AEROSPACE & DEFENSE

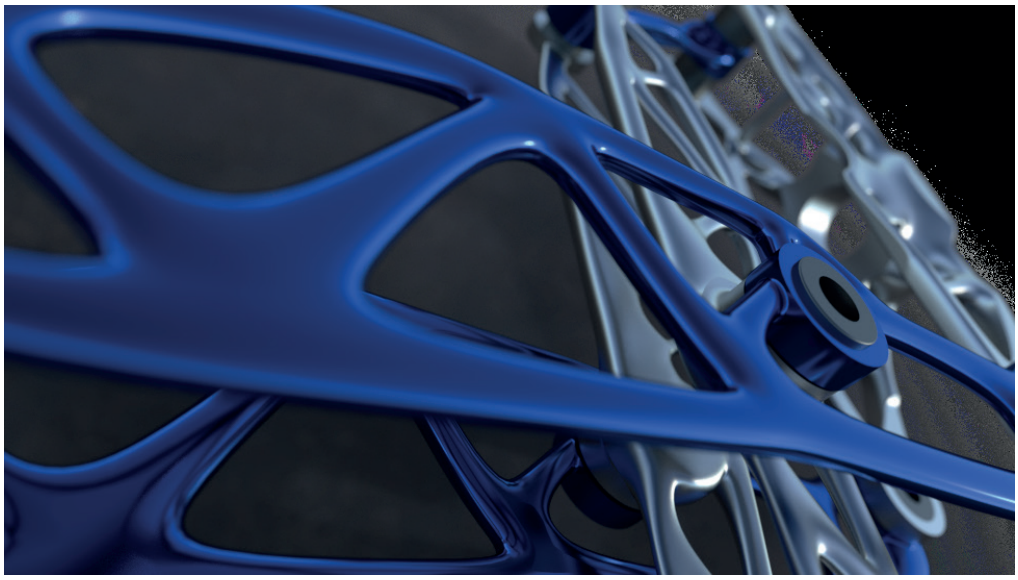
DESIGN REVOLUTION

DASSAULT SYSTEMES

The emergence of new technologies is unapologetically evolving the status quo, triggering a radical change in the engineering landscape as we know it. These technologies typically emerge in the hands of a small number of specialists, using niche specialised software, off the main track, pushing at innovation boundaries.

Design engineers constantly strive to minimize part weight, maximize stiffness, reduce cost and optimize material usage. Today it is often cost-prohibitive to explore optimized parts. It can be difficult to collaborate across disciplines due to different systems and tools, delays and errors in data translation. Optimization has traditionally required experts and has not been available to designers.

In this white paper we explore how innovative approaches to democratizing this technology in the hands of generalist engineers will transform mind-sets and processes, empowering designs without limits within the new (*Generative*) Design Revolution.



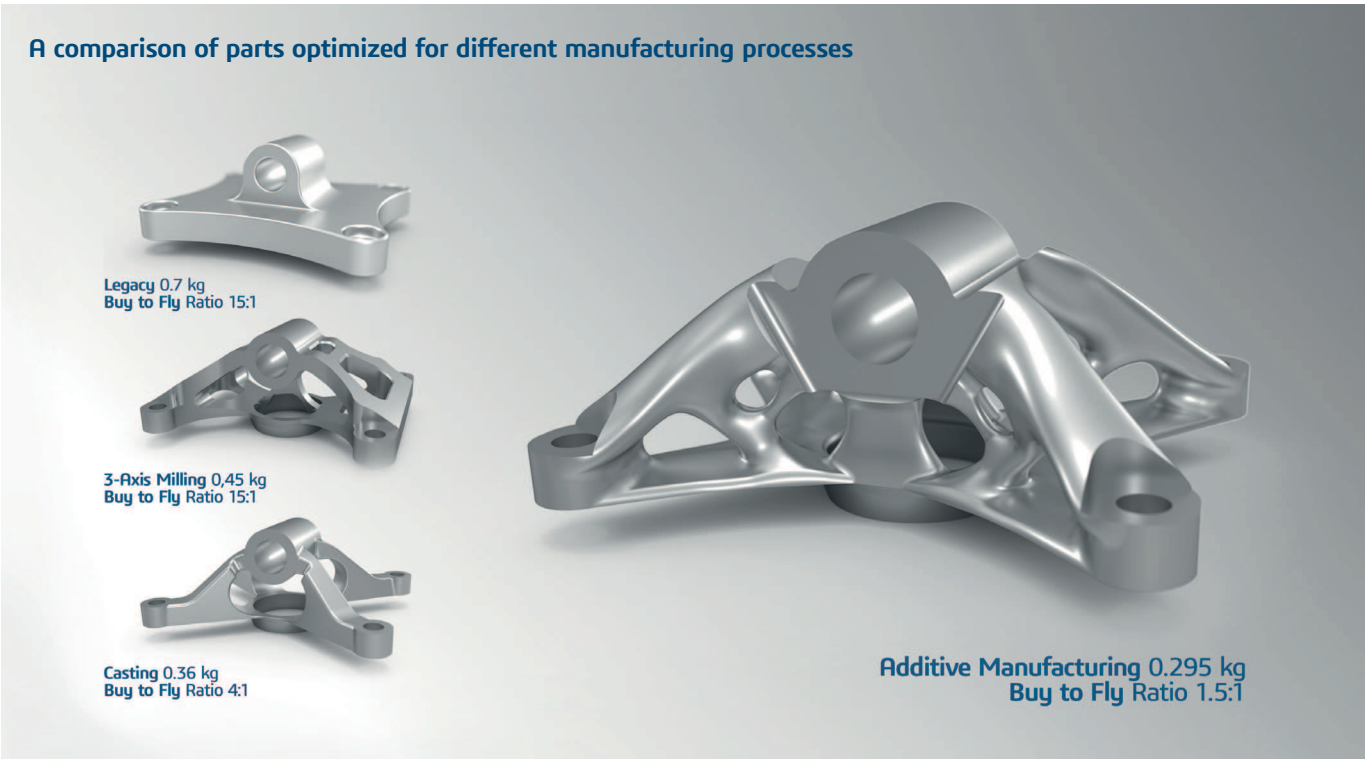
Increasing pressure from customers and competitors

The changing industry landscape has empowered customers more than ever before. Customers have higher expectations, greater choice and are more informed. The ability of agile new entrants to quickly leverage new technologies has disrupted many markets by reducing barriers to entry.

More complex products/personalised products

This increasing pressure demands that design engineers produce better ideas and products to create new customer experiences that will delight. Traditional and new industries are developing products which have become increasingly complex, demanding a corresponding increase in the complexity of the ecosystem and processes that realize them.

> **"We no longer talk about CAD as 'Computer Aided Design', but CAD for 'Cognitive Augmented Design'. What does it mean? It means that science augments the capacity of the human being to create innovative designs. It empowers rather than replaces the engineer."**
>
> — Daniel Pyzak, Director, CATIA Engineering Centre of Excellence EMEAR



Reducing weight

Weight reduction is one of the primary focuses during design phases as it is widely recognised that lightweight designs have benefits for multiple industries. For example, the automotive industry is under increasing pressure from regulators and customer demands to improve engine efficiency and enhance car safety and reduce harmful emissions. A lighter aeroplane will use less fuel, cost less and can be built in less time.

Lead time and cost pressure

Time to market is a vital component within the design cycle, design engineers must guarantee and deliver their designs on time and within specification.

As companies strive to differentiate their offerings, products are inevitably becoming more complex and diverse. Alternative design options are needed to explore and develop the optimal design goal. However this is often a labour intensive process and requires additional engineering resource which may not be available.

The reality of today's design engineer is made up of impossible demands with extreme and relentless pressure. All future operations must be considered during the early stages of the design process, including; manufacturing, assembly, installation, maintenance and even recycling.

> "Traditional approaches involve going back and forth between multiple solutions. It is very time consuming and painful to reconstruct optimized parts, and doesn't allow for downstream design changes. There is no standardization, no talking to each other. It is an error-prone, non- repeatable process."
>
> — Rani Richardson, Technical Director, Additive Manufacturing and Composites, Dassault Systèmes

WHAT ARE THE BARRIERS TO DELIVERY?

There are many industrialised geographies with skill shortages which is limiting the ability of organisations to achieve the desired product development to meet industry demands. However, not only are organizations struggling to recruit the number of engineers required to meet the increasing industry demand. They struggle to recruit those with the correct technical skills and experience.

Optimization has traditionally required experts and has not been available to designers. With niche optimization tools, creating "real" geometry which can be re-used and matured is time consuming and error-prone.

Traditional tools and methods are unable to achieve the innovation and agility to achieve the next generation products. The ability to explore optimized parts is difficult using traditional processes. It is difficult to collaborate across disciplines due to disjointed tool sets that disconnect the early concept design from the product development, resulting in long delays and errors in data translation.

For most engineers, it is too time-consuming to create and validate multiple concepts to select from. The result can be uncompetitive sub-optimal products.

> **"We no longer start from a blank sheet of paper. We start from the design space, and then you add some specifications, boundary conditions and forces.**
>
> **Concepts are then automatically generated and can be explored and examined to achieve the best possible result. This is the Generative Design approach."**
>
> — Daniel Pyzak, Director, CATIA Engineering Centre of Excellence EMEAR

Design constraints from a variety of factors often limit a designer's ability to be able to 'think outside the box'. All too often, technical issues, functionality requirements and even macro factors such as the environment and the economy are limiting creativity. Purposeful design can often be over shadowed by such constraints and explicit goals.

ONE TEAM WAS ABLE TO CREATE A PRODUCT IN 2 DAYS WHICH NORMALLY TOOK 3 MONTHS.

ANOTHER ACHIEVED TIME SAVINGS BY FACTOR OF 4 AND FOUND WEIGHT REDUCTION IN THE ORDER OF

20 TO 30%

DESIGN WITHOUT LIMITS

Nature solves difficult (design) problems by adapting, evolving and optimizing its fundamentals for survival and efficiency. We need to develop similar ways of thinking in order to design better solutions, services and experiences that solve our current design problems.

Generative Design technology has emerged from nature. By using similar techniques, Generative Design technology iterates, evolves and empowers designers to innovate.

In a unique, unified design and simulation environment with a new intuitive workflow, non-specialist designers are able to automatically generate conceptual parts from a functional specification. A push of the button runs a simulation and generates the optimized concept shape. The part can then be comprehensively validated in the context of the previously defined specification. It is easy for the non-expert to create expert results.

Many designers are already using Generative Design and achieving impressive results; "*One team was able to create a product in 2 days which normally took 3 months. Another achieved time savings by factor of 4 and found weight reduction in the order of 20 to 30%.*"

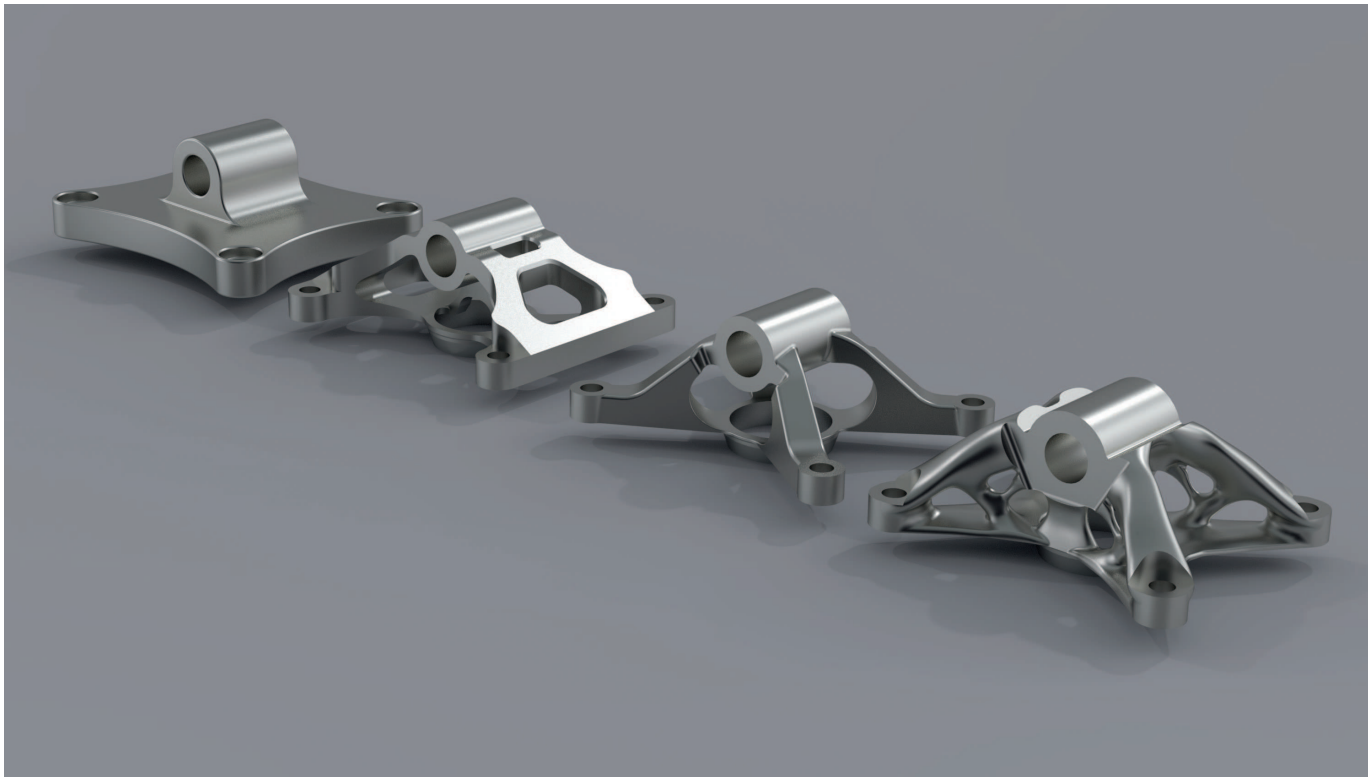
The concepts created are not simply meshes or point clouds, but real high quality solid models that can be directly refined and detailed without translation. The software then explores and learns from each concept, quickly iterating and evolving, in order to produce multiple and often previously unimaginable concepts. Traditional design processes are reversed as simulation and decision making move to the start of a design process. Creativity now emerges directly from the specification and uses constraints as design parameters.

Using Generative Design, manufacturing can now be considered at the start of the design process by quickly creating multiple organic variants for comparison and trade-off studies. By varying the inputs, such as weight reduction targets, load cases, constraints and manufacturing processes (molding, forging, machining and additive manufacturing) they can then compare and assess the resulting mass and other Key Performance Indicators to select the best concept. Design engineers can quickly optimize for a given manufacturing process, or compare and achieve the most suitable manufacturing method whether that is additive manufacturing or more traditional manufacturing processes.

NIAR (National Institute for Aviation Research) at Wichita State University (WSU) opened an innovation centre in order to use new technologies, such as parts produced using additive manufacturing for aeronautical industry applications. In 40 hours they were able to re-engineer a complete assembly and reduce weight by 15%.

The result is better, lighter products with the flexibility of not being bound by traditional manufacturing methods. If traditional manufacturing makes the most sense the software can then streamline and optimize the parts or assemblies for manufacture, all in one unified design environment.

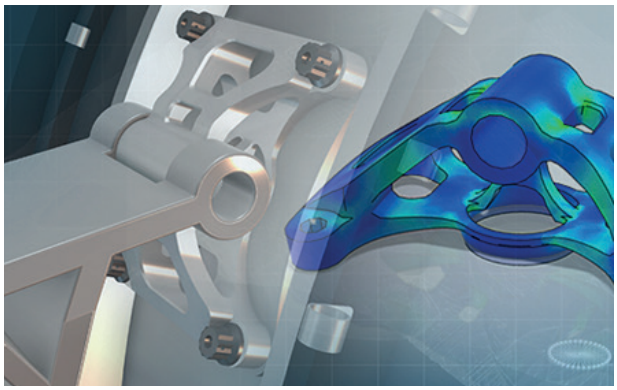
This augmented engineering approach can produce dramatic results as multiple organic variations are produced allowing design engineers to choose the best solution for their design goal.



NO GOING BACK—THIS IS THE FUTURE

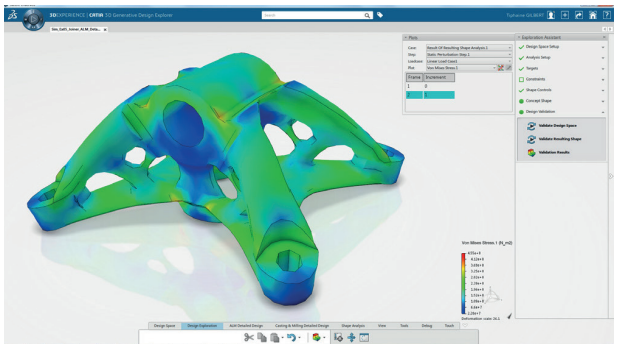
Generative Design has been suggested as the future of engineering. Unconstrained lightweight design means reducing weight, resources, time and ultimately cost. It addresses complex design challenges and delivers an entirely new perspective that stretches beyond what could have been imagined.

With the ability to explore thousands of design solutions, generative design is not limited to mechanical assemblies but brings transformational potential to every aspect of design.



AESTHETICS CHANGE FOREVER

The aesthetics of products will change. Generative Design technology empowers design engineers to innovate beyond the rigid straight edges and geometric curves of the past to create something very different: designs which are incredibly beautiful and entirely unique will **shape** the design revolution.



WORKFORCE OF THE FUTURE

This technology accelerates the way design engineers can meet the increasing demands of industry by improving quality, efficiency and performance across all departments by fitting into existing workflows. However, a change in mind-set is required in learning the necessary skills to embrace this new technology.

3DEXPERIENCE PLATFORM—SEAMLESS INTEGRATION AND NO WASTE

Using the **3DEXPERIENCE®** platform design engineers are able to seamlessly collaborate across all departments and disciplines in real-time across all phases of product development. Using one collaborative space saves time, secures intellectual property and empowers users to work smarter to realise design goals.

THE AUGMENTED ENGINEER

Historically, new technology transforms, replaces and eliminates certain roles and products. The irreplaceable component is the design engineer—the human element. A new generation of ultra-empowered engineers will emerge, strengthened and augmented by the power of technology. They will be the ambassadors of the future.

Are **you** ready for the revolution?

For more information visit www.3ds-designrevolution.com/aerospace-and-defense

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