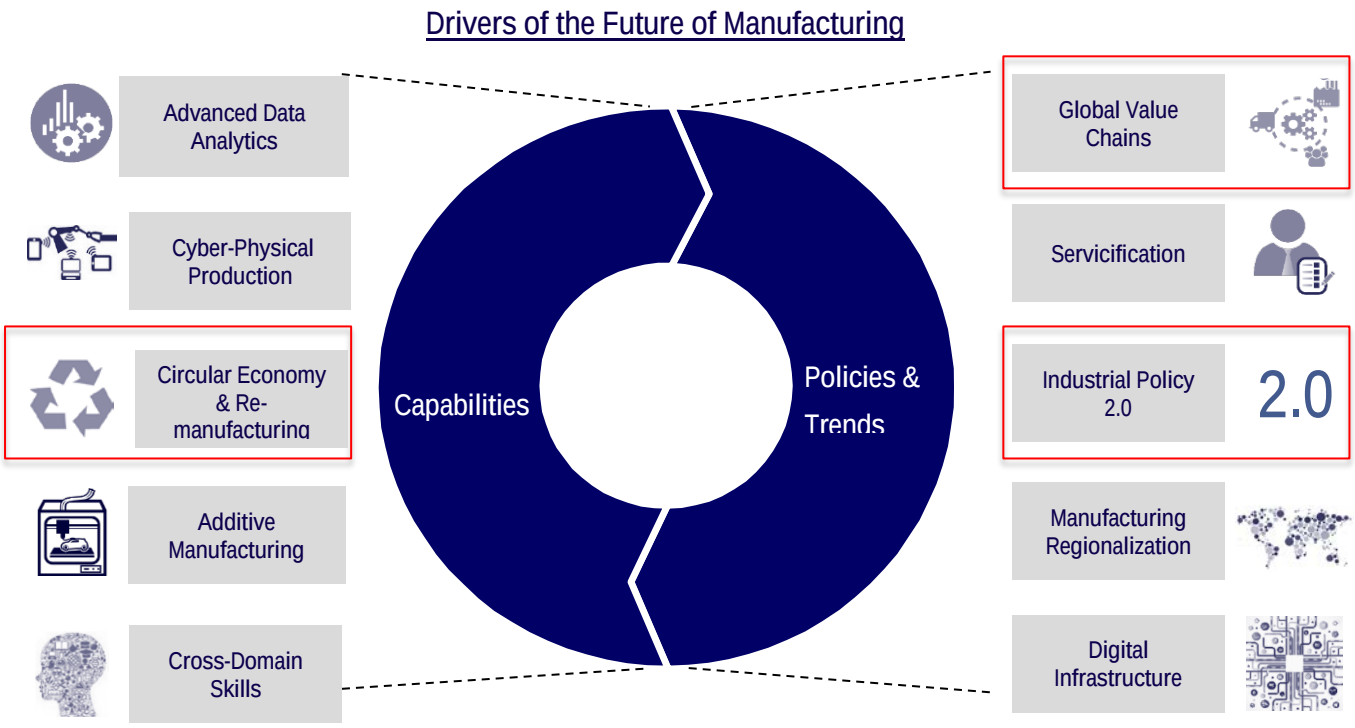
Case 8

Success of the Circular Economy of Automotive Battery Recycling



Source: World Economic Forum Global Agenda Council on the Future of Manufacturing, Whiteshield Partners framing

Executive Summary

1. Challenge Confronted

More than 1 billion vehicles are on the world's roads today. Every year, the global automotive industry produces more than 85 million new vehicles – almost 10,000 new cars every hour. On average, each of these vehicles uses three to four replacement batteries over its life.

The materials used to make vehicle batteries are subject to price volatility, increasing cost and supply constraints as the demand for batteries continues to climb. In addition, all types of batteries contain materials that can be energy and greenhouse gas intensive to produce, and may cause harm to health and the environment if not appropriately managed at all stages in the life cycle.

2. Solution Used

Johnson Controls, working hand-in-hand with customers, suppliers and logistics partners, created a circular supply chain in North America and Europe that ensures millions of batteries are properly recycled and materials are recovered for reuse. The supply chain *starts and ends* when a consumer buys a new battery while returning a used one to a retailer. Johnson Controls has therefore helped establish the world's most successful example of a circular economy – designing, making, transporting, recycling and recovering vehicle batteries using more sustainable methods.

3. Lessons Learned

When fully optimized, a circular economy enables economic value by minimizing volatility, while providing raw materials for new products at reduced cost with a lower environmental footprint.

Further, the most sustainable and responsible way to minimize the health and environmental risks of vehicle batteries is to responsibly recycle and reuse the materials to make new ones.

Description of the Work Performed

Johnson Controls and network partners re-evaluated all aspects of the battery life cycle, including how to most effectively and efficiently design and sell new batteries, collect used batteries from the retailer, recycle the materials and turn them back into new batteries.

As the largest manufacturer and recycler of conventional batteries, the company's ongoing optimizations across its recycling network played a significant role in improving recycling and recovery rates of vehicle batteries in North America and Europe – reaching 99% in 2015.[1] As a result, Johnson Controls produces batteries in North America and Europe containing more than 80% recycled material.

Success of the Circular Economy of Automotive Battery Recycling

Dates: 2000 – present

Keywords: recycling, circular economy, manufacturing, supply chain, automotive battery, lead, raw materials

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Entities involved: Johnson Controls, customers, logistics providers, suppliers

Key facts:

- A fully optimized circular economy enables economic value – minimizing volatility and providing raw materials for new products at reduced cost with a lower environmental footprint.
- Johnson Controls' supply chain *both starts and ends* when a consumer purchases a new vehicle battery and returns a used one.
- Today, 99% of vehicle batteries are recovered and responsibly recycled in the US and EU.

Key Outcomes

According to the European Battery Association, the recycling rate for conventional batteries is higher than that of any other mass manufactured product.[1] The United States Environmental Protection Agency also affirms that conventional vehicle batteries have the highest recycling rate in the country.[2] The sustained improvement in used battery recovery rates in North America and Europe means that today *nearly every used vehicle battery* is recycled and turned back into a new one after its useful life.

Argonne National Labs has concluded that the circular economy created around conventional vehicle batteries is a model for success, resulting in significant reductions in energy and emissions.[3] The recovery and reuse of metals from used vehicle batteries reduces greenhouse gas emissions by 99% per ton versus the use of primary metals processed from a mine. In addition, recycled plastic from battery cases requires 90% less energy than virgin plastic made from oil or natural gas.[4,5]

Drivers & Enablers

Six key enablers are required to establish and optimize a circular supply chain:

1. Design: Not only the product but also the entire life cycle must be designed to optimize resource recovery and reuse.

2. Scale: Adequate quantities of used batteries must be available to justify investments in recycling infrastructure.

3. Policy: Regulations must prohibit inappropriate disposal, establish appropriate incentives and enable manufacturers to recycle both their own as well as competitors' products.

4. Collection: It must be possible to integrate the collection of the used product through the same channels and partners as the distribution of new batteries.

5. Cost: Economically and environmentally preferable technology must enable the cost-effective recovery and reuse of materials.

6. Continuous improvement: The ability to identify, monitor and adjust for issues and opportunities that can impede or unlock value is necessary.

Barriers

The most important lesson learned is that strict, linear thinking must be abandoned in a circular economy since every element impacts another. All parties involved need to re-evaluate their roles and previous paradigms. Business functions can miss opportunities or destroy value if acting in isolation. Consumers need to be willing to purchase and return a used product to the retailer. Manufacturers, suppliers, transportation partners and customers all need to have the right incentives to participate in a circular economy. Policy-makers should carefully evaluate the consequences of regulations to avoid unintentional disincentives anywhere in the system.

Endnotes

[1] EUROBAT – The Association of European Automotive and Industrial Battery Manufacturers and Battery Council International
[2] United States Environmental Protection Agency, *Advancing Sustainable Materials Management: Facts and Figures 2013.*
[3] Argonne National Laboratory, Energy Systems Division, *Role of Recycling in the Life Cycle of Batteries*
[4] Bureau of International Recycling, *Report on the Environmental Benefits of Recycling*
[5] G.P. Thomas, *Recycling of Polypropylene*