Empower automakers to engineer and manufacture multi-material assemblies with confidence.

Introduction

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

Read on to learn about feasibility assessments, assembly process prediction, performance validation – all-virtual, costeffective and “first time right”.

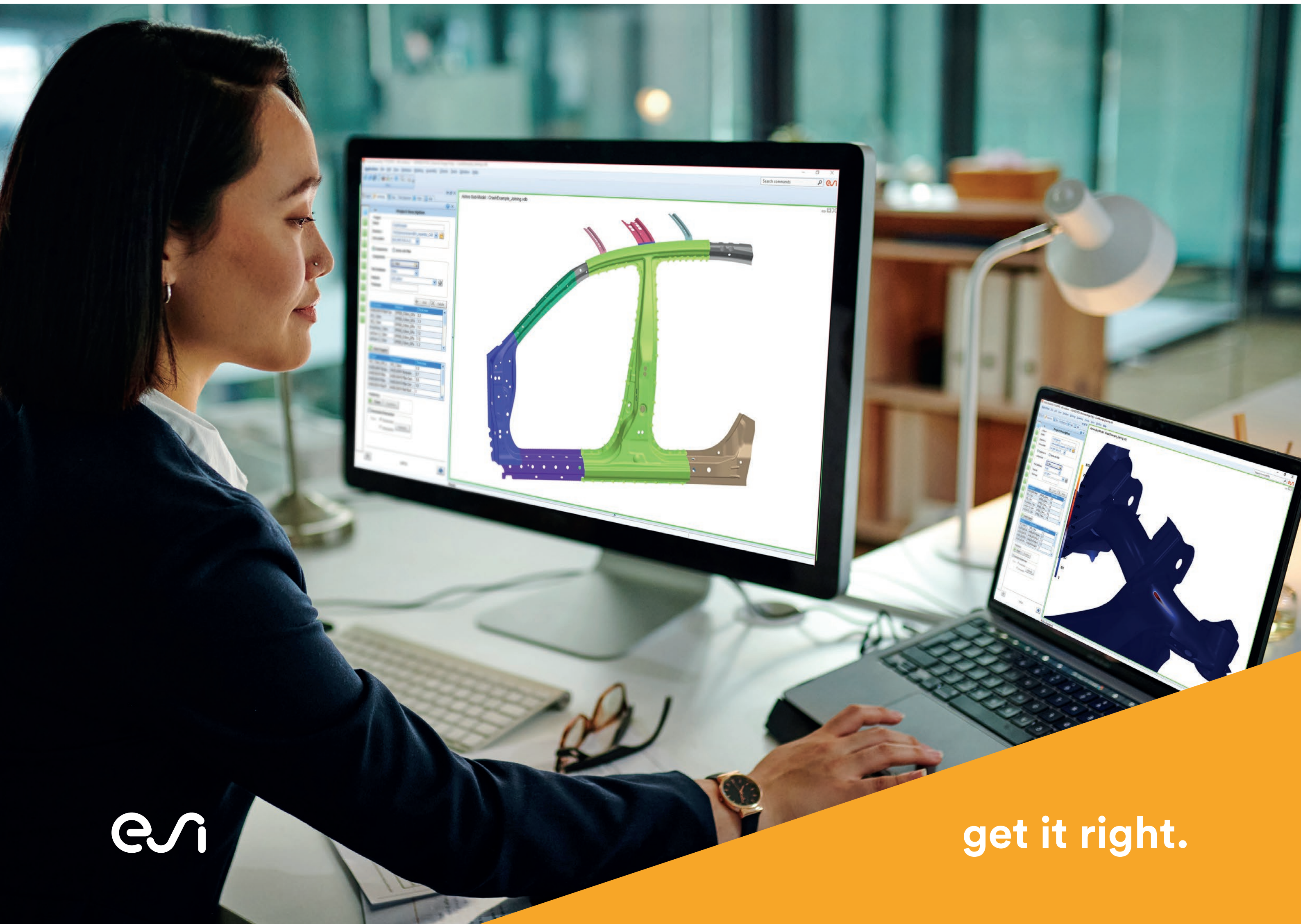
Lightweight is the new must have

Driven by the need to reduce CO_2 emission and by the new e-mobility trend, automotive OEMs and suppliers have been on a journey towards developing lightweight, disruptive, individual and sustainable products that can be manufactured in scale and a 'lot size 1' factory architecture.

Lightweight has become the new must have in body and chassis design, shifting from 100% steel body and chassis manufacturing to multi-material strategies that mainly now combine steel with aluminum and composites.

Finding the right material mix, applying the right material at the right place, optimizing geometries and thicknesses and selecting the optimal joining technologies, for their strength and also their manufacturing feasibility and cost – early clarity and confidence in predicting these problematics are key to efficiently managing the increased complexity in the manufacturing of those advanced assemblies and to achieving the vehicle mass targets.

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



get it right.

Shifting from single-point numerical simulation to end-to-end Virtual Prototyping

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

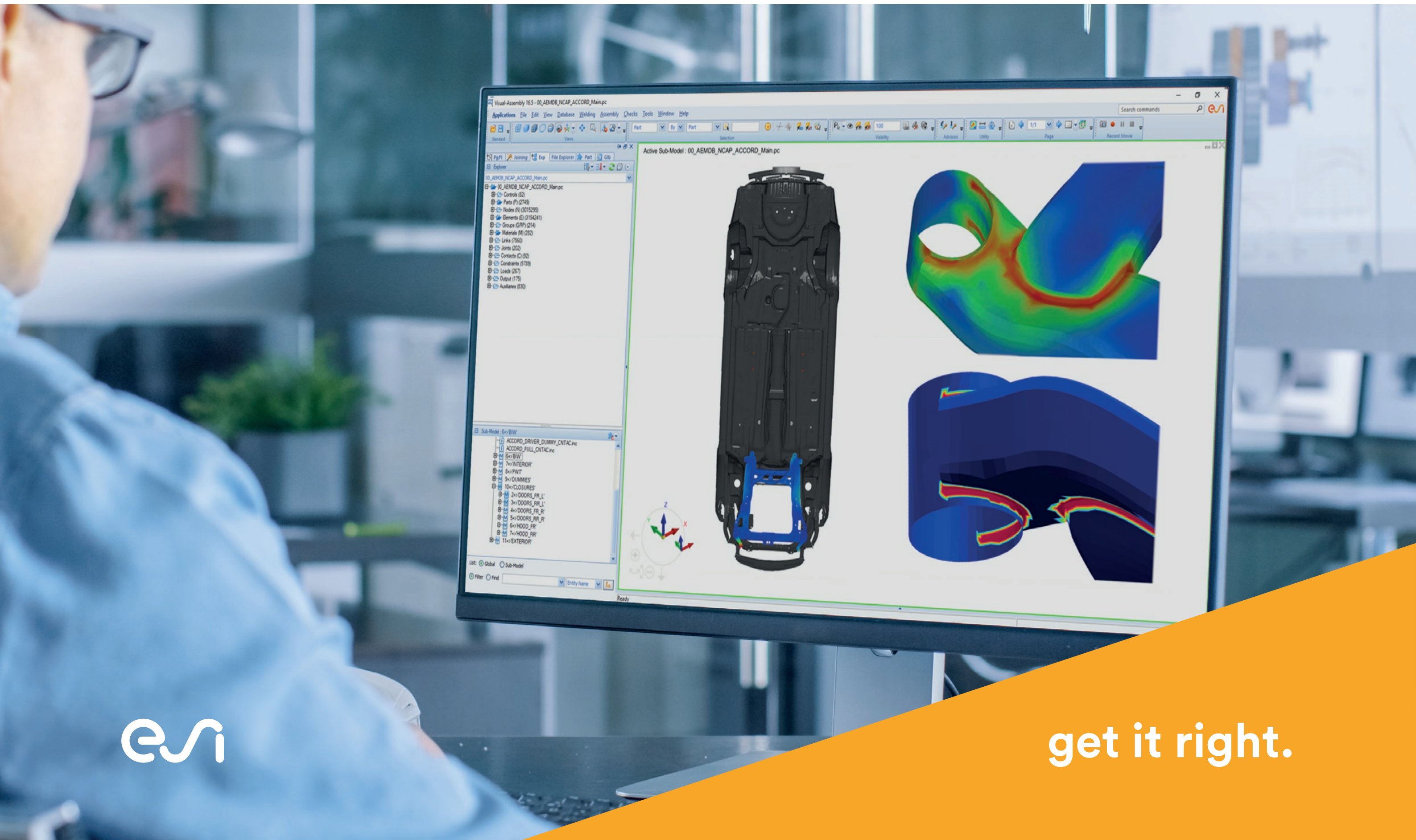
The ambition to frontload manufacturing decisions is not new. But the design-tocost requirement brings an additional push. Indeed, best practice is to find an optimal design as early as possible and to validate it in the engineering phases, and this in a highly predictive manner, to avoid costly prototypes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

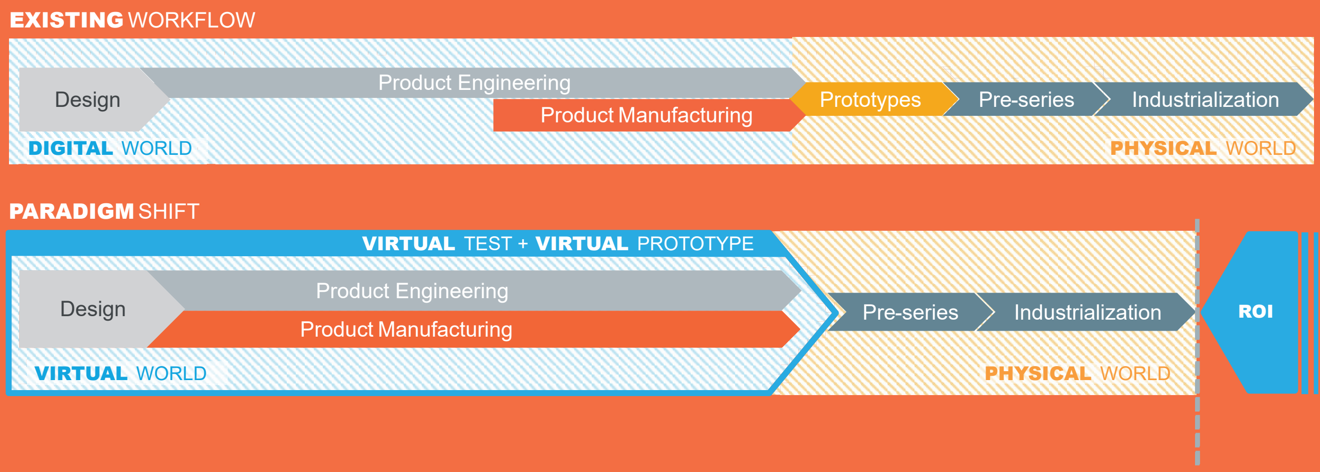
Achieving such an optimal design through a pure digital approach is not straightforward. Two main aspects need to be accounted to ensure a fluid journey until serial production:

Single Parts Manufacturing

Detailed simulation of single-part manufacturing has been established in the industry for many years. However, typically it comes later in the workflow because engineers need to define various tool environments first. With the rise of advanced mix-materials, automakers, need early confidence to make the right decisions about which material works best at which place.

Thus, it is very important to be able to estimate the manufacturing feasibility since the beginning, when the first CAD data and bill of material (BOM) are generated. Virtual Prototyping allows engineers to consider all this information in early development phases and therewith improving the predictivity of the function and performance validation as well as the assembly process simulation – even prior to process tools and dies definitions.





Joining Process

The possibilities to join multi-material assemblies are numerous. To find the right match, it is crucial to accurately model and simulate the joining process in order to transfer the connection strength into crash and durability optimization. In addition, engineers need to account for the impact of the joining process on the parts' geometries in order to predict assemblies' quality. The final target is always to have best predictivity as early as possible, with minimum computation time.

Pre-production validation

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

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

Customer Story

Nissan reduced engineering lead times for new lightweight material by as much as 50%

To address the weight reduction objectives of Nissan's Green Program, the Japanese OEM has been investigating mixed material use (aluminum, steel, and composites assemblies). Nissan engineers used ESI simulation solution for composites manufacturing to develop a new process method of injection molding and compressed molding, bringing significant efficiency gains for their production lines.

By trading the usually long and costly trial-and-error period for developing a new manufacturing process with numerical simulation, Nissan's engineers managed to make early decisions on lightweight material types, while securing design requirements and production goals. By their estimation they succeeded in reducing engineering lead time by as much as 50%.

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

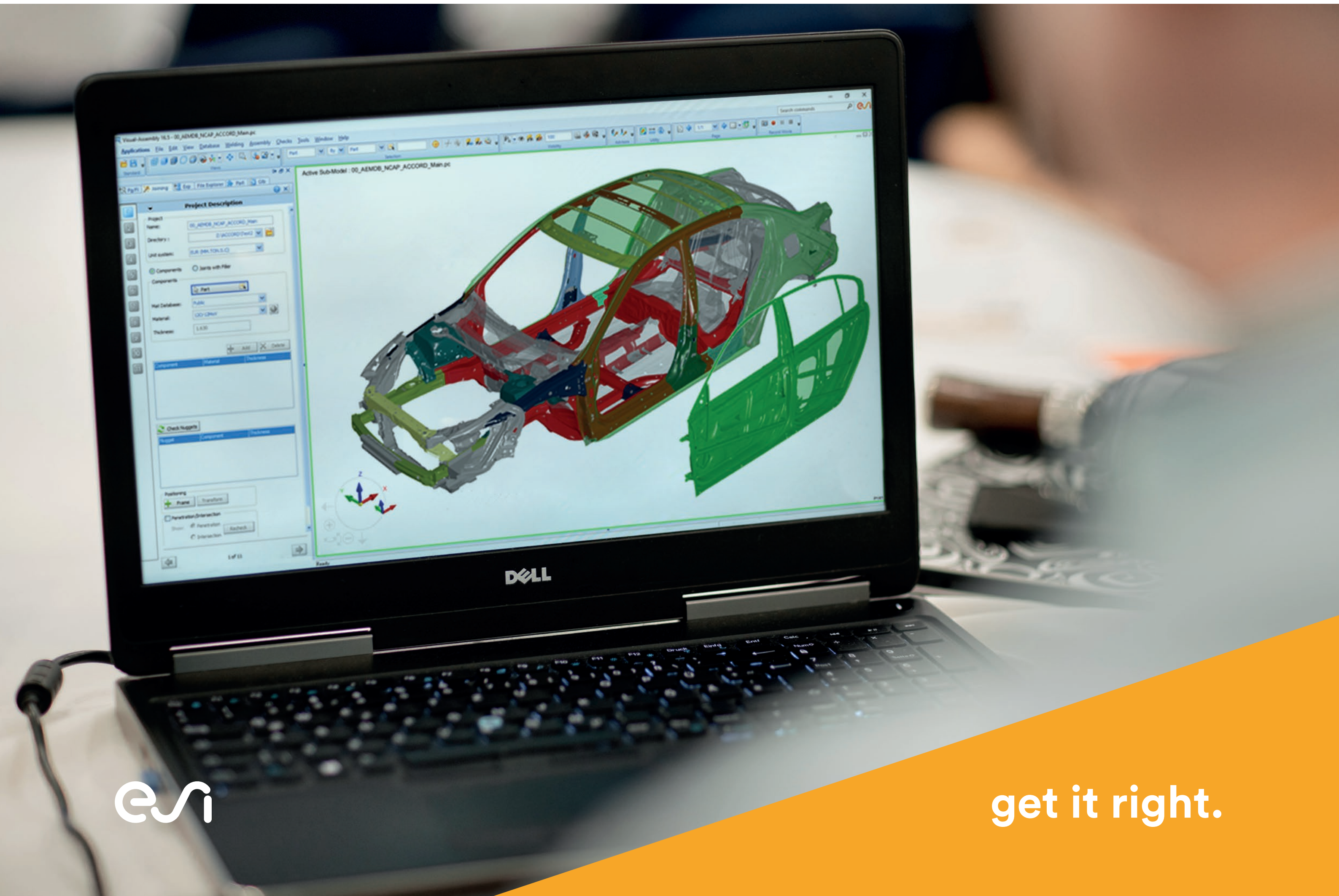
Such an achievement became possible not at least thanks to the ability of confident decision-making and early optimization and thanks to synchronized activities in both design and manufacturing engineering for forming, heat treatment, joining and assembly processes.

Our long-term vision: Evolve towards zero physical prototypes in auto manufacturing.

Virtual Prototyping represents an end-to-end approach, for early validation of material and design choices, manufacturing and assembly process strategy, with significant benefits over the complete body development cycle.

It empowers automakers to effectively validate all the leading lightweighting material candidates for vehicle structures and safety-critical components and to associate the optimum joining processes to achieve assemblies at best performance-cost-quality ratio.

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



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