyes spot more risks, different minds find more solutions. Where a test engineer might confirm that a button is too hard to press, an ergonomics engineer might point out that it is too small and not easily accessible, and a sales manager might wonder why there is even a button to begin with. The more interaction, the richer the analysis and the more potential to confirm solutions or to identify problems and suggest design opportunities as a group. The design team can then rework the product with confidence that all parties are aware and on board of the improved solution.

At the scale of a global enterprise being able to experience and interact with a product, before it is ever physically manufactured, on-screen, with a head-mounted display,



With ESI IC.IDO, CRRC ZELC improved the efficiency of the product development and subsequent assembly
Courtesy of CRRC ZELC

on a power wall or in a Cave, as an individual engineer, as a group, with a supplier or with a customer team, is invaluable. The discussions engaging team members and other stakeholders in an interactive quest for issues and improvements so early in the program, before tools are even kicked-off, inevitably lead to a stronger confidence in the design and manufacturability of the product from all involved, and ultimately from the whole company.

With IC.IDO, ESI offers a Human-Centric Assembly Process Validation. This immersive platform empowers multi-disciplinary teams to evaluate, discuss, and resolve the challenges that new products and processes bring to the factory of the future. It allows individuals or teams, together or on remote sites, to explore and interact with digital designs, so that engineering teams can identify necessary improvements and corrections before work starts on tooling for the manufacturing plants.

for more information
www.esi-group.com/human-centric

3 Questions for...

Marcelo Lima

Manufacturing Engineering Coordinator - Manufacturing 2020
FCA Brazil

FIAT CHRYSLER AUTOMOBILES

At Fiat Chrysler Automobiles (FCA) Brazil, you quickly moved ahead with implementing ESI IC.IDO in production, applying it to the Fiat Argo and most recently the Cronos line. Prior to that move, how did you perform production validation and what drove you to use Virtual Reality?

The processes validation was done manually with numerous physical prototypes with great chance of rework or modifications, which could consequently increase the cost and time of development of the project.

The market in Brazil has become increasingly competitive, forcing the adoption of global initiatives such as Industry 4.0 as well as development of FCA strategies for world class manufacturing (WCM) and world class technology (WCT).

The currently methodologies used in FCA consist of the constant search for simulations solutions to facilitate the day-to-day of our operations. In collaboration with the best specialists in the world we optimize our processes, seeking efficiency thinking about the quality of our products. During the development of the process we make several analyzes to minimize the physical tests implementing virtual tests, so we can devote more time from development to "best in class" in the operations that demand greater attention and assertiveness.

With this latest project, our goal was to digitize the engineering for a new launch of the upcoming "Cronos" automobile.

Courtesy of Diota

ESI IC.IDO allowed us to implement complex tooling evaluations, without the cost of building them, and also enabled us to arrive at the best assembly process through collaborative decision-making.

Of course we also eliminated tooling costs that would have been needed to support pilot builds in a physical process of trial the full extent of what we saved because of how many potential errors we avoided.

could also extend to allow collaboration with vendors and maintenance teams globally to make sure we are at the top of World Class Technology. After the validation step, IC.IDO and Diota for Augmented Reality would be a next step.

You recently shared your success with IC.IDO and reported that the initial investment paid for itself in just eight months. In which areas of the planning process did you apply VR and how were you able to quantify the value of the Virtual Assembly activity?

The estimate is based on the costs we avoided by not building physical prototypes and performing conventional pilot assembly. The largest saving was probably related to the costs we avoided for unnecessary downtime and launch delays because of the production risks we discovered and resolved ahead of time using Virtual Assembly in IC.IDO. We were able to predict potential issues before they became a problem. Therefore, we eliminated cost to acquire pre-production components needed for pilot assembly, plus weeks of waiting for prototypes from production and launch project timeline.

Given the success of Virtual Assembly Validation at the FCA LATAM facilities on those specific challenges, where do you see your team and Virtual Assembly Validation technology going next?

We will continue to use Virtual Assembly on the next generation of vehicle models and for the improvement of existing products. Because of the great success we had, it is also a possibility that we will use it in other LATAM plants and FCA sites globally. We are an innovative leader among the FCA Group and constantly share our success globally within the company. There is potential for VR collaboration with other IC.IDO users within FCA, using the capability for remote users to join and experience the same Virtual environment together. This way FCA Group could visit the FCA LATAM facilities virtually. Potentially Virtual Assembly Validation

About Fiat Chrysler Automobiles (FCA)

Fiat Chrysler Automobiles (FCA) designs, engineers, manufactures and sells vehicles and related parts and services, components and production systems worldwide through 159 manufacturing facilities, 87 R&D centers, and dealers and distributors in more than 140 countries. Its stable of brands includes Abarth, Alfa Romeo, Chrysler, Dodge, Fiat, Fiat Professional, Jeep, Lancia, Ram, Maserati and Mopar, the parts and service brand. The Group's businesses also include Comau (production systems), and Teksid (iron and castings). In addition, retail and dealer financing, leasing and rental services related to and in support of the Group's car business are provided either through subsidiaries or financial partners (such as captive companies, affiliates, joint ventures with leading banks and/or financial institutions, and specialized providers).

for more information
www.esi-group.com/human-centric

FCA Industry 4.0 Virtual Assembly Project Achieves ROI in 8 Months with ESI IC.IDO

FIAT CHRYSLER AUTOMOBILES

Fiat Chrysler Automobiles (FCA) has production units in 40 countries and commercial presence in 150 countries. The group is home to brands like Alfa Romeo, Chrysler, Dodge, Fiat, Jeep, Lancia, Ram, SRT, Maserati, and Mopar (parts and services).

As part of FCA's ambitious MFG2020 initiative, an Industry 4.0 project, FCA LATAM considered how to further improve the engineering and validation of assembly operations for the new Fiat Argo car model, seeking to further reduce costs and delays. For this action, they turned to ESI's Virtual Reality solution, ESI IC.IDO.

The 'Fiat Argo' was the current program for FCA LATAM and had a strong focus on interior assembly and trim. It was the first time that FCA LATAM applied IC.IDO throughout an entire project, including in the validation of vehicle assembly. The Virtual Reality solution was used to identify risks in the product design before construction of a physical prototype. All of their engineering groups – manufacturing, production, and ergonomic health & safety (EHS) – were involved in the action, which enabled them to reach an optimized solution for all areas reviewed.

"Due to ESI Group's disruptive Virtual Reality solution, IC.IDO, it was an easy decision for us to implement their software. It met the growing need for increasingly assertive virtual simulations generated by industry 4.0."

Eric Beremis Baier Laia
Virtual Reality Specialist of MFG2020
FCA LATAM

IC.IDO enabled FCA LATAM to evaluate different process scenarios and design variants for the program, including the validation of the manipulator arms of passenger compartment assembly. During this review, it was identified that a manipulator arm collided with the vehicle conveyor hook. By evaluating the process in advance, FCA LATAM was able to implement a corrective action plan to develop a new device and optimize and validate assembly process.

The above validation occurred following the Global Vehicle Development (GVD) process, from step 2 for Product Engineering to step 5 for Process Verification, which historically the validation using a physical prototype. In practice, once the product geometry is released, the design enters the technical development phase, which is when the project should be complete for packaging, tooling kick-off, and definition of the manufacturing processes. It is crucial, prior to the next phases of the program, to assure the products are safe and feasible to assemble.

18 months was considered to be an acceptable ROI for this Industry 4.0 technology investment. But in fact, the project reached full ROI after only eight months and FCA was able to successfully assemble the new vehicle as planned. ESI IC.IDO brought agility, reduced time and enhanced workplaces. IC.IDO enabled FCA LATAM to experience the real process conditions of assembly and assure the conformity of the product by considering all the interferences in the virtual phase of development.

The team reviewing the Fiat Argo.

Today, FCA LATAM has IC.IDO rooms at the Automotive Industrial Center of FIAT Betim and at Jeep Goiana, which allows them to use the tool across the entire range of FIAT's brands, including Toro, Mobi, Argo, Cronos, and Jeep (Renegade and Compass).

for more information
www.fcagroup.com
www.esi-group.com/human-centric

Space Structures Grow their Business and Customer Satisfaction with Help from ESI VA One

The aerospace industry has been striving to find a tool that can accurately predict acoustic and vibration responses under rocket launch conditions, which create an intense diffuse acoustic field during the early launch phase. This can compromise the integrity of both the spacecraft and protective fairing, along with sensitive ground-based equipment.

test results from legacy designs, which provided little opportunity for design optimization. The realization of the need for advanced simulation came during the development of a multi-functional panel for large satellites. Space Structures' project incorporated a new, cutting-edge technology that reduced uncertainties and risks. Overall, the uncertainty was related to the inability to verify the appropriate strength of the structure for the acoustic pressure during the design phase. They had already been using ESI VA One, ESI's vibro-acoustics simulation software, and extended their simulation capabilities to include the prediction of structural stress/ strength responses during acoustic noise excitation.

Space Structures was the first ESI customer to successfully perform a BEM model with more than 250,000 nodes, which was a landmark achievement unthinkable in the industry just 10 short years ago. In addition, Space Structures was able to predict interlayer stresses of carbon fiber composites, which was being used to meet design targets by reinforcing sandwich composite parts subject to high acoustic loading. They even expanded their business thanks to the simulation tool and now have a customer service department that conducts analytical verification and design optimization of spacecraft structures, including vibro-acoustic simulation.

"ESI VA One is an outstanding software product. However, the real success is provided in the proactive, flexible, timely and high-quality support of the ESI team from our first contact with the sales team to our contact with technical support."

Florian Ruess
Managing Director
Space Structures GmbH

With the assistance of ESI's technical service, Space Structures learned to benefit from the full functionality of VA One. The company realized a high return on investment and saw rising levels of customer satisfaction. In the future, Space Structures intends to continue their use of VA One to better design structures for all acoustic noise environments.

FEM and Vibro-acoustic simulation models of a payload for space applications

Based in Germany, Space Structures GmbH is an independent engineering firm that specializes in space applications, the development of metal and composite structures, and structural mechanics. One of their core competences is the development of carbon-fiber composite structures, including primary structures for large spacecraft. With years of experience under their belt, Space Structures is familiar with the challenges of designing the right equipment for the launch environment.

The aerospace industry previously relied on trial-and-error testing as well as

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

Creating the Perfect System: Siemens Minerals Utilizes ESI's SimulationX to Optimize Belt Conveyors

SIEMENS
Ingenuity for life

Designing, dimensioning and modifying drive systems for belt conveyors is one of the core competences of Siemens Minerals, and requires extensive knowledge of a conveyor's behavior. No prototypes are built for these machines, making it difficult to test emergency and hazardous scenarios and requiring time-consuming and costly on-site commissioning processes. Yet finding the most energy-efficient and cost-effective layout while delivering expected performance is a priority. Most simulation solutions available today represent only a part of the system – but they don't address the dynamic and physically realistic conveyor system's behavior, including that of the belt, drives and controls.

Siemens Minerals discovered that by using dynamic system simulation, a significant part of the commissioning process could be completed before any machine was installed. This reduced time to operation and eliminated the need to send staff on-site for extended periods of time. Additionally, it made it possible to explore various scenarios in a cost-efficient manner, without risk to humans or the environment.

To realize the benefits described above, Dr.-Ing. Torsten Hellmuth and his colleagues at Siemens Minerals turned to ESI's SimulationX belt conveyor solution; a solution that is more than a software tool because it comes with the extensive experience and technical expertise of ESI engineers, knowledgeable of the mining industry.

Siemens Minerals uses SimulationX to:

- Create a model of a planned or existing belt conveyor system, based on data from a supplier or operator, as a basis for the drive system design, optimization and virtual commissioning
- Analyze the belt conveyor's behavior in conjunction with the planned or existing drive system
- Assess the effects of modifications on the drive system or the belt conveyor (e.g. increased loads, changes in the topology)
- Test control algorithms for the drive system and evaluate the effects on the belt conveyor's behavior
- Analyze the belt conveyor's overall behavior in extreme situations, such as emergency shutdown, power outage or component failure.

For Siemens Minerals, the use of simulation goes beyond design optimizations and virtual commissioning of the belt conveyor. Real-time testing of controller hardware with a Hardware-in-the-Loop (HiL) platform is one of the next steps. In that context, a SimulationX model on the HiL-platform represents the behavior of the complete belt conveyor system. Based on that model, the HiL platform provides the same feedback to the controller device as for the real plant.

"Linking the digital models of a belt conveyor's mechanical and electrical components in ESI's SimulationX produces a digital twin which allows for design optimizations and virtual commissioning of the belt conveyor. We're able to test parameters for converters and motors, as well as complex controllers, and chose in advance to validate the technical performance, and to minimize time and tests on site for a faster and safer commissioning process – something from which we benefit as much as our customers."

Dr.-Ing. Torsten Hellmuth
Product Manager Bulk Material Handling
Siemens AG, Process Industries and Drives Division, PD LD MN AMA

for more information
www.simulationx.com/belt-conveyor-systems
www.industry.siemens.com/verticals/global/en/mining-industry/pages/mining-industry

For Nissin Kogyo, ESI ProCAST is an Indispensable Tool for Assuring Production Quality

Nissin Kogyo Co. Ltd., established in 1953, develops, manufactures, and sells brake equipment for two- and four-wheeled vehicles. Honda Motor Co., Ltd. and Toyota Motor Corporation are among their largest customers. One of their main challenges is meeting crucial demands of such OEMs, including reducing the weight by using lightweight aluminum – without sacrificing performance and durability.

Brakes are the primary safety device of an automobile and at the same time are often visible and must be aesthetically pleasing. They typically experience temperatures of 200° - 300°C as a consequence of friction during braking and must function well under the adverse environments of dirt, water, snow and salt. The challenge for many manufacturers, such as Nissin Kogyo, is to deliver, in the shortest time, optimal designs that meet the stringent requirements of automobile OEMs.

The level of defects Nissin Kogyo experienced in their product lines was too high and was delaying deliveries to their customers. With increase in production and product diversification, the problems amplified.

The main challenge was to produce a "quality casting" (right size, shape, weight, strength) without internal defects and with a good after-machining surface finish. At the same time, the manufacturing process had to be designed to provide the highest possible yield. Nissin Kogyo realized that their success depended on understanding the casting process inside the mold cavity.

Choosing the right simulation software

Nissin Kogyo adopted ProCAST, which provides an accurate description of the complex casting surface, and the detail of the molten metal filling inside the mold cavity.

"Before the introduction of ESI ProCAST, the percentage of defects was relatively high, leading to a smaller yield. It was impossible to accept this with an increase in production and the diversification of products. We were able to reduce the percentage of defects to a very large extent thanks to a high accuracy simulation tool like ProCAST."

Mr. Katsuhiko Ashida
Chief Engineer, Development Operations
Nissin Kogyo Co. Ltd

One of the challenges in casting is that the wall thickness is always non-uniform. ESI ProCAST captures this non-uniformity very well, which is important to Nissin Kogyo as their product portfolio is diverse and they need to accurately predict flow and solidification in several designs and process variants.

Effective in-house implementation

Using ProCAST in the development cycle, Nissin Kogyo was able to produce high integrity castings and greatly reduce their scrap rate. By increasing production and diversifying their products, while maintaining quality, they gained the confidence of their customers. Future simulation work will focus on the design of molds, which compensate for change in geometry during solidification and cooling.

About Nissin Kogyo

Nissin Kogyo is a Japanese automotive parts company that specializes in the manufacture of braking systems. The Nissin Group as a whole, which has more than 9,000 employees, has evolved into an integrated brake system manufacturer able to globally provide brake systems for motorcycles and automobiles. The company was founded in 1953 and is listed on the first section Tokyo Stock Exchange.

for more information
www.nissinkogyo.co.jp/en/
www.esi-group.com/ProCAST

Will the Parts you Build Today Enable the Vehicles of Tomorrow?

www.esi-group.com/castingthefuture

Visit the ESI booth at GIFA 2019!

E-mobility is creating new market opportunities for the casting industry

Automotive die casting is key for lightweight engines, powertrains, electric drive systems, and body work. The geometrical complexity and high production volumes that can be achieved make it the process of choice for manufacturing thin-walled, lightweight, and premium quality parts for the automotive industry.

ESI ProCAST simulation solution has been designed with the sole purpose of delivering premium quality castings and lets you cast and innovate with confidence.

Smart Virtual Prototyping Engineering Solutions

ProCAST

Interior Design for Optimal Comfort and Energy Consumption

How Virtual Seat and Cabin Prototyping Support the Challenges of Electric and Autonomous Vehicle Interiors

As mobility is transforming, most automotive manufacturers are either developing or commercializing electric vehicles (EVs). The range of these electric vehicles is a critical hurdle in broadening their adoption. Typically, this is measured for average weather conditions, while in real life the varying conditions (hot, cold) may cause the activation of a cabin HVAC or climate system that reduces the range by up to 40%. In such circumstances, it is not surprising that reducing the energy consumption of every system is a critical concern.

Today, key components of a vehicle are being reinvented to meet the requirements of electric and autonomous vehicles. Here, engineering teams face an arduous challenge as they are called on to reinvent the cabin design while maintaining occupant safety and comfort and delivering highly performant vehicles. With the advent of flexible and sometimes revolutionary interior layouts and the many possible uses of the car cabin, thermal and climate systems have to be rethought to be consistent with cabin configuration and the demand for individualized comfort.

To overcome these challenges, interior and seat engineers must develop new and innovative cabin designs and iterate quickly on different scenarios without impacting the final delivery schedule. With ESI's Virtual Prototyping solutions for seats and interiors, engineering teams test occupant thermal comfort, taking into account heated or ventilated seats and the overall cabin HVAC system. These solutions, applicable from the early stage of the development cycle, support designers and engineers in engineering the thermal equipment of the cabin and seat, assuring it is optimal in terms of passenger comfort and energy consumption, for both nominal and in-operation conditions.

Prediction of seat and cabin thermal behaviors and occupant comfort that is as good as real, human models dedicated to comfort, accurate virtual seat prototypes, and cabin HVAC transient modelling are needed. Also, and most importantly, the correct interaction between all these components must be addressed.

ESI human models represent not only nominal conditions, but also predict the body's thermal behavior (passive behavior and thermoregulation) and provide thermal comfort scores to give objective characterization to an experience – thermal comfort – that may be viewed as highly subjective.

As noted, heated and ventilated seat engineering is quite complex and requires consideration of all the interactions between the occupant, the seat, and the heating or ventilation systems. Even the thermostat rules and sensor location must be defined. With all this modeled faithfully, the movement of the air and fluctuations in temperature in the cabin can be predicted by CFD techniques, to provide continuously updated information to ensure the right thermal exchanges between the seat, the occupant and the cabin.

ESI Interior Solution offers a unique capability for interior engineers to virtually test and optimize innovative cabin layout of electric and autonomous vehicles, while contributing to the car range increase in real driving conditions.

for more information
www.esi-group.com/vehicle-interior

The Additive Revolution: the Edge of Advanced Manufacturing

Breaking Down the Barriers of AM and Finding your Way to the Forefront of the Uprising

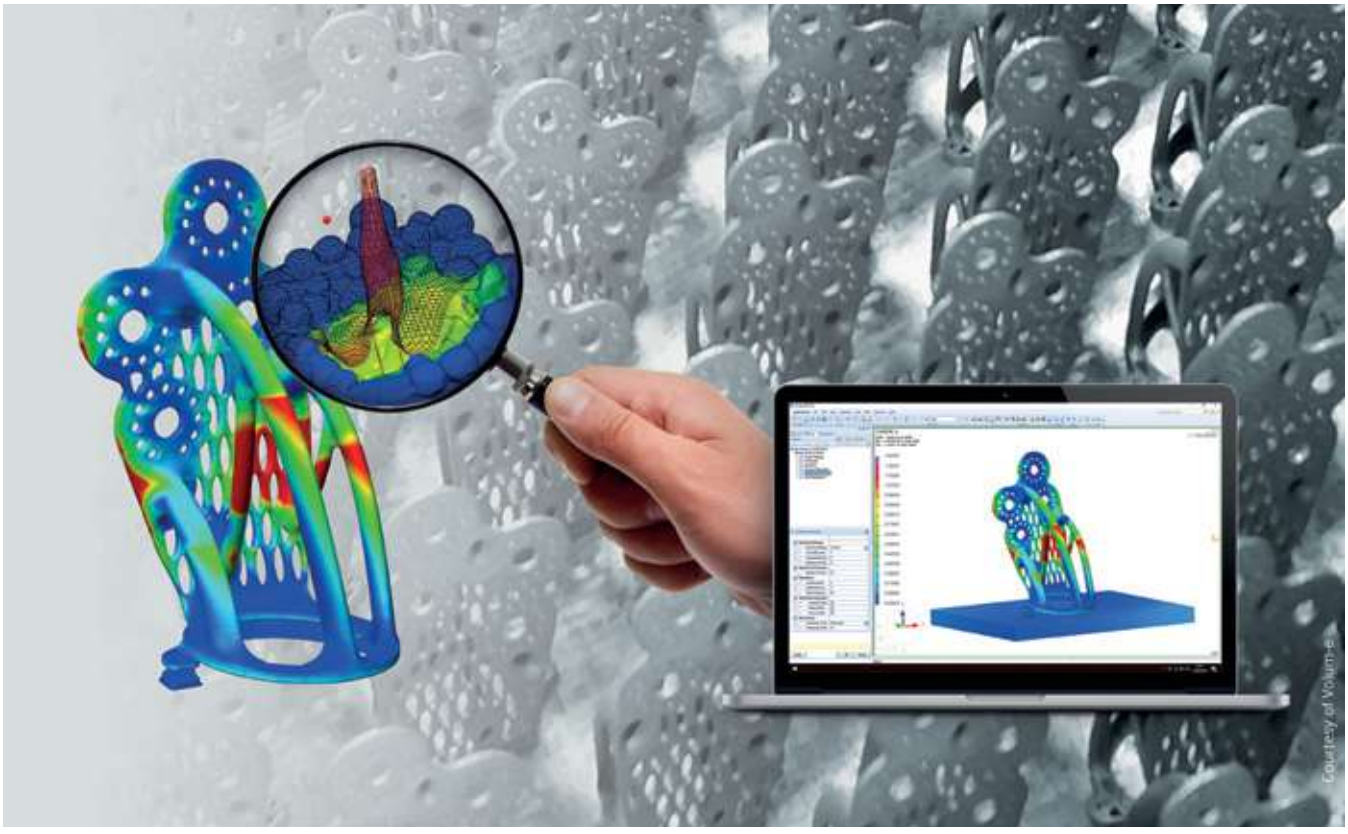
Additive Manufacturing (AM), also known as 3D printing, is the wave of the future. Design any shape you can dream up, produce it on-demand, anywhere; with nothing more than a machine and some powder. For professionals, one of its greatest benefits is the fact that AM offers designers and manufacturers the ability to create complex parts in small batches without the need for costly and time consuming tooling or machining fixtures. So, why isn't everyone using additive manufacturing when it has such compelling advantages?

Today, there are two distinct users of AM: those who have adopted the technology and those who still need to understand if it might be a good fit for their business. Manufacturers and designers already making parts with AM, for example in the aerospace industry, seek answers to questions for every new design. Is it physically possible to make this part? Is there a better way to make this part? What would be the optimal manufacturable design using the full potential of AM freedom of geometry? This group of users wants to answer these questions without neglecting the need to deliver on time, within the allotted budget, and, if needed, to provide guidance to the designer on the optimal geometry.

> *"Detailed manufacturability evaluation is essential to find optimum adequacies between AM materials and processes, in a bid to increase the productivity of AM processes – perhaps the most crucial aspect to see AM develop rapidly within the industrial landscape."*
>
> **Lionel Ridosz**
> Industrialization Development Manager
> Zodiac Aerospace

Newcomers to AM, on the other hand, have different questions. Is it a good move for my bottom line? How mature is the technology? When should I stop investing in traditional processes, such as machining, and start investing in AM?

Adopting Additive Manufacturing potentially puts industrial manufacturers ahead of competition and entering the game with ESI's Additive Manufacturing solution can secure that advantage. By combining their in-house competencies with ESI's expertise in materials and process performance, such companies are able to identify the most adapted setups and designs. ESI's simple, yet effective, software solution delivers meaningful answers to complex questions such as



optimal process time and throughput, the material price, and paves the way to faster certification.

In summary, ESI Additive Manufacturing solution, which provides an end-to-end solution for both heat treatment and AM processes, helps:

- assess manufacturability, to achieve both optimal design and cost-effective processes;
- harmonize printing technology, material and process parameters to guarantee a reliable high quality of parts;
- eliminate guesswork by accurately exploring competing physical phenomena to eliminate small-scale defects, distortions, and residual stress early in the development cycle;
- predict material properties such as porosity and surface finish;
- reduce cost and time to certification by eliminating the need for physical trial and error; and
- advance capabilities in a cost-effective manner, mitigate risk, and accelerate the deployment of a disruptive technology

ESI Additive Manufacturing offers a unique solution to ensure continuous flow of information from concept through manufacturing to certification. ESI's Center of Excellence for Additive Manufacturing has been leveraging our company's existing expertise in multiphysics, material science, and integrated computational material engineering, to study the specific effects associated to Additive Manufacturing processes. ESI's research teams are involved in numerous projects, including DARPA Open Manufacturing, SOFIA and AMANDE. Collaborating closely with industrial leaders like Honeywell, the team has published numerous technical papers on the challenging topics of AM material quality, process certification and qualification for aeronautics industries.

ESI is constantly improving the AM solution and related services. The latest release addresses distortion, residual stresses and recoater interaction assessments, and expertise on material quality analysis with local understanding of powder spreading and meltpool dynamics effects. Reasons for late adopters of AM are vanishing fast!

"To achieve manufacturing excellence in Additive Manufacturing, engineers must first understand and control the complex relationship between part design, 3D printing processes, and material quality. This know-how is essential to engage in process qualification."

Dr. Jean Sreng
Business Development Manager
ESI Additive Manufacturing

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

United States France Germany Japan Korea China India

Worldwide Customer Forums
on Smart Virtual Prototyping

www.esi-group.com/forums2019

Lightweighting: Assessing the Impact of the Use of New Materials on Performance

ESI Delivers Seamless Integration of nCode to Enable Fatigue and Durability Predictions

nCode

As automotive OEMs strive to reduce vehicle weight, engineers must introduce and combine new, innovative materials and reduce design margins without impairing product performance. To anticipate the risk of non-performance and to avoid costly design changes, product design teams seek an early evaluation of all performance domains – including fatigue and durability. Only then, can they efficiently understand design trade-offs and define optimum solutions.

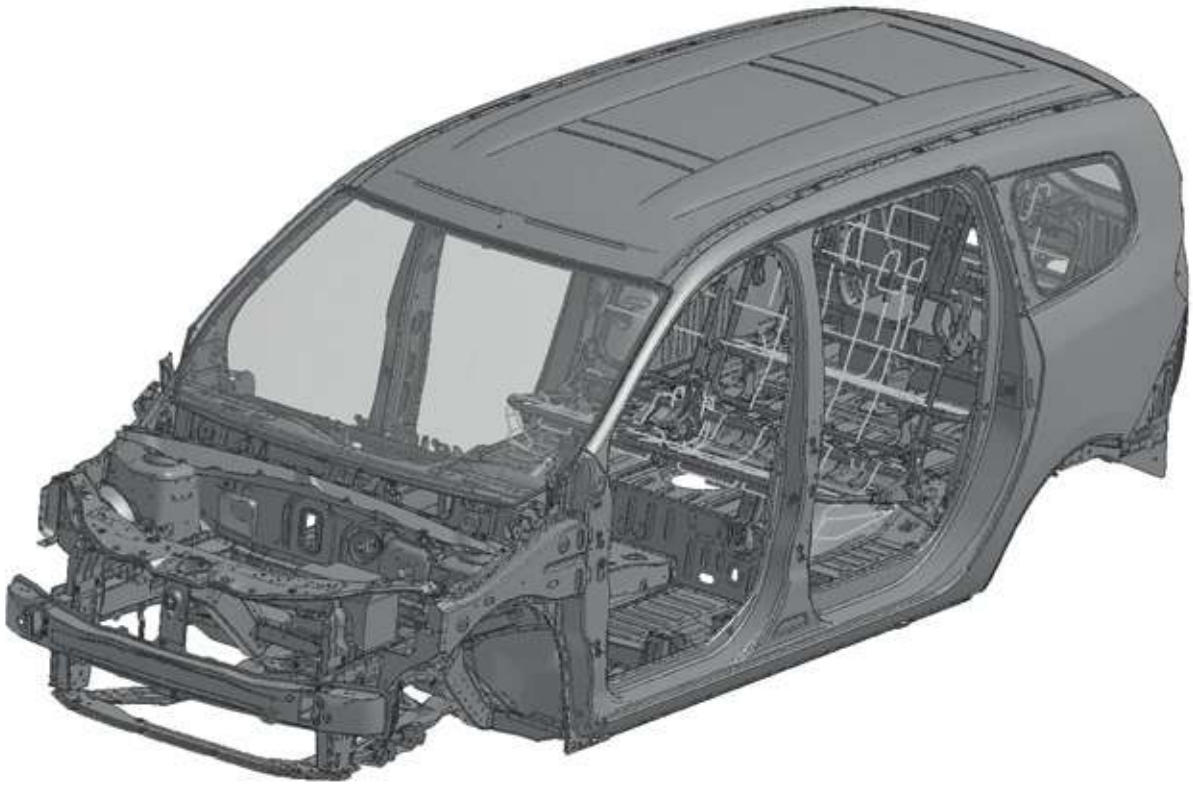
To support engineering teams in meeting or exceeding lightweight and performance target requirements, ESI Virtual Performance Solution (VPS) enables early prediction of product performance across multiple domains, using a single core model: from crash and safety performance to static and dynamic strength & strain analysis, NVH, and even water flow. ESI's flagship software empowers engineering teams to accelerate innovation while keeping time and cost under control.

To further strengthen its solution, ESI is partnering with HBM, the British company behind nCode and a leader in fatigue and durability prediction. Using nCode Design Life, design engineers in charge of the body, chassis and closures can now address fatigue and durability at the same time as all the other performance domains already supported in VPS. Improving workflows and skipping the cumbersome and error-prone tasks of file formatting and transferring, engineers gain time and efficiency to achieve more numerous iterations before the design freeze – essential to driving automotive innovation.

"Renault, HBM-n-Code and ESI have been conducting durability tests in Virtual Performance Solution on simulations for over 24 different load cases. Using those calculations, fatigue analysis was successfully conducted with nCode Design Life™."

René Denisse
Simulation and Validation Section Manager
Renault

for more information
www.ncode.com
www.esi-group.com/VPS



Body in white durability prediction using ESI Virtual Performance Solution and nCode. Courtesy of RENAULT

Harnessing the Hybrid Twin™ for Robot-Operated Vineyards

Leveraging Smart Data to Improve Performance in-Operation

Vitirover weeder-robot (Courtesy of Vitirover)

> *"By using both the advanced real-time simulators provided by ESI, the knowledge accumulated by Vitirover, and the data collected and cured using ESI AI technologies, Vitirover could join the 4.0 generation gaining on robustness, efficiency and operational and predictive maintenance."*
>
> **Arnaud La Fouchardiere**
> Chief Executive Officer
> Vitirover

And just like that, the digital transformation has made its way to the Saint-Émilion vineyards in France. The sun is shining. The bees are buzzing. Herds of robots are efficiently programmed to eliminate grass and weeds around the vines without the need for harmful glyphosates (herbicide). All is well in a perfect world until, suddenly, the mechanical workforce ceases to function, and the entire vineyard is threatened by weeds. In engineering terms, it's a system shutdown.

Systems fully composed of robots can become over-constrained and any slight malfunction generates a system shutdown. Attempts are made to overcome the issue, but most of them are unable to offer robustness, efficiency and flexibility. Thankfully, such systems collect large amounts of data which can be exploited.

Here, the robotics company Vitirover and ESI have joined forces to ensure that Vitirover's robotics system remains robust, efficient and flexible. How are they doing this? Harnessing the power of the Internet of Things (IoT) and the data captured by sensors on operating robots, Vitirover and ESI are building a Hybrid Twin™ of the robot.

Today, data can enrich models in many ways, three of them being decisive for defining digital and hybrid twins: (i) real-time decision-making based on collected and cured data currently integrated into artificial intelligence techniques; (ii) real-time model calibration based on efficient data assimilation; (iii) the deviation between predictions and measurements that is used to construct on the fly a data-based model of that deviation.

The efficient use of data is subject to two main issues: (i) the amount of data to be collected and cured can compromise real-time feedback and, (ii) despite the flexibility that data-based correction contribution offers, when addressing complex systems composed of many agents (in this case robots), system control and data-based adaptation become inefficient if the correction operates at a local level.

To circumvent these two issues, ESI's Hybrid Twin™ approach offers a new paradigm based on the use of key data (also called smart data) within a multi-scale approach. By defining the most appropriate data to be collected, the places and time to collect it, and the best metrics and analysis tools, the solution aims at providing maximum knowledge, while at the same time keeping each agent informed on the global state of the system. The fact that each agent (or robot) has a vision of the global system and the state of the other agents allows for the enhancement of local decisions and plans (e.g. using strategies based on consensus and advanced topological data analysis [TDA] techniques).

Collaborative behavior naturally emerges for such a system when all its agents are successfully interacting. Think of a chamber orchestra in which each musician can hear and differentiate their fellow musicians, without requiring a conductor. That becomes more difficult when the size of the orchestra increases. But not for robots: as soon as they're all adequately connected, they can function regardless of how many they are.

for more information
www.vitirover.fr/en-home
www.esi.group.com/hybridtwin

ESI COO, Vincent Chaillou, Joins the 2018 Saint-Petersburg International Economics Forum (SPIEF)

This past May, ESI's COO Vincent Chaillou was part of the official French delegation of 90 French companies, led by MEDEF International, at the Saint-Petersburg International Economics Forum. One of the pinnacles of this event was the Industry 4.0 roundtable session during which ESI presented its unique value proposition in front of key Russian industrial players.

Industry 4.0 is deeply impacting organizations and business processes worldwide. In that context, and over the last decade, ESI's Virtual Prototyping approach has enabled enterprises to drastically reduce the use of physical prototyping and testing; reducing costs, accelerating time to market, and spurring innovation. Creating demands for new skills and challenging existing organizational structures, this digital transformation is bringing disruptions at different levels – including the shift of perceived value from the certified product to the "outcome" (the product in use and in operation).

In response the new challenges of the "Outcome Economy", ESI has developed the Hybrid Twin™, which blends the knowledge based on Virtual Prototyping with the intelligence extracted from data collected from the product in use in its actual environment. This In-Service phase breaks the traditional silos of R&D, Factory and Operations, and paves the way for sustainable value creation.

ESI acts as a technological catalyst and integrator, with partners and customers, as they implement end-to-end Virtual Prototyping in their processes and organizations in the frame of their Industry 4.0 roadmap and transformation. Speaking to that topic, Chaillou commented on ESI's engagements in Russia with the aerospace and automotive industries to drive innovation in advanced composite materials and new processes like Additive Layer Manufacturing.

> *"It was a great honor to be part of the official French delegation for the SPIEF and to be able to share our projects and our ideas during the Industry 4.0 roundtable. Establishing a strong ecosystem is key to succeeding in the journey towards Industry 4.0."*
>
> **Vincent Chaillou**
> Chief Operating Officer
> ESI Group

Industry Leaders Unite at the 2018 ESI Executive Meeting

ESI held its 2018 Executive Meeting in July in Versailles, France. Leaders from the main industry sectors worldwide gathered for this one-day event to exchange ideas, problematics and experiences with one another, accompanied by selected thought leaders from ESI.

ESI's CEO, Alain de Rouvray, opened the day with a discussion on industrial transformation on the road towards Industry 4.0 and noted, "Today, one of the most credible and inescapable paths is through the use of digital simulation, amplified by many disruptive technologies including artificial intelligence, big data, Internet of Things and machine learning." From Engineering to Manufacturing and In-Service, ESI solutions serve as accelerators for industrialists to manage risks related to innovation, increase manufacturing productivity, and predict the performance of a product.

The meeting spurred open discussions between leading industry experts on their challenges, solutions and results, as well as their expectations and priorities. Additional discussions about the challenges of Industry 4.0, regarding Smart Factory, Big Data, Machine Learning and IoT, got the participants thinking more about the future and what it holds.

Other main theme discussions included enabling the virtual world, from numerical simulation to virtual prototyping and the Hybrid Twin™. ESI's Hybrid Twin™ is a complete virtual representation of a product that can co-exist throughout the lifecycle of the actual physical asset – from creation (manufacture), through operational life and to disposal. This provides essential insights into both the design of the product and its overall quality and is importantly a platform for intelligent maintenance and support.

In closing, the Executive Meeting shared the "Rules of the Garage" articulated by Carly Fiorinia, former CEO of Hewlett-Packard (1999), including the famous 11th rule; "Invent". Alain de Rouvray added: "Nothing is new under the sun! We just have more capabilities now thanks to new exponential technologies, Big Data, Machine Learning and more."

ESI Group & Chinasoft International Join Forces to Foster Smart Manufacturing in China

ESI Group and Chinasoft International, the largest software and information technology service provider in China, formalized a strategic cooperation agreement to upgrade the manufacturing capabilities of the Chinese manufacturing industry in accordance with the ambitions expressed in "Made in China 2025".

Chinasoft International plans to support this major Chinese government initiative by integrating and delivering ESI's Virtual Prototyping solutions on its "Honeycomb" intelligent industrial internet platform. ESI and Chinasoft will collaborate to create a new ecosystem of industry and research institutes for smart manufacturing in China to promote Hybrid Twin™ and Virtual Manufacturing solutions, which foster innovation.

"The signature of this strategic cooperation is a crucial step for Chinasoft towards its goal of becoming a major player in the national construction of 'Made in China 2025'. We are deeply convinced of the bright future of our cooperation given our complementary strengths and the extraordinary opportunities in the market."

Bob Ma
Senior Vice President
Chinasoft International

"We are excited to sign this agreement and work together to influence and create the future of manufacturing in China based on a common vision and sense of urgency. Democratization of our solutions through Chinasoft's strong integration capabilities in smart manufacturing will greatly benefit China, the world's leading manufacturing country."

Christopher St John
Chief Operating Officer
ESI Group

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

ESI Presents its Hybrid Twin™ for Nuclear Dismantling at the World Nuclear Exhibition 2018

Secure and Manage Nuclear Decommissioning in Real Time Thanks to Virtual Prototyping

Manufacturers are facing major obstacles as they seek to make facilities more efficient and effective, while enhancing safety and reducing cost. A digital approach has become the most relevant answer to address these challenges.

Last June, ESI presented its "Hybrid Twin™ for hostile environment intervention" exclusively at the World Nuclear Exhibition (WNE) 2018. By increasing operators' safety, while reducing the cost and time associated with dismantling operations, this methodology becomes an essential ally for experts in civil nuclear engineering.

In the field of nuclear power, ESI supports and accompanies its customers in projects related to plant safety, digitalization, performance, and dismantling. Strategic and complex projects like these often face interruptions in order to remap the site and to allow operators to move safely; actions which extend the duration of the project.

ESI's Hybrid Twin™ enables hazard detection and prediction while updating the radioactive mapping of areas in an integral Virtual Prototype in real-time. The methodology is particularly interesting as results are available on different media, like mobile devices and computers, and also scalable to an immersive platform using Virtual Reality.

With this use of the Hybrid Twin™, dismantling scenarios are adjusted in real time to ensure optimum safety for operators, while reducing the overall duration of projects and their associated costs.

for more information
www.esi-group.com/hybridtwin-nuclear

ESI Recognized for its Growth and Commitment to Corporate Social Responsibility (CSR)

ESI Group has been awarded first prize in the Gaïa campaign 2018 for midcaps with annual revenues under €150m. This is the third year in a row that ESI has come in first in this category, which singles out the 70 top-rated companies in the Corporate Social Responsibility (CSR) domain.

This award recognizes the efforts taken by ESI to continuously improve its commitment to social, societal and environmental responsibility. In 2018, the Group reached a new milestone by joining the United Nations Global Compact, illustrating its beliefs and its willingness to act in these domains.

The Gaïa Index was created in 2009 as the benchmark sustainable development index for listed French mid-caps (ETI). Developed by EthiFinance, the Index selects SMEs based on their CSR performance. The Gaïa Index has outperformed the CAC 40 and CAC Mid & Small Indices every year. The methodology uses CSR data to evaluate a company's transparency and maturity in terms of CSR policies, best practices and performance.

"We are proud to be recognized for our social, societal and environmental practices for the past three years. This confirms our willingness to pursue actions started several years ago and to federate our teams around these challenges. Beyond our own actions, we are glad to offer solutions which support the reduction of our customers' environmental footprint for example by building lighter vehicles or by improving work conditions for their employees, in line with the ambitions of Industry of the future."

Vincent Chaillou
Chief Operating Officer
ESI Group

for more information
www.esi-group.com/gaia-award

ESI Pursues its Commitment to CSR by Partnering with Gelato Globe

With a worldwide presence in more than 40 countries, ESI faces the challenge of limiting its environmental footprint around the world. To support this ambition, ESI has partnered with Gelato, a software platform that gives companies global access to local high-quality printers around the world.

This partnership will allow ESI to change its historical practice of printing and storing printed material in Paris before shipping them, as needed, around the world.

The partnership with Gelato is a further step in ESI's commitment to reducing its environmental footprint, while at the same time streamlining processes to deliver quality printed materials, worldwide. This is achieved through a portal from which customers can centrally manage brand-compliant printable assets, which can then be printed and delivered locally, without jeopardizing quality. This significantly reduces shipping distances and delays and can eliminate wastage and storage costs.

As a new signatory of the United Nations Global Compact, ESI pursues environmentally sensitive actions more ferociously than ever. The company is reducing paper usage and the energy consumption related to printing and reducing greenhouse gas emissions related to long distance shipments.

Beyond the environmental benefits, the partnership brings agility to ESI's printing processes and ensures a global brand consistency. The improved efficiency helps reinforce the excellence that ESI is committed to offering its customers.

for more information
www.esi-group.com/CSR
www.gelato.com

"We found Gelato as we were searching for a partner who would be able to address our global printing requirements and our growing need for flexibility and adaptability to local markets. By adopting Gelato's cloud platform, we were able to achieve this and at the same time reduce the shipping distances, delays, and waste that go along with printing in one single location and shipping to our global entities. Local production has, during the first phase of our rollout, reduced delivery distances by 70% (149,000 km or 93,000 miles) and reduced associated CO_2 emissions. It also eradicates the need to over-order print materials 'just in case' – greatly cutting waste!"

Amy de Rouvray
Director Worldwide Marketing
ESI Group

ESI Virtual Manufacturing Solutions Support the Digital Transformation of SMEs

Thanks to the French Government-Sponsored SIMSEO Initiative, Small Businesses Can Benefit from Simulation Software Investment

ESI Group announces its participation in SIMSEO, an initiative aimed at democratizing the use of CAD/ CAE solutions and supporting the digital transformation of smaller businesses. Several of ESI's software solutions, specifically in the field of Virtual Manufacturing, have been granted the SIMSEO label, highlighting their ability to support Small- and Medium- Enterprises (SMEs) as they seek to leverage digital tools to increase their competitiveness.

At a time of globalization and digitization, SMEs try to stay in the race for innovation, despite their limited resources. Entering emerging markets or implementing new production methods can be tough as the associated risk is often high. However, smaller companies and even start-ups have succeeded in making a shift towards numerical simulation: Expliseat (ultra-light aircraft seat manufacturer) and Gazelle Tech (composite vehicle manufacturer) are two great examples of SMEs who managed to develop highly innovative products faster and at lower cost using ESI's solutions.

SIMSEO, a government-sponsored initiative carried out by the French association for numerical simulation, Teratec, has been running roadshows across the country since 2016. They visit local SMEs to offer innovative solutions that deliver a cost-effective alternative to traditional trial and error testing. The scheme offers to fund up to 50% of simulation software investment, with a maximum contribution of SIMSEO of 10,000 Euros. Local businesses can select software solutions from the SIMSEO catalogue, which lists tools that have been carefully chosen to address recurrent challenges of the manufacturing and building industries. Amongst the industry leaders using the same ESI solutions we find Renault, ArcelorMittal, Framatome and Safran – all compelling references for SMEs.

Thermoformed automotive gearbox simulated with ESI's composites manufacturing simulation solution (top) and real part (bottom). Courtesy of ARRK Shapers

ESI's solutions for Manufacturing come as flexible packages, including the appropriate training and support to allow smaller businesses to rapidly implement innovative technologies and reap the benefits of digitization in terms of production quality and volume.

In their catalogue, SIMSEO is promoting ESI's simulation solutions for metal fabrication, enabling manufacturers to maximize product quality and reduce scrap rates by getting the parts cast right the first time. The casting solution provides the ability to virtually test an extensive range of processes and delivers quick answers to all technical problems that cause casting defects.

Another solution that is part of the SIMSEO catalogue, ESI's simulation suite for composite materials, brings virtual manufacturing of composite parts and enables defects to be anticipated early in the product development cycle, when it's easier to correct and fine-tune the manufacturing process. Manufacturers can analyze and optimize individual manufacturing operations and link those by transferring material history and parameters history from one operation to the next. This helps minimize manufacturing defects, insure reproducibility, and decrease development costs.

> *"Simulation helps decrease the financial risk associated with innovation, but SMEs need support to implement it. That's precisely the objective of the SIMSEO program."*
>
> **Karim Azoum**
> Program Coordinator
> SIMSEO

Other ESI solutions included in the catalog are ESI's die face design and sheet metal forming solution, PAM-STAMP, ESI's welding, assembly and heat treatment solution, SYSWELD, and 3D Timon, a Japanese software, developed by Toray Engineering, commercialized by ESI in France.

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

ESI Joins the United Nations Global Compact

As a signatory of the UN Global Compact, and in line with its Corporate Social Responsibility (CSR) approach, ESI Group has pledged to practice the 10 principles of the United Nations in the areas of human rights, labor, environment and anti-corruption. The Group commits to communicating on its progress to its stakeholders yearly through the release of a Communication on Progress (COP) report.

Through the implementation of its six core social values, ESI has distinguished itself for the past three years within the Gaïa Index for its continuous commitment towards a CSR approach, structured around four priorities:

- Being a committed employer
- Being an outstanding partner for its customers by offering innovative and sustainable solutions
- Being an environmentally responsible player
- Serving civil society

Through its Virtual Prototyping solutions, ESI supports its customers in their industrial and operational challenges, while helping them achieve sustainable development objectives by offering solutions that enable them to develop and launch products which are not only more environmentally friendly but also offer increased safety for end consumers.

for more information
www.esi-group.com/company/about/our-responsibility

"Our membership of the United Nations Global Compact is a further step in our commitment to social, societal and environmental responsibility. It demonstrates our strong beliefs and our will to act in these areas. While the 10 principles of the United Nations are already included in the Group's development strategy, we commit ourselves to amplifying our action so that these principles are disseminated and adopted more widely."

Alain de Rouvray
Chairman and
Chief Executive Officer
ESI Group

Meet us!

Nov 13-16, 2018	**Formnext 2018**	International exhibition and conference on the next generation of Additive Manufacturing technologies.	Frankfurt, Germany
Nov 14-16, 2018	**JEC ASIA 2018**	Learn about ESI's solutions for Composite material engineering and manufacturing.	Seoul, South Korea
Nov 15-16, 2018	**PUCA Forum 2018**	For its 29th edition, PUCA will illustrate the successful and challenging applications of Virtual Prototyping in "Engineering", "Manufacturing", and for industrial products "In-Service".	Tokyo, Japan
Nov 20, 2018	**Scilab Conference 2018**	Bringing together users and developers of Scilab , an open-source software installed by 100,000 engineers & scientists per month around the world.	Paris, France
Jan 8-11, 2019	**CES 2019**	Innovating the future of e-mobility. Join us at CES to experience, engineer and manufacture the most innovative vehicles with Smart Virtual Prototyping.	Las Vegas, Nevada, USA
June 17-23, 2019	**Paris Air Show**	The world's premier and largest event dedicated to the aviation and space industry.	Paris, France
June 25-29, 2019	**GIFA 2019**	E-mobility is creating new market opportunities for the casting industry. Join us for a complete overview of ESI's latest solutions supporting foundries in their transformation towards these new markets.	Düsseldorf, Germany

view all ESI events:
www.esi-group.com/events

get it right®

SMART VIRTUAL PROTOTYPING

Deeper data analytics. Animated systems. Virtual sensors for intelligent products. A fully immersive experience.

As a leading innovator in Virtual Prototyping, ESI brings your innovations to life through a realistic virtual experience of your product, as manufactured. This helps engineers secure a reliable solution in the virtual world, and save time in the real one.

www.esi-group.com/smart

ESI software and services enable your digital transformation

Copyright © ESI Group 2018 - G/OM/18.25/A

get it right®

Headquarters Subsidiaries Agents and Distributors

ESI WORLDWIDE

ARGENTINA
AUSTRALIA
BELARUS
BELGIUM
BRAZIL
BULGARIA
CHINA
CZECH REPUBLIC
EGYPT
FINLAND
FRANCE
GERMANY
GREECE
INDIA
INDONESIA
IRELAND
ISRAEL
ITALY
JAPAN
MALAYSIA
NETHERLANDS
POLAND
PORTUGAL
ROMANIA
RUSSIA
SLOVAKIA
SLOVENIA
SOUTH KOREA
SPAIN
SWEDEN
SWITZERLAND
TAIWAN
THAILAND
TUNISIA
TURKEY
UNITED ARAB EMIRATES
UNITED KINGDOM
UNITED STATES
VENEZUELA
VIETNAM

myesi

Customer Portal
myesi.esi-group.com