

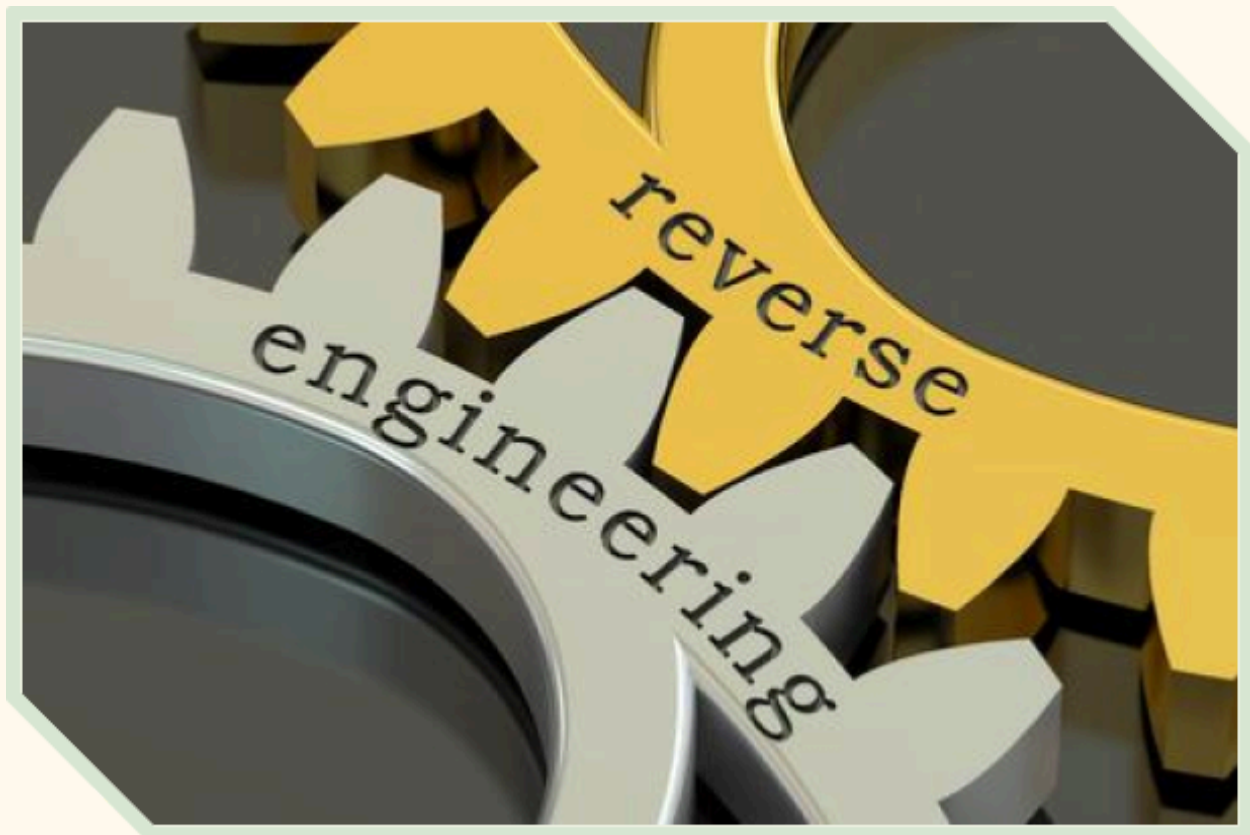
White Paper

Reverse Engineering

Services: Unveiling the Inner

Workings

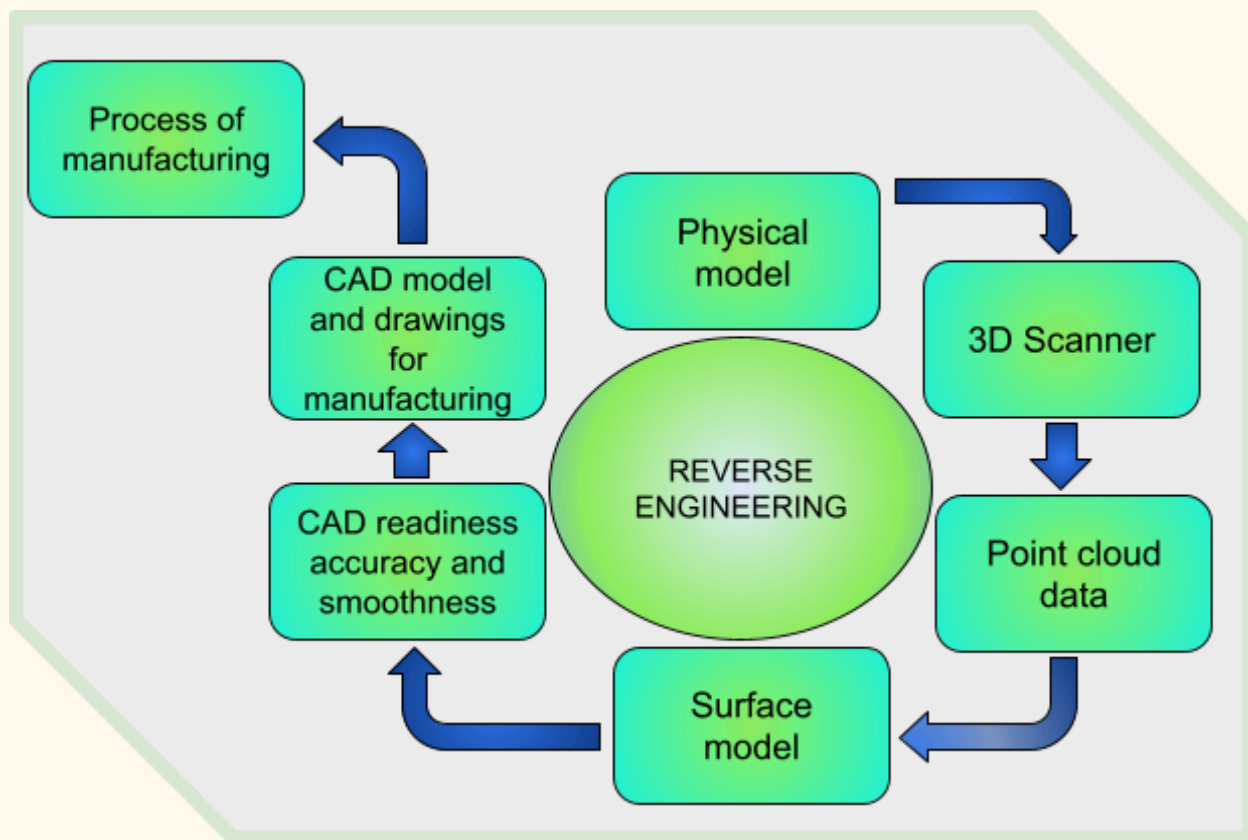
By [NewAgeRobots](#)



INTRODUCTION

In today's dynamic world, innovation is key. But what if the inner workings of a groundbreaking product remain a mystery? Reverse engineering services provide the answer. This white paper explores the process of deconstructing a product to understand its design, functionality, and composition.

We'll delve into the various methods, technologies, and tools employed to unlock the secrets behind existing creations.



Types of Reverse Engineering Methods

Physical Analysis: This method involves dismantling a product to study its components, materials, and assembly techniques.

Software Disassembly: This approach focuses on decompiling software code to understand its functionality and underlying logic.

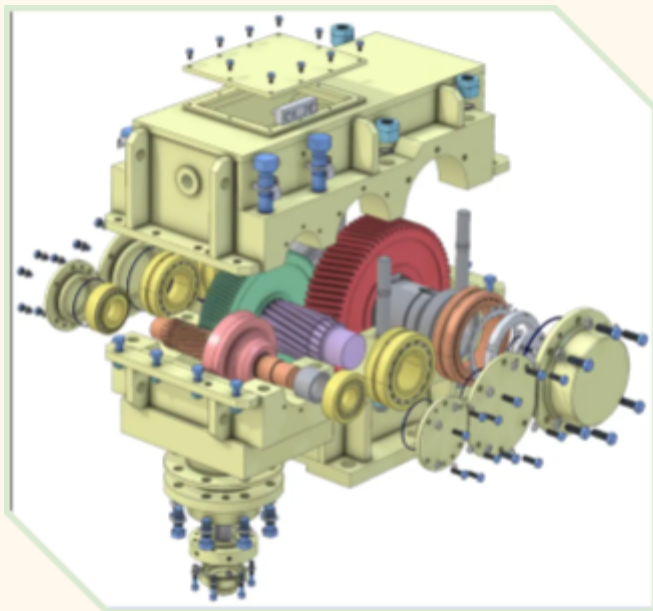
Functional Analysis: Here, the product's behavior and performance are evaluated to infer its design principles.

3D Scanning: This technology creates a digital model of the physical object, enabling further analysis and manipulation.

Prototyping: We also validate 3d scanned or model data by prototyping using 3d printing and other modeling methods.

Technologies Used in Reverse Engineering Services

Computer-Aided Design (CAD):



A way to digitally create 2D drawings and 3D models of real-world products before they're ever manufactured. Our high end modeling softwares allows for reconstruction and modification of the reverse-engineered design.

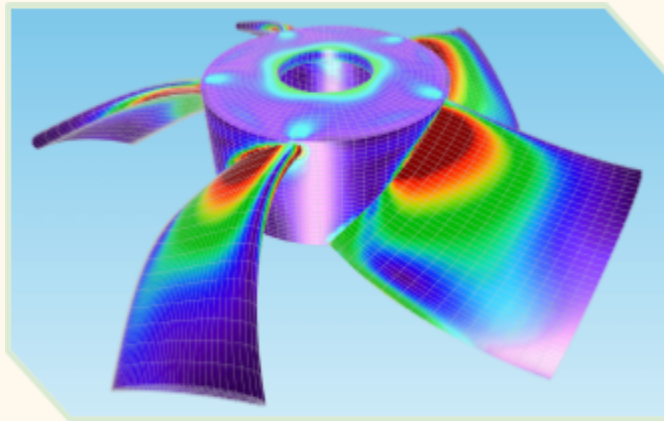
Computer-Aided Manufacturing (CAM):

This technology translates the digital model into instructions for fabrication of new parts or products.

"the use of computer systems to plan, manage, and control the operations of a manufacturing plant through either direct or indirect computer interface with the plant's production resources".



Finite Element Analysis (FEA):

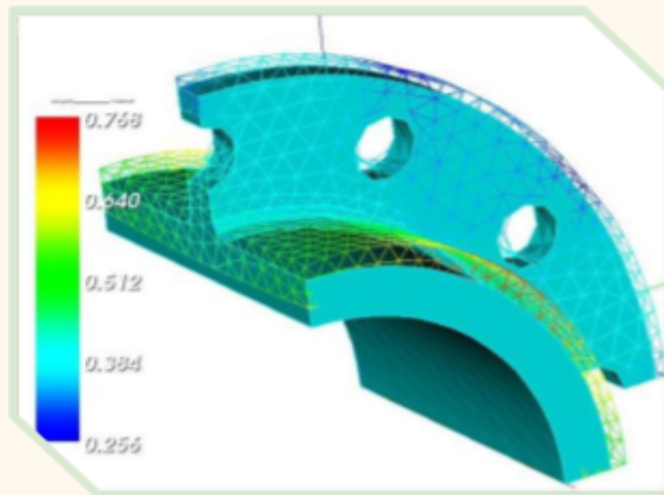


FEA software simulates the physical behavior of the product, aiding in design optimization.

A mathematical technique for analyzing stress, which breaks down a physical structure into substructures called "finite elements." The finite elements and their interrelationships are converted into equation form and solved mathematically.

Computer-Aided Engineering (CAE):

Computer-aided engineering (CAE) is the general usage of technology to aid in tasks related to engineering analysis. Any use of technology to solve or assist engineering issues. consistent improvement in computer graphics and speed, computer aid assists engineers with once complicated and time consuming tasks with the input of information and a press of a button.



Tools and Machines Employed in Reverse Engineering

3D Scanners:

These devices capture the physical dimensions of an object to create a digital model.

3D scanning creates an accurate digital replica of the object in question, and due to the model's accuracy and precision, engineers would find it convenient to recover the materials and ingredients, as well as the measurement of each compound, in order to further study or develop it, or in some cases, to reproduce it.



Disassembly Tools:



Specialized tools are used to safely dismantle a product without damaging its components. Like screwdrivers, pliers, allen keys set, wrench and hammers, spanners etc..

Coordinate-measuring machine (CMM):



CMM is a device that measures the geometry of physical objects by sensing discrete points on the surface of the object with a probe.

CMMs are an integral part of reverse engineering processes where manufacturing or production pieces are being deconstructed. These machines measure the physical geometrical characteristics of the object. They obtain point cloud data through CMM scanning

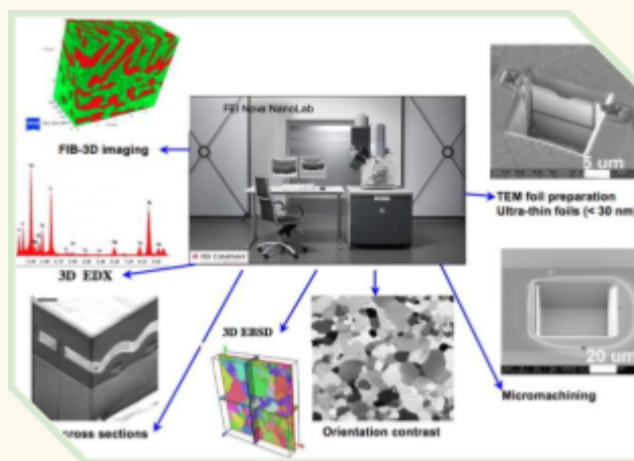
and export the data to the modeling software. A CMM helps obtain any unknown details on the component and intricately measure its surfaces which are unmeasurable by any other method.

Microscopy Equipment:

High-powered microscopes allow for detailed examination of materials and manufacturing techniques.

Scanning Electron Microscope (**SEM**): Unveils a sample's surface in high-resolution detail, revealing its morphology and composition. This allows engineers to understand the external features and material properties of a component.

Transmission Electron Microscope (**TEM**): Peers deep inside a sample, offering a view of its internal structure at the atomic level. This is crucial for analyzing the intricate arrangements of atoms within the material.



Focused Ion Beam (FIB): Acts like a super-precise milling tool, meticulously removing material from a sample to expose specific layers. These exposed layers can then be examined in detail using SEM or TEM for further analysis.

By combining the capabilities of these microscopy tools, reverse engineering experts can gain a comprehensive understanding of a product's design and functionality, down to the tiniest atomic details.

Electronic Debuggers:



We use these tools to help analyze the behavior of software and hardware systems.

Electronic debuggers are powerful tools in reverse engineering, allowing us to inspect a program's internal state and behavior line-by-line during execution, aiding in understanding its functionality.

Solutions Offered by Reverse Engineering Services

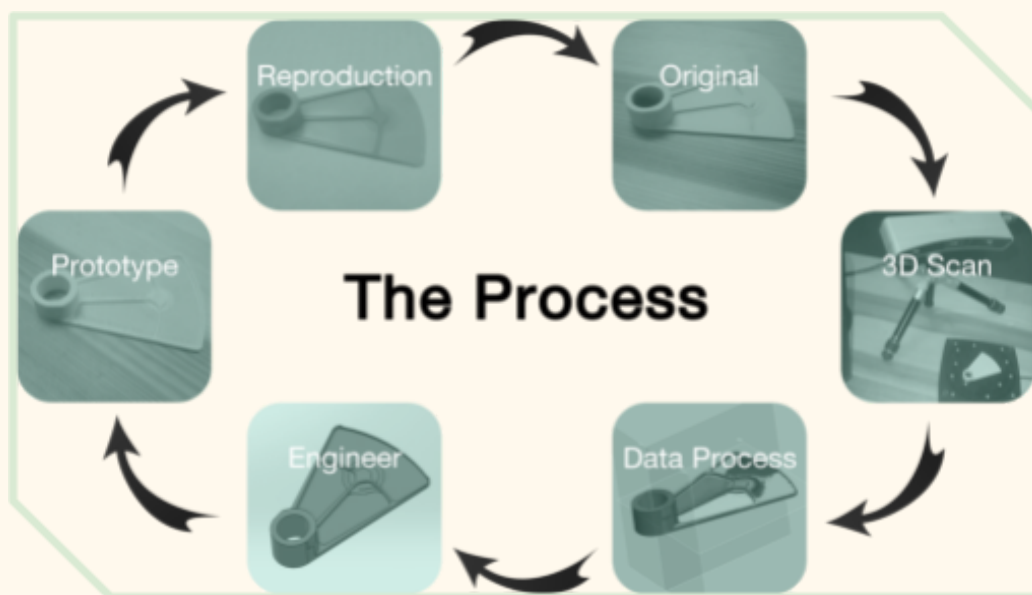
Product Innovation: By understanding a competitor's product, companies can develop improved designs with enhanced features.

Replacement Part Creation: Reverse engineering enables the creation of replacement parts for discontinued or hard-to-find products.

Quality Control & Improvement: Analyzing competitor products can reveal potential weaknesses and guide quality improvement efforts.

Interoperability Development: Reverse engineering facilitates the creation of compatible components that work with existing systems.

How Reverse Engineering Works (The Process)



Product Acquisition: The product chosen for reverse engineering is obtained legally and ethically.

Data Acquisition: Physical analysis, 3D scanning, or software disassembly techniques are employed to gather data.

Analysis & Interpretation: The acquired data is meticulously analyzed to understand the product's design principles, materials, and functionalities.

Documentation & Reporting: A comprehensive report is generated, detailing the findings of the reverse engineering process.

(Optional) Design & Development: The extracted knowledge can be used to develop new products, improve existing ones, or create replacement parts.

Advantages and Disadvantages

Advantages:

Innovation & Problem-Solving: Unlocks valuable insights for product development and improvement.

Cost Reduction: Enables the creation of cost-effective alternatives or replacement parts.

Quality Enhancement: Provides a benchmark for evaluating and improving existing products.

Knowledge Acquisition: Offers valuable insights into competitor's design strategies and manufacturing processes.



Disadvantages:

Ethical Considerations: Copyright and intellectual property laws must be strictly adhered to.

Complexity & Time Consumption: The process can be intricate and time-consuming, depending on the product's complexity.

Limited Scope: Reverse engineering may not reveal all aspects of the product's design or functionality.

Case study and examples:

We have done hundreds of reverse engineering projects, some of them are domestic products and some are overseas projects with global clients.

Recently we have provided reverse engineering for the numerous robots like

1. Barn cleaner robot

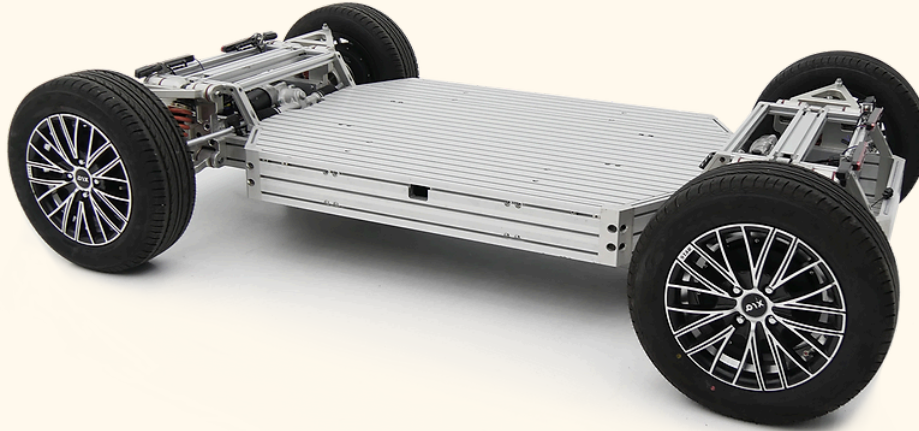


The barn cleaner is specifically designed for barns with solid floors and takes a revolutionary diverse approach when compared to traditional manure scrapers. The Collector does not push manure, but vacuums it. This makes the build-up of manure – in which cows stand – a thing of the past. This not only makes for a cleaner floor, it also ensures the cows' hooves remain cleaner. This improves both cow health and the well-being of the animals.

The cows will experience little to no hindrance from the cleaner. The machine does not require cables or gutters. This ensures a more secure living environment for the cows. Thanks to its compact design the robot can easily navigate in between the cows, , the sorting gates and around the cubicle passages and waiting area.

So this is all basic application and working of the barn cleaner, some of the cleaners also have the features like mobile application for various real time data like location and its fluid levels etc.

2. Self driving skateboard chassis



Overview

Autonomous Chassis is a Skateboard Modular type Chassis which can be used for passenger and other wide variety of applications.

Chassis goes itself with the help of drive by wire technology with autonomous driving algorithms. From a starting point to a predetermined destination in “autopilot” mode using various in-vehicle technologies and sensors. It is modular in construction and can be used for a wide variety of applications such as passenger cars, food trucks, office space and many more.

The idea is based on designing a high-performance drive-by-wire chassis platform. A future chassis concept whose parameters are determined based on the purpose of the vehicle and area of usage.

Mechanical Design Considerations

Before initiating the design process one must need to understand the components used in a car, current automobile mechanisms and technologies as well.

Mechanisms used in a vehicle are as follows and each mechanism contains a number of components.

So here we first start with the list of mechanisms used for a vehicle which is as follows.

Base structure (chassis)

Steering mechanism (ackerman steering principle)

Suspensions

Knuckles

Wheels

Braking system

Driving engine/motors

Door auto mechanism

So before starting the design process ,we needed to understand all these mechanisms and



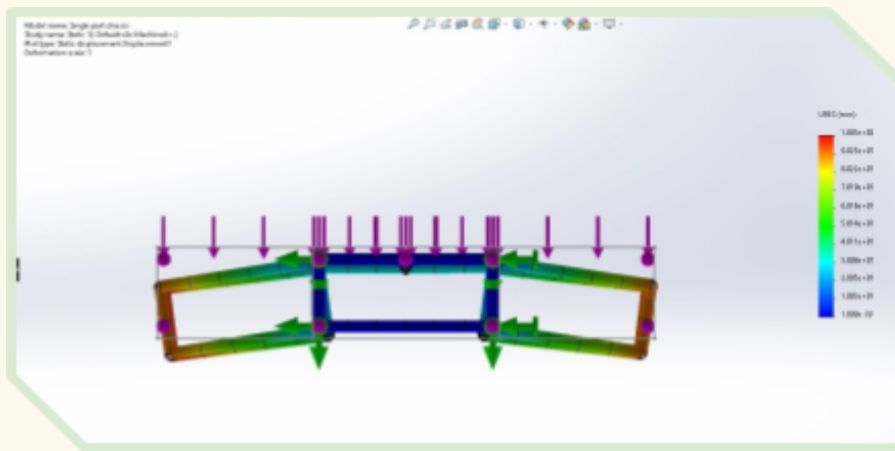
its components and availability of each component for prototyping. Because if the design process is done and we don't have market availability of any of that product, then the whole design should be changed as per product availability of the market.

Now while working with aluminum material and for this kind of rigid application, we must implement some structure analysis and design studies to verify the structure's correctness.

So we used an 80 x 40 mm extrusion profile with 6061 grade and made a structure with all design constraints. Also studies applied with all forces and fixtures applied. As per seating capacity of 6 people and considering other payload, design simulation with 1000 kg force is carried out.

Static & dynamic simulations

While designing the structure we chose 80 x 40 medium series and considering the fixture and applied on the structure we got factor of safety = 1. Which is normal and can go ahead with these. But in the stress analysis ,strain distribution data and graph, we saw some weakness in structure which is not appropriate.



This is the result of a displacement graph study with 2 ton load where we get displacement of a particular structure member by 10 mm. Both sides of structure and deformation are not good for any part.

Resultant forces are excessive than the structure's capacity. So more optimisation needed in design structure and heavy series is preferable.

So After understanding all mechanisms and working of each Component , we also needed to understand the topology of each and every component. Because we are not going to buy all components of the vehicle.

Some of the components should be customized as per our requirement so before designing we needed to understand the topology of a particular component and we also needed to consider various materials of it and need to Go through various design studies and simulations of each component, with different materials and find suitable material for each component.

Suspension system



Car's suspension system is a protective lattice of shock-absorbing components such as springs and dampers. Car's suspension helps ensure that your drive is safe and smooth by absorbing the energy from various road bumps and other kinetic impacts.

Basically the suspension system on vehicles is between frame and road.

Need of suspension system in vehicle

Supports weight

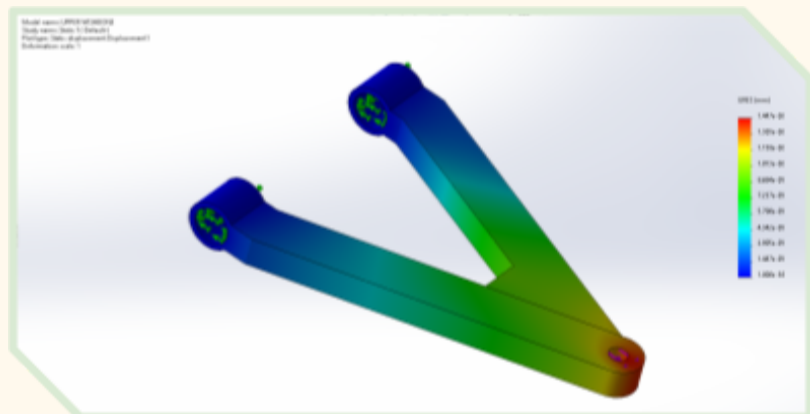
Provides a smooth ride

Allows rapid cornering with extreme body roll.

Keeps tyres in firm contact with the road

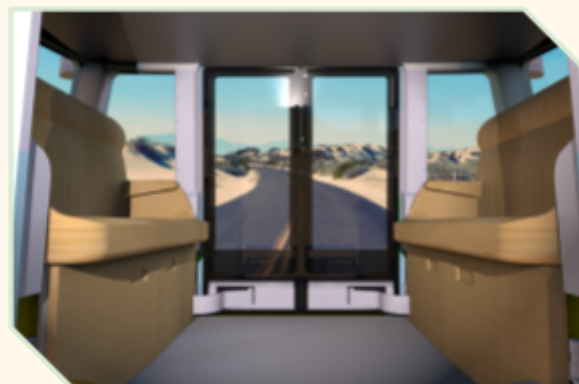
Works with steering system to keep the wheels in correct alignment

Isolates passengers and cargo from vibrations and shocks.



Product Design

Our team works on various cad softwares like, solidworks, catia, autocad 2D-3D and creo. Here are some products we have designed in respective softwares and rendered in keyshot and photoview 360.



So from reverse engineering [NewAgeRobots](#) are expert in,

Market study

Design study

3d modeling

FEA

static / dynamic simulation of parts for longer life

Rendering and product design

Manufacturing drawings and reports

Conclusion

Reverse engineering services offer a powerful tool for unlocking the secrets behind existing products. By leveraging this process, companies can gain valuable insights to drive innovation, optimize designs, and create cost-effective solutions. However, it's crucial to ensure ethical and legal compliance throughout the process. By understanding the methods, technologies, and applications of reverse engineering, businesses can unlock a world of possibilities for product development and improvement.