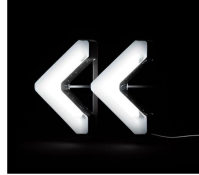


CATALYST FOR RESHORING

could remanufacturing reboot the economic machine,
with factories as close as possible?





CATALYST FOR RESHORING

COULD REMANUFACTURING REBOOT THE ECONOMIC MACHINE, WITH FACTORIES AS CLOSE AS POSSIBLE?

Imagine a world where we could take used physical products and give them a second life, and a third life, and even a fourth life. Imagine a world where all products could live in infinity. In such utopian what-if scenario, it would mean that once products reach their end of life, they need a process for rebirth. This would require logistics back to the far-away factory where it once was created, right? Maybe not. Maybe factories of the future that can remanufacture products could be viable to be placed as close to the consumer of a product as possible.

In this episode, we'll dive into how remanufacturing could support a seismic reversal, at least partially, of the large-scale offshoring of manufacturing to low-cost countries in the past 50 years. If renewable materials and recycling technologies enable manufacturing of physical goods and products close to the point of consumption – could we see a manufacturing investment boom in high-cost countries in a decade or two? And could we see a new wave of innovation and new startups through the democratization of manufacturing?

Not only could regenerative manufacturing lead to a potentially lowered global carbon emissions footprint, but also become a catalyst for bringing back manufacturing jobs and capabilities, close to where the consumption takes place. A catalyst for reshoring.



KEY TAKEAWAYS

Part 2
Episode 12



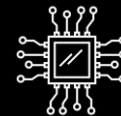
Manufacturing has substantially **offshored** to low-cost labor countries



Globalization of manufacturing took shape over half a century



Once we can **remanufacture** 'everything' – we could **reshore close to consumers**



Manufacturing creates **major derivative effects** in society



Remanufacturing could unleash seismic **reshoring capex wave**

The future potential shift towards remanufacturing could be compared to how the currently developed countries have transformed their economies in favor of services in the past 50 years, as labor in low-cost countries outcompeted a lot of local high-cost labor. In developed countries, the services share of GDP has gone from roughly 40% up to 80%, in many cases. Inversely, the manufacturing share of GDP has gone from 25-30%, down to 10-15%. And the third and last piece of the GDP pie, agriculture, has gone from one-fifth to low single-digits. Also consider that manufacturing jobs in the US in 1950 comprised one-third of all jobs in the countries, and that it fell to 10% by 2010.

And although it has reversed a few percentages in the past decade, it is a telling picture for how many developed countries have seen their labor force transform. Globalization has calibrated the economic differences between countries and found a new global equilibrium for global supply chains of trade, which are worth around 25 trillion dollars by the way (merchandise goods, according to the UN). Low-cost countries are now more prone to have a higher share of manufacturing compared to high-cost countries. But if usership and remanufacturing become big and disruptive, we could see the reversal of the historical GDP compositional change within and between countries (as well as a shift from business cycles to business environments as discussed in the previous section).





With remanufacturing, which contains components such as recycling technologies and renewable materials, low-cost labor and long distance transport of products could reverse manufacturing capacity to developed countries. This would imply a seismic shift for GDP compositions for countries, similar to the past 50 years. Remanufacturing is not only a manufacturing process and novel economic model, but also a potential transformative force for how countries and their labor forces are structured.

GLOBALIZATION REBOOTED THE ECONOMIC MACHINE

But before we go any further into the prospective future of regenerative manufacturing, let's quickly answer the question of how we got to where we are right now. Why and how globalization of manufacturing came to be the bedrock of our society.

Once upon a time, manufacturing was a local affair. Products were made where they were needed, by craftsmen and small factories that served their local communities. But then, in the 1950s, something began to change. The world started to become more connected, and manufacturing began to globalize.

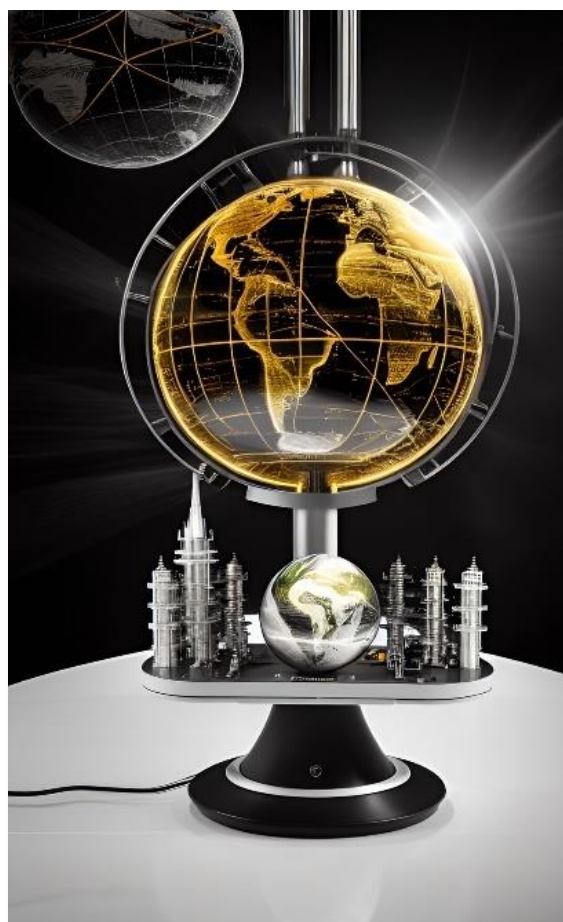
At the heart of this globalization was the desire for **cheap labor**. Companies realized that they could save money by moving their factories to countries where wages were low. This started with Japan, which was still recovering from the devastation of World War II, but soon spread to other countries in Asia and beyond. Countries like China and India had large populations willing to work for lower wages than their counterparts in the West. As companies began to realize the cost savings of moving their manufacturing operations to these countries, they began to do so in droves.

Another enabling factor was the dilution of **political and country barriers**. As the Soviet Union collapsed, the Berlin wall fell, countries like China and India opening up trade to, and investments from, the outside world – countries that had been closed off to the world suddenly became accessible to businesses looking for new markets and sources of labor. And in Europe, the formation of the European Union and the introduction of its own currency, substantially decreased barriers.

Technology was also an important factor. Advances in transportation and communication made it easier and cheaper to move goods around the world and to manage global supply chains. Companies could now coordinate production across multiple countries, with each country specializing in a particular aspect of the manufacturing process. As an example, the development of containerization made it possible to ship goods more efficiently, while the widespread use of computers and the internet allowed manufacturers to manage their global operations more effectively.

Trade agreements also played a role. Countries began to sign free trade agreements – for example the General Agreement on Tariffs and Trade (GATT), which was established in 1947, reduced barriers to trade between companies and countries. This paved the way for the formation of the World Trade Organization (WTO) in 1995, which further promoted free trade and helped to create a global marketplace.

All of these factors combined to create a new era of globalization in manufacturing. Companies could now produce goods more cheaply than ever before, by taking advantage of low-cost labor and global supply chains. As a consequence, inflation rates were pushed down to historically low levels at around 1%, from the turn of the Millennium at least. It also created new types of geopolitical interdependencies between countries, and between continents. Between World War 2 and present day, the world map of how we make physical products has been completely redrawn. It's not day and night, but its vastly different, and seismic on a historical timeline. The world was rebooted and reconfigured itself on new settings.





MAJOR DERIVATIVE EFFECTS

But, with the prospective emergence of regenerative manufacturing in the next few decades, could we see the next era of reconfiguring of our global settings? It's certainly not unprecedented as it's happened in our lifetimes. Because, if thousands of remanufacturing factories would open up shop in a certain developed country, with a currently very small manufacturing footprint as it imports most physical products and goods, it could lead to major positive derivative effects. Effects such as an explosion of startups that now have the possibility to harness manufacturing capabilities close at hand and with much greater security of delivery than before.

Currently it is a **significant hardship for engineers to start new manufacturing companies**, with high and complex value-added throughput, that requires newbuilt factories with specific capabilities. Purely digital startups inversely, are in order of magnitudes easier to birth than a company with original manufacturing capacity. But once general-purpose remanufacturing factories are built in close proximity to engineers in developed countries, it opens up the floodgates for manufacturing innovation, perhaps similar to how US manufacturer Tesla has created a platform for engineering innovation that's been super difficult to establish over the past few decades. Tesla can be considered a pioneer of a new breed of manufacturing companies that rethinks the whole process and notion of manufacturing.

ENABLING THE ENGINEERS

Currently, engineers with dreams of starting their own companies have a difficult time realizing their dreams as the process of creating manufacturing companies is difficult. The capital needed is difficult to attain as the risk-level is high for investors. But when remanufacturing capabilities are introduced at-scale, it will attract massive interest for engineers to realize their aspirations of novel products, and the capital needed can be de-risked and investors will have an easier time to find more attractive investment opportunities. Furthermore, when a manufacturing startup doesn't have to purchase its own robots, equipment, other fixed assets, and perhaps even entire buildings to put their fixed assets, **it substantially lowers the capital need for manufacturing startups to initiate production**. Just like digital productivity tools such as smart databases, client relationship management systems, or human resources tools, have lowered the bar of complexity to start a company in the digital world – subscribing to vital physical fixed manufacturing assets could have a similar effect in the physical world.

Take the example of a handful of aspiring young (or old) engineers that have pinpointed a market need that is currently not met, in this case it's an innovative chair that people can customize in their own liking. This team of engineers want to realize this idea by setting up

manufacturing capacity, supply chains, and distribution network. They need all three and today this process is extremely consuming in terms of capital, time, and human relationships. Consequently, most startups in high-cost countries only focus on high value-added products that solve complex problems. Mass production of low value-add products doesn't make economic sense to do in high-cost countries, relative to low-cost countries. This is today's reality and the reason for offshoring manufacturing capacity to low-cost countries.

But when we're able to remanufacture any type of product and actually compete with low-cost labor due to super-effective remanufacturing technologies and material, the ability to establish mass production anywhere on earth, arises. This is far from true today. The current established model of buying virgin materials, using low-cost labor, shipping to high-cost countries, and paying import tariffs on the value-add – could be replaced with renewable materials, high-cost labor, very little shipping, and no tariffs involved. The business model effect of this makes it super reasonable for selling usership instead of ownership of products, which in turn implies stickiness for revenues. Furthermore, a remanufacturing model could replace a lot of middlemen of the linear manufacturing model.

So, theoretically, this could change the minds of the five aspiring engineers that today wouldn't dare to start a customized chair-manufacturing company with manufacturing footprint in a high-cost country. In this future, they would start an account at a local remanufacturing factory with all types of autonomous robots and pay usership fees for manufacturing their chair. They wouldn't have to invest in fixed assets, instead pay usership of others' fixed assets, to manufacture their product.

DEMOCRATIZING INNOVATION

Now, if we'll experience a future significant wave of manufacturing startups in developed countries relying on domestically circulated renewable materials and sophisticated autonomous robots, these will need to employ teams that design their products, service them, connect them with each other, and ultimately remake them to the products they were before depletion. **And with ease of creating a manufacturing startup comes the gravitation of entrepreneurial people of all kinds**, not only engineers that know manufacturing from within. This would supercharge manufacturing innovation to levels not seen before. Similar to how innovation has been unleashed in the digital world, with hundreds of thousands of tech startups replacing previous legacy companies, so too could happen in the physical world. Anybody with an idea and driven mindset would be able to become a manufacturing startup. Democratization of manufacturing capacity and capabilities.

With democratizing technology comes new mindsets of people. Hence, current investments into robotics, smart





sensors, additive manufacturing, and recycling technologies, should be seen as precursors to an aggregate mindset shift of entire populations. When novel advanced manufacturing technologies reach critical mass in the next 10-20 years, they will form a platform for people to create new endeavors. And this is way different compared to automation and deploying smart data software into our current manufacturing complex, which have supported continuing offshoring. This is disruption of how we structure manufacturing from the ground and up, instead of incremental improvements of processes.

UNLEASHING RESHORING CAPEX

If a groundbreaking remanufacturing wave comes to fruition, **it would unleash reshoring capex investments that could last for multiple decades** and substantially rebuild manufacturing capacity for many developed countries. The offshoring of the past 50 years could stop, and potentially reverse. Take Sweden as an example. The manufacturing share of GDP halving to 12% of the past 50 years could see a rise in the long-term. It could enable a next generation of smart manufacturing startups that would slowly but surely creep into the export accounts of nations. It would also fill the need for new employment once our services sector has become so efficient that increased GDP doesn't need more employment. Although multiple decades away from a steady state equilibrium in this aspect, this state of optimal efficiency will arrive.

Furthermore, when also accounting for an **aging population and a lower aggregate share of people producing value for the economy**, it is clear we need entirely new sectors to fill a future inevitable economic gap. At this point, developed nations' employment outlooks point toward a reality where pension payments to the old exceed the monetary inflow from those working. There are substantial reasons for projecting large imbalances 50 years from now. However, while there are plentiful long-term assessments of long-term outlooks of nations, they rarely incorporate structural change in how we manufacture products – and its derivatives effects. So instead of extrapolating current trends, our thoughts apply novel emerging technologies and account for learnings of history. Change is the only constant, but still most people think in extrapolation instead of thinking in disruption. This is a mistake, as history shows us.

THE FUTURE IS NOT ALWAYS LINEAR

As there are ample signals for projecting significant economic imbalances in the long-term, there are also signals for **projecting the very opposite**. When reshoring starts taking off, these oppositional signals will get stronger, and we will see the extrapolators producing way different research reports compared to today. In 50 years, economic outlook reports of today could become so obsolete that we'll wonder how we could've missed such a major factor of structural transformation. In some respects, remanufacturing enabling an internet of material, could actually enable similar effects and significance as the internet of information did from the 1990s and onwards.

The information internet made possible the shift from bilateral to universal data exchange. Today, our manufacturing complex is entirely bilateral and as such it is more or less impossible to use certain materials in any other way its currently shaped. This was true for information prior to the internet, but today all types of information are universal and can be reused however we choose. When materials become universal, the reusability will enable an internet of material. First a digital internet, then a physical internet. Each yielding substantial novel innovations previously unforeseen.





CONCLUSIONS

Let's now wrap up this section. Prospectively, the reversal of offshoring manufacturing capacity and capability from developed nations could materialize in the next couple of decades. A future remanufacturing platform could ease the pain of creating a startup in manufacturing, which could yield an explosion of innovation and creative derivatives effects similar to how the internet of information took the world by storm.

Ultimately, there are early signals for obsoleting current extrapolation projections for the outlooks of developed nations. Remanufacturing could unleash a wave of innovation similar to the internet and offer support for balancing state budgets. This is certainly a fascinating subject from so many angles....

In the next episode, 'Regenerative Inputs Changing Comparative Advantages' (episode #13), we'll dive into the potential of decoupling our global economy from depletive natural resources. If we were able to scale up both renewable materials and renewable energy, it could alter the current comparative advantages between countries. It could change geopolitics. Perhaps even lower tension between countries. Could recurring inputs into the economic machine create recurring outputs?





SUMMARY

- In this episode, we'll dive into how remanufacturing could support a seismic reversal, at least partially, of the large-scale offshoring of manufacturing to low-cost countries in the past 50 years.
- The future potential shift towards remanufacturing could be compared to how the currently developed countries have transformed their economies in favor of services in the past 50 years, as labor in low-countries outcompeted a lot of local high-cost labor.
- Remanufacturing (which contains components such as recycling technologies and renewable materials) could outcompete low-cost labor and long distance transport, and reverse offshoring manufacturing.
- Once general-purpose remanufacturing factories are built in close proximity to engineers in developed countries, it could open the floodgates for manufacturing innovation.
- When remanufacturing capabilities are introduced at-scale, it will attract massive interest for engineers to realize their aspirations of novel products, and the capital needed can be de-risked and investors will have an easier time to find more attractive investment opportunities.
- When a manufacturing startup doesn't have to purchase its own robots, equipment, other fixed assets, and perhaps even entire buildings to put their fixed assets, it substantially lowers the capital need for manufacturing startups to initiate production.
- If remanufacturing comes to fruition, it could unleash reshoring capex investments that could last for multiple decades and substantially rebuild manufacturing capacity for many developed countries.
- Regenerative manufacturing (of which remanufacturing is an essential part) could democratize the ability to make physical products in society, and consequently lead to increased interest and investments into manufacturing in developed countries – as low-labor costs are outcompeted by autonomous remanufacturing, ultimately leading to reshoring of manufacturing.





SOURCES OF INSPIRATION

- **Re-Industrialising Europe: A new reality for high volume electronics manufacturing.** Oak Universe. While the trend towards offshoring was mainly motivated by cost-cutting or economic aims, location decisions of the present day require the analysis and consideration of risk management, flexibility, strategy and supply chain reliability. Quantitative factors are no longer enough to make location decisions.
- **Why innovative manufacturing and circularity are key for a resilient manufacturing industry.** A more resource efficient circular manufacturing model needs to replace the current linear production systems, which are highly wasteful and polluting, by enhancing the symbiotic relationship between local consumption and production cycles to achieve sustainable production and consumption. Green Growth Knowledge.
- **The reshoring revolution: when to reshore in a new global economy.** As focus shifts from efficiency to resilience, what is the right balance between globalization and localization? The answer varies by industry and requires bold end-to-end structural choices. It's time to re-evaluate and balance the entire value chain. Kearny.
- **Disruption in Resource-Intensive Supply Chains:** Reshoring and Nearshoring as Strategies to Enable Them to Become More Resilient and Sustainable. Academic paper.
- **The Role of Urban Manufacturing for a Circular Economy in Cities.** In recent years, implementing a circular economy in cities (or "circular cities") has been proposed by policy makers as a potential solution for achieving sustainability. One strategy for circular cities is to reintroduce manufacturing into urban areas (or "urban manufacturing"), allowing resource flows to be localized at the city scale. Academic paper.
- **The New Age of Urban Manufacturing?** With an increasing common awareness of the faults of linear production (pressing evidence in the recent Paris climate talks), we need to understand how to take advantage of locally produced and consumed resources. Cities of Making is exploring the what (technology and resources), the where (spatial conditions) and how (the governance and application) of urban based manufacturing. Cities of Making.
- **Contribution of remanufacturing to Circular Economy.** European Environment Agency.
- **Function replaces product in a circular economy.** RISE.
- **If a circular economy is the goal, microfactories are the solution** – WEF. Transitioning the manufacturing world to a microfactory localises production. By bringing the end product closer to the consumer, transportation of goods is shortened, reducing transportation costs and carbon emissions.
- **VIDEO – What Will It Really Take to Make Reshoring Happen?** – Supply Chain Brain
- **VIDEO – From Offshoring to Reshoring** – Wharton
- **TED TALK – Introducing the Future of Manufacturing** | Tyler Alvarado | TEDxCoeurdalene

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