



# REMANUFACTURING – A NECESSARY DRIVER FOR SUSTAINABILITY

## Contents

The world is quickly running out of resources.....	2
What is Remanufacturing?.....	2
Differences between Manufacturing and Re-Manufacturing.....	3
The Future of Remanufacturing.....	5



## Increasing demand for sustainability is just another important reason to start remanufacturing

### The world is quickly running out of resources

“Manufacturing productivity has increased by more than 300 percent over the past half century.”

Sustainability has become the number one topic across Boardrooms in recent years and rightly so – given the alarming effect our activities are having on the environment.

While it is apparent that alternative and renewable resources and energy are

needed as population and industry grow, there is another preventive step toward sustainability whose benefits are currently outweighing the recognition it has received: **remanufacturing**.

Remanufacturing is a key element of the Circular Economy – wherein the products can be repaired, renovated, reconditioned, or remanufactured.

In the manufacturing industry, material costs can reach more than 40% - often the largest cost factor in the company.

Remanufacturing makes it possible to save material and energy expenses:

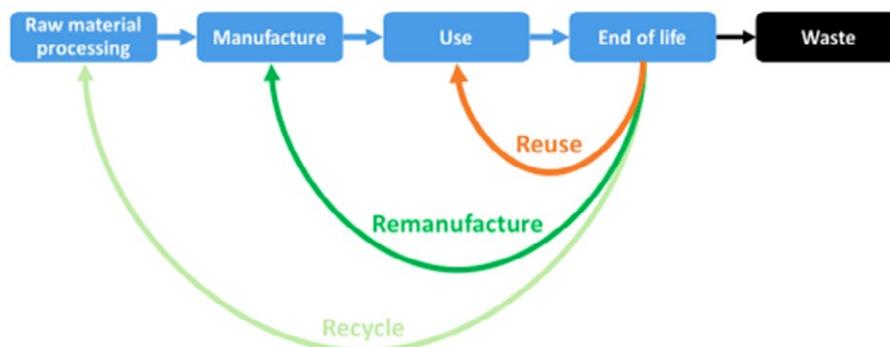
- Remanufactured products help achieve up to nearly 90% reduction in emissions and materials
- Remanufactured products use 56% less energy compared to equivalent newly manufactured products
- Some Remanufactured products can be offered at approximately 40-80% of the acquisition price for an equivalent new product

### What is Remanufacturing?

“The energy requirement for new manufacturing using recycled raw material being as much as 6 times as much for Remanufacturing.”

Remanufacturing is a well-defined industrial process, the most rigorous and structured of all value regeneration processes. The industrial process consists of restoring a worn-out component or product (broken, at end-of-life, obsolete or waste), to a product with equal -or even higher- performances to its original state. Commonly referred to as “reman” it is a truly closed-loop industrial process that intentionally recaptures the value-added component of a product so that it may lead an additional useful life rather than being landfilled or recycled.

Remanufacturing is also known as the **backbone of the circular economy**.



## Differences between Manufacturing and Re-Manufacturing

“A remanufactured car engine, which performs as well as or better than a new one, can cost 30-53% less than installing a completely new engine.”

Parameters	Manufacturing	Remanufacturing
 Basic life cycle stages	Design, sourcing materials, production, assembly, quality control	Disassembly, sorting, inspection, cleaning, refurbishment, reassembly, quality control
 Patterns in input	Known quality and quantity	Uncertain quality and quantity
 Process time	fixed	Highly variable
 Production volume	high volume/low volume	Often low volume
 Patterns in output	Know quantity and quality	Know quantity and quality
 Inventory cost	Often low cost	High cost
 Inventory planning approach	Market driven approach	Waste stream and market driven approaches
 Man-machine production	Machine driven	Labor intensive
 industrial pollution	High pollution	Less pollution
 investment	High investment	Less investment
 Economy model	Linear	Circular
 Production scale, size	Small scale	Larger scale

Source: [https://www.researchgate.net/publication/301346190\\_The\\_evolution\\_and\\_future\\_of\\_manufacturing\\_A\\_review](https://www.researchgate.net/publication/301346190_The_evolution_and_future_of_manufacturing_A_review)

Controlling solid wastes is one of the main intentions of Sustainability. This can be done through Reducing, Reusing and Recycling. Remanufacturing and Recycling are generally confused or used interchangeably, but there is a stark difference between the two processes. Remanufacturing is a process in which used products are disassembled, cleaned, repaired, or refurbished, reassembled, and qualified for new or like-new equipment's. Recycling reduces products into raw material to be reused for

the new products being manufactured from the scratch.

There is a difference in the environmental impact created by Remanufacturing and Recycling also. Though the intent of both the processes is to reduce solid and hazardous wastes, remanufacturing clearly stands out because of the reduction in energy use, greenhouse gases and air/water emissions.

The differences are mainly due to the additional handling and transportation

required for reintroducing recycled materials into the manufacturing process.

Thanks to remanufacturing, industrial sectors that rely on high-value assets like these can dramatically extend the useful life of their vehicles, machinery, other heavy-duty equipment, and even some electronic components. This results in significant cost savings for both businesses and daily consumers.

### Many large discrete manufactures have pioneered and emphasized on remanufacturing:

- **Caterpillar**

- Started their remanufacturing journey as early as in 1973. Have been able to increase profit margin while not compromising on producing high quality components.
- The design consideration is to create a product which can be remanufactured multiple times rather than to use less material.
- One of the most well-known examples involves an engine block with a removable sleeve in the cylinder bore. When the component is recovered, this material can be removed and replaced to return the engine as-new performance.

- **Daimler**

- Factory in China to focus specifically on remanufacturing equipped with state-of-the-art production lines only to remanufacture engines and transmissions.

- ❑ Currently, around 20,000 parts are remanufactured. These parts include engine, transmission, clutch, propeller shaft, moving parts (eg: starters) and electronic components (eg: engine control units).
- ❑ The independent testing organization TÜV Süd measured and published a lifecycle assessment study:

For example, the remanufacturing of a **single remanufactured G281 truck transmission saves 445 kg of carbon dioxide and 7300 megajoules of energy compared with production of a new unit. In other words: eleven trees would take ten years to convert the CO2 saved by remanufacturing.**

- **ABB**

- ❑ Adopts Sustainable Manufacturing by using recycling and remanufacturing in their global remanufacturing and repair center for robots.
- ❑ “Remanufacturing enables existing robot users to sell inactive or legacy robots to ABB with an attractive buyback service, rather than scrapping them or leaving them unused. Over the last 25 years, thousands of robots have been refurbished and upgraded by ABB’s remanufactured robot teams, to give them a second life.” as quoted from ABB website.

- **GKN Automotive**

- ❑ Remanufacturing enables saving at least 1,600 tons of steel per year by re-using 80% of the steel from cores collected.
- ❑ Remanufacturing of driveshafts saves raw material and protects the environment.

- **GE Healthcare**

- ❑ Introduced GoldSeal™ brand for refurbished systems.
- ❑ Cost effective imaging and ultrasound solutions are provided through this Program backed up by comprehensive warranty and field service team from GE Healthcare.

- **Cisco**

- ❑ Runs a program called Cisco Refresh in which they offer remanufactured products at extremely competitive, pre-discounted net-prices.





## Challenges in Remanufacturing:

The product life cycle and product characteristics of remanufactured products lead to the challenges faced by remanufacturing company.

### 1. Collection

The number of sources increases the complexities of collection. Uncertainties in the supply of used products and demand of remanufactured products causes an imbalance in the supply – demand. When this supply-demand problems are being handled the companies land up in inventory management issues and control functions. Some of the other issues include storage and disposal costs, consideration of quality, quantity, and timing of returns as well as variability in processing times.

### 2. Remanufacturing process

The remanufacturing process is approximately 3-5 times more labor intensive than manufacturing of the same product. There are two different reasons for this. First, the activities disassembly, cleaning, inspection, and sorting are not present in manufacturing. Second, the batch sizes are much smaller, and the degree of automation is lower than in manufacturing.

### 3. Redistribution

The complexity in the redistribution is that they use diverse product offerings and strategies to serve several small niche markets. Inadequate standards for product recovery, rapid changes in product technology, lack of assessment tools to identify re-manufacturability of used items, and unwillingness of consumers to purchase refurbished items are barriers to appropriate end-of-use product remanufacturing. This means that finding a market for remanufactured products can be very hard.

Presently, an updated record reflecting the status of a product is not available to the remanufacturing personnel. Future generations of intelligent products, having features such as extended data sensing, communication, and processing and in some cases decision-making capabilities, provide new opportunities for the remanufacturing industry. In the future, research should focus on how to use the data collected from the previous life cycles of product enables making efficient decisions about future lifecycles.

## The Future of Remanufacturing

The existing remanufacturing industry is strong, but it has a plethora of opportunities to grow. Remanufacturing holds approximately 2% of all manufacturing in the U.S. and even lesser, about 1.9% in the European Union. The small market capture reflects the complexity of the industry. But the positive side is that both policymakers and investors are exploring sustainable manufacturing methods to advance what is known as [the circular economy](#), they are increasingly turning to remanufacturing. In doing so, advances within remanufacturing are happening like never before in its 80-year history.

Recycling has become almost a way of life, continuing to gain momentum through legislative and public awareness efforts. We can see the focus on reusing in other industries especially the apparel industry. In context of Recycling, Forrester says - "It's even growing faster than e-commerce". Lot of companies such as Lululemon, ThredUp, Levis, Madewell and Patagonia are actively pursuing their own resale and buyback programs.

However, in Manufacturing the major share of impact is limited to simpler items such

as beverage containers, steel products, and paper goods. This is because recycling a more complex product, like an automobile or industrial machinery, results in a loss of up to 95 percent of the value-added content. [Remanufacturing, by contrast to this loss of value is considered as the ultimate form of recycling.](#) Not only is the raw material content conserved, but there is also added benefit in value from the processes required to manufacture new products. This represents the [largest untapped opportunity for improving productivity in manufacturing industry.](#)

The main problem is that remanufacturing mostly comes into consideration in the post-sale phase. There is less awareness of the fact that it would immensely contribute during the design and production of new products. Changes in legislation and economic incentives will lead to increase in awareness and hence, the enormous potential can be tapped!

The ["right to repair"](#) for the customer is starting to enter legislation. In 2021, U.S. President Joe Biden ordered the Federal Trade Commission to create national right to repair regulations. This is also gathering momentum in the European Union and other parts of the world.

Recently, Apple expanded to multiple countries a free and independent repair provider program for its out-of-warranty products.

In the automotive sector, the World Economic Forum's WEF is working on the Circular Cars Initiative. The Circular Cars Initiative is a partnership between stakeholders from the automobile ecosystem (e.g., industry, policymakers, and fleet purchasers) to eliminate or minimize total lifecycle emissions with a special emphasis on manufacturing emissions. This initiative which has started with EU policy, includes expansion plan to China and U.S. in 2022.

[By 2030 EU remanufacturing could attain an annual value of ~€70bn and ~€100bn with the associated employment of ~450,000 and almost 600,000 respectively.](#)

Remanufacturing is a strategic industrial way to recollect lost value, create jobs, reduce waste, and potentially change the customer manufacturer relationship.

Undoubtedly, Remanufacturing will become the future trend in manufacturing industry providing businesses a choice to buy less expensive, environment friendly remanufactured equipment!!!



## About the author



**Sandeep Karyotakalam** Associate Vice President, Infosys

Sandeep helps Industrial Manufacturers and Automotive OEMs to navigate their 'Digital' next with his 25+ years of experience in the industry. He is based in Europe and works with marquee customers of Infosys on their Digital Transformation journeys. He is very passionate about sustainability and is also a practitioner of the same in his personal life.

## Contributors



**Aarthi Krishnamachari** Senior Client Solution Manager, Manufacturing Value Design, Infosys



**Madhuri Prasuna A** Client Solution Manager, Manufacturing Value Design, Infosys

## References

- Remanufacturing and the Circular Economy -<https://emf.thirdlight.com/link/mnxp9x4dat3w-h9yiw4/@/preview/1?o>
- <https://ellenmacarthurfoundation.org/circular-examples/design-and-business-model-considerations-for-heavy-machinery-remanufacturing>
- Product Design for Automated Remanufacturing—A Case Study of Electric and Electronic Equipment in Sweden <https://www.mdpi.com/2071-1050/13/16/9039/pdf>
- <https://www.rit.edu/sustainabilityinstitute/blog/what-remanufacturing>
- <https://www.remanufacturing.fr/en/pages/basics-remanufacturing.html>
- <https://www.thomasnet.com/insights/7-examples-of-companies-that-increase-revenue-customer-value-with-remanufacturing-part-2/>
- <https://www.greenbiz.com/article/remanufacturing-central-circular-economy#:~:text=Also%20known%20as%20the%20backbone,of%20the%20newly%20manufactured%20product.%22>
- <https://homeguides.sfgate.com/difference-recycling-remanufacturing-79389.html>
- <https://www.remanufacturing.eu/assets/pdfs/remanufacturing-market-study.pdf>
- <https://theconversation.com/what-a-sustainable-circular-economy-would-look-like-133808>
- [https://www.researchgate.net/publication/229049090\\_Industrial\\_challenges\\_within\\_the\\_remanufacturing\\_system/link/02e7e51892fc535703000000/download](https://www.researchgate.net/publication/229049090_Industrial_challenges_within_the_remanufacturing_system/link/02e7e51892fc535703000000/download)
- <https://www.daimler.com/sustainability/closeup/remanufacturing.html>
- <https://www.gknautomotive.com/en/Aftermarket/aftermarket/green-technology/remanufacturing/>
- <https://www.rematec.com/news/strategy-and-concept/remanufacturing-does-save-money-and-resources-and-heres-the-proof/>
- <https://www.infosys.com/iki/insights/new-era-sustainability.html>
- <https://www.marketplace.org/2021/10/05/resale-becomes-fashions-fastest-growing-trend/>

For more information, contact [askus@infosys.com](mailto:askus@infosys.com)



© 2022 Infosys Limited, Bengaluru, India. All Rights Reserved. Infosys believes the information in this document is accurate as of its publication date; such information is subject to change without notice. Infosys acknowledges the proprietary rights of other companies to the trademarks, product names and such other intellectual property rights mentioned in this document. Except as expressly permitted, neither this documentation nor any part of it may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, printing, photocopying, recording or otherwise, without the prior permission of Infosys Limited and/ or any named intellectual property rights holders under this document.