



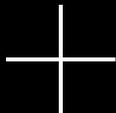
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DESIGN-TO-MANUFACTURING INNOVATION



# EXAMINING THE END NGERED

THE SUMATRAN RHINO'S ANATOMY EXPLORED WITH **PROTOLABS** AND 3D TECH



## MATERIALS

A look at the lifecycle of additive manufacturing powders

## PRODUCT DESIGN

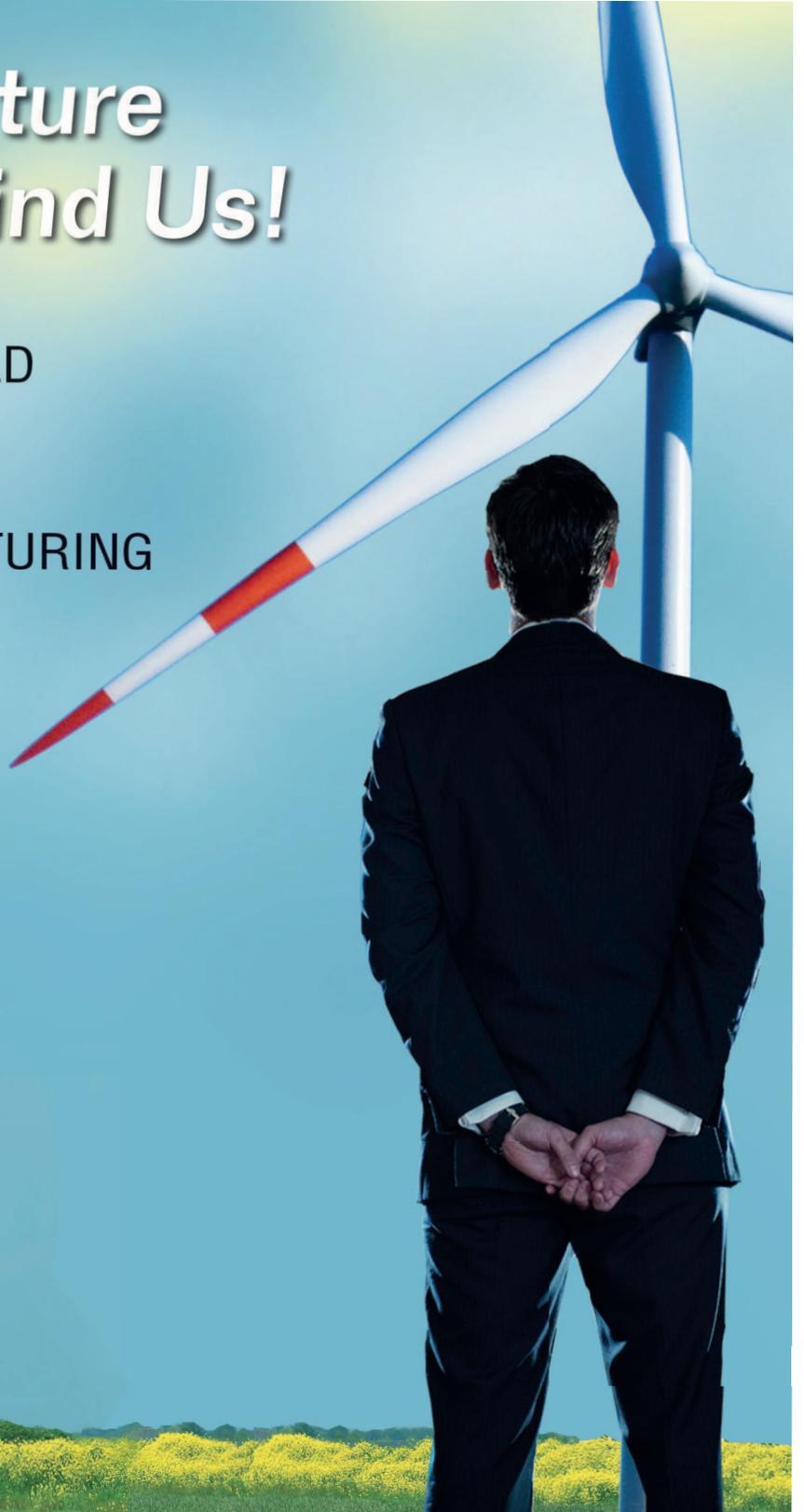
How 3D tech is speeding up consumer product design

## EDUCATION

How industry aims to plug the engineering skills gap

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# EDUCATION MAKES THE WORLD GO 'ROUND

**SAM DAVIES**  
ASSISTANT EDITOR



The art of manufacturing is thousands of years old and, in the last few hundred, we've come through a number of industrial revolutions.

Yet, talk to any business executive in the manufacturing sector today and they'll tell you there's a skills gap that needs to be combatted, that the size and condition of the talent pool doesn't reflect the industry's requirements.

Asking how a skills gap has happened - has been allowed to happen - is likely to invite a complex answer that cites a myriad of intertwining causes: economy, job opportunities, public service budgeting, etc. The solution, however, is more straightforward. And increasingly, private companies are taking the initiative.

In a word: education. In a sentence: nurturing the skills of apprentices, helping graduates apply their knowledge, appetising teenagers during work placements, and, more and more, appealing to schoolchildren. Among all the benefits additive manufacturing offers to industry, perhaps being able to plug in a desktop machine in a classroom and engage children in an engineering tutorial is up there with the lot.

GE Additive, this academic year, will provide its one-millionth K-12 pupil with access to 3D printing since 2017. At TCT Show this month, schoolchildren will get a taste of the technology through the Inspired Minds programme with support from Ultimaker, Autodesk, HP and Rolls-Royce. And in our education feature this issue, there's more.

Renishaw (p39) is installing 3D printers in classrooms similar to GE, but is also installing classrooms in factories where with every imparting of knowledge comes a link to a real-world job. Similar problem-centred learning happens further up the education ladder, like at Virginia Commonwealth University (p43), who have partnered with MakerBot to enable students to harness 3D printing technology across its engineering, medicine and dental departments. We also spotlight Carbon's learner-centred approach (p45) this summer as they hosted a Kode With Klossy boot camp where the message to the girls was one of positivity and support and the message to the industry was that these girls need more opportunities. Circling back, Renishaw is also committed to encouraging females into the sector and is looking to nip misconceptions around engineering in the bud.

As good as all these programmes are, showcasing how children can channel creativity to solve real-world problems and planting that seed when they're at their most impressionable, alone they won't be enough.

The call for more education programmes on a conference stage, at a trade show or in the pages of a magazine might feel about as new as the manufacturing trade itself, but that makes them no less imperative. As it falls to industry to take the initiative, there should be plenty of inspiration in this issue.



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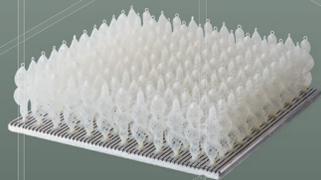
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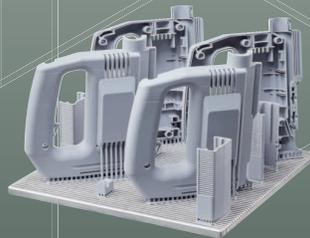
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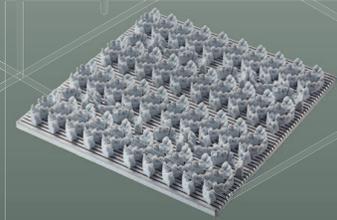
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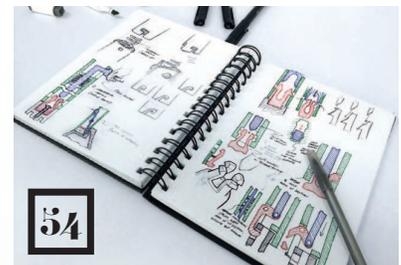
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# EXAMINING THE ENDANGERED

## 3D PRINTING: A CREATIVE RESOURCE FOR CULTURAL ADVANCEMENT AND SCIENTIFIC UNDERSTANDING

**R**ight now is an exciting time to be in manufacturing; it is an industry that is rich with change. Of course, industrial innovation is a constant, but the technological progress we're seeing at the moment is the most significant in decades. Not only are we moving towards the 'smart factory' model where integrated manufacturing systems operate according to customer demand; we're also seeing major developments in specific manufacturing processes. And nowhere are these developments more revolutionary than in 3D printing.

It's interesting to note that as 3D printing evolves, the adventures at the cutting edge of this world are sometimes in the pursuit of cultural advancement or scientific understanding. For example, the creation of high fashion garments, the realisation of art installations, the understanding of ancient civilisations. These kinds of projects are increasingly aligning with digital manufacturing, where we often witness a perfect symbiosis of engineering and culture or the natural world.

This synergy is very well illustrated in the recent collaboration between digital manufacturer Protolabs, industrial tomographer Yxlon, and Hamburg University's Natural History Centre (CeNak). Through their collaborative

project, industrial imaging techniques and 3D printing allowed a near extinct species of rhinoceros to be closely researched without interference, offering new information about their living conditions.

### 3D PRINTING TO PROVIDE RESEARCHERS WITH NEW INSIGHT

The relics of extinct animals, and the examples of those near extinction, allow us to conclude very little about their actual living conditions with any certainty and it is difficult to name hard facts based on purely superficial analysis. Climate change, the disappearance of habitats, not to mention poaching by humans mean that more and more species of our present wildlife are threatened by extinction or have already disappeared from the face of the earth. As a consequence, CeNak is engaged in research into biodiversity and evolution, using state-of-the-art X-ray technology and 3D printing. Detailed analysis, using computer tomography and high-resolution 3D printed models, offer up a range of completely new opportunities for basic scientific research.

### DIGITISING THE SUMATRAN RHINOCEROS

CeNak's recent exhibition, entitled "Vanishing Legacies: The World as a Forest", aimed to draw attention to the plight of the Sumatran rhinoceros. It is estimated that there are only 100 animals of the species still alive and CeNak has owned a skull of one since the 1920s.

Prof. Thomas Kaiser, Head of Mammalogy and Palaeoanthropology at CeNak used the exhibition as an opportunity to look for partners capable of making a more detailed study of the





3D printed by Protolabs  
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 PROTOLABS 3D PRINTED  
 SUMATRAN SKULL ON DISPLAY

skull. The expert's choice was Yxlon International, a specialist company focusing on industrial radiography and computed tomography. The goal was to create a 3D scan and print of the skull, for the purpose on the one hand to draw attention to the near extinction of this critically endangered species at the exhibition, and on the other hand to be used for scientific investigation into the mammal.

At Yxlon, normally more at home with castings, engines and electronics, this extremely challenging task featured among the rapidly growing demand for applications in the natural sciences. In previous scans, Yxlon had only studied small animals such as frogs, snakes, fossils or individual animal organs; the skull of the Sumatran rhinoceros, which was many times larger, therefore posed a remarkable challenge. "Ultimately, for specimens as big as this, we need to use an appropriately large system and special recording techniques to obtain

the maximum possible resolution," explained Dr. André Beerlink and Philip Sperling, Sales Manager Science & New Materials at Yxlon. In the end, it was decided to use the YXLON FF85 CT system with the dual helix technique, in which the skull was rotated several times during the scanning process in order to image it completely and obtain good resolution. As a result, it was possible to achieve the goal of the team of scientists working with Prof. Kaiser of obtaining the most realistic and high-resolution digital 3D volume to simulate biomechanical behaviour.

## ACCURACY AND DETAIL

After the tomography and some post-editing of the raw data and scan files, the experts at Yxlon turned to Protolabs to replicate the skull through a highly detailed 3D print. Using Protolabs' stereolithography service, a high accuracy, finely detailed replica was printed in Accura Xtreme White 200 material.

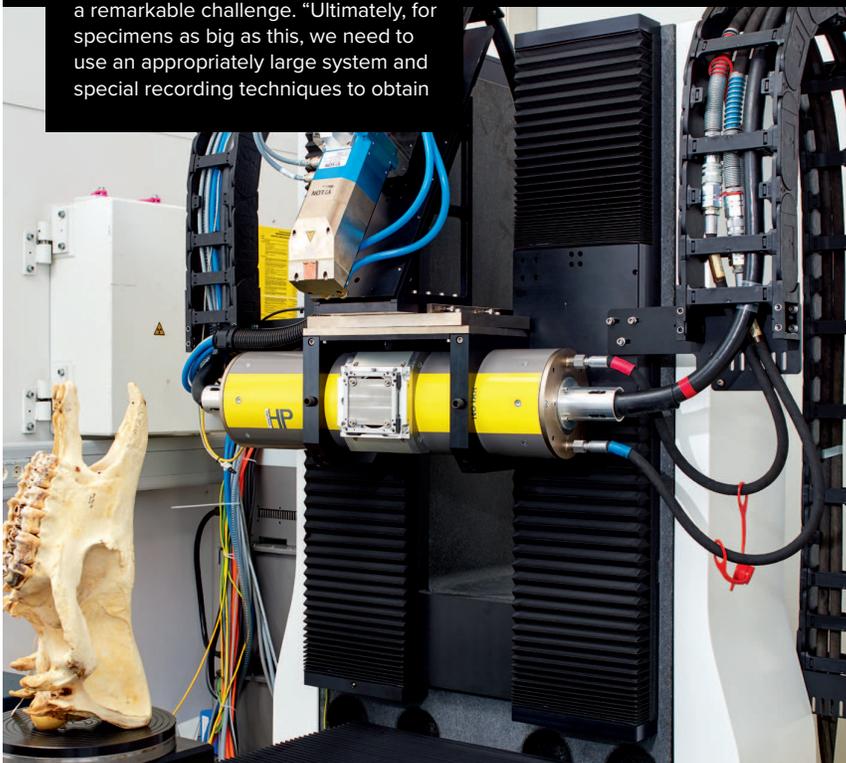
Thanks to the computed tomography scan and the 3D printed replica, it was possible to detect and record the finest structures, inside and outside the skull. The researchers at CeNak were furnished with a wealth of new information which had remained hidden during previous research. New insights into the bone structure plus the biomechanical positions of the jaw parts in relation to each other immediately enabled the scientists to gather new evidence regarding the animal's diet and way of life which were hitherto unknown.

Daniel Cohn, Managing Director of Protolabs Germany, commented: "Even if reproducing the replica presents a special challenge, all the effort is worth it for such a faithful 3D print. We are proud to provide a great service to science with our replica and also to contribute to the protection of the species."

## A CREATIVE RESOURCE

The example of the Sumatran rhinoceros has shown that 3D scanning and 3D printing can be used to create deceptively real replicas of rare fossils and bones that are invaluable for research and teaching. Modern technologies can be used to make assumptions about the way animals live and behave and, at the same time, they can create exemplary research objects for tests and further research into living creatures that are endangered or have long since ceased to inhabit our earth.

The success of this project, like many others that push the boundaries of scientific understanding, was down to the collaborative approach between Protolabs, Yxlon and CeNak, but more so down to the revolutionary developments we're seeing in 3D scanning and 3D printing. Additive manufacturing technologies should not be reserved for the purely industrial landscape, but should also be used as a creative resource to push the boundaries in cultural and scientific contexts.

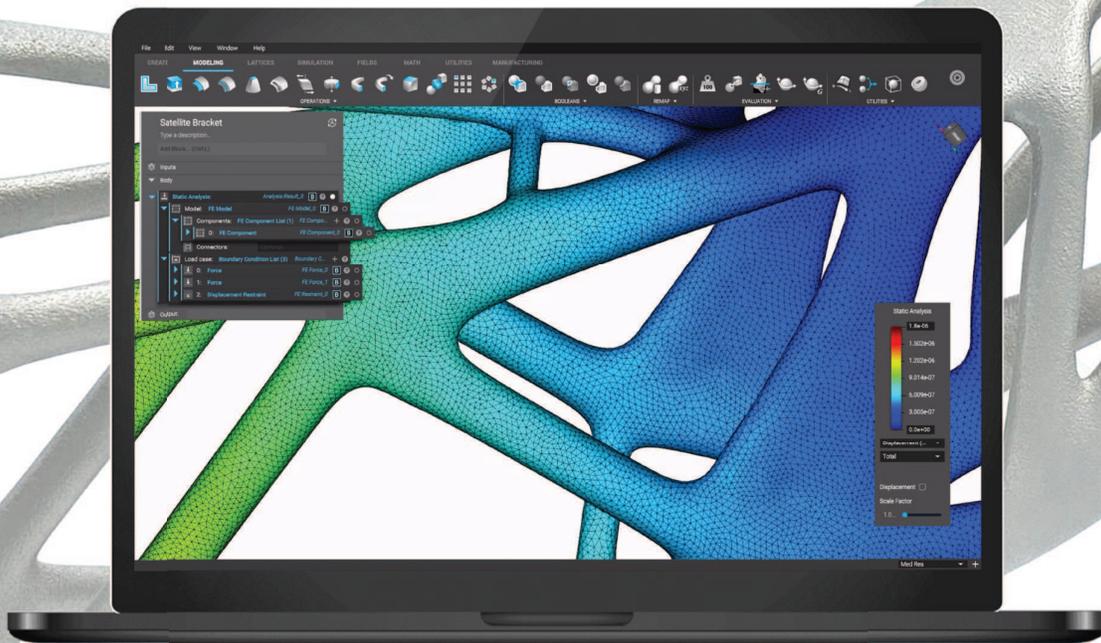


◀ **FAR LEFT:**  
 A RARE SUMATRAN RHINO SKULL

◀ **LEFT:**  
 SUMATRAN UPPER JAW DURING  
 SCANNING

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