



CIRCULARITY INSIGHTS DIGEST

Transform circularity goals into
achievable, scalable and profitable results.



The circular economy could unlock \$4.5 trillion¹ by 2030. Are your plans for circularity well underway?

For far too long, industries have relied on the linear take-make-use-waste approach, which has depleted resources and diminished value across the supply chain. This needs to change fast.

“As the world transitions from a linear to a circular economy, we must undergo a metamorphosis in the way we live, trade and consume.”



– Philippine de T'Serclaes,
Chief Sustainability Officer,
Dassault Systèmes

In our pursuit of a more sustainable coexistence with the planet, we need to rethink how we design, produce and operate. By adopting circular principles, you are not only shrinking your carbon footprint but also positioning your business for enduring success.

Within the pages of the Circularity Insights Digest, you will find practical strategies from Dassault Systèmes' seasoned industry experts. These experts don't just understand the urgency of circularity; they excel at turning theory into meaningful action.

Explore the three key pillars of circularity: Materials, products and enterprise. They are disrupting the conventional linear economy, eliminating value leakage and paving the way for an achievable, scalable and profitable transformation. Let these insights guide and inspire you on your journey towards a circular economy.

¹ [World Economic Forum](#) (2022)

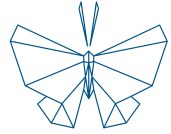


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Did you know that your material choices can have a big impact on your product's environmental footprint?

The shift toward a circular economy hinges on sustainable material extraction, innovation and design.

Explore how to infuse circular principles into product development through materials that are recyclable and biodegradable by design.

MATERIALS

How can companies improve their processes to incorporate more **recycled materials** in **manufacturing**?

It starts with lifecycle assessment to know which materials have the biggest impact on the final product. So, let me give some examples. **If it turns out that the biggest impact is in supply chains, then optimizing your sourcing strategy may be helpful here.** And this is going to be a true challenge because of the number of suppliers, the availability and the quality of the recycled materials.

If the impact is in manufacturing, like in most industries, it's easiest to just use virgin materials. With optimization, however, we can use more recycled materials instead. For example, in the steel industry, chemical composition is very important. You can't just put all the scrap materials into the final product. You need to carefully mix and blend the right

type of scrap materials together for that final product. And for that, matching the demands and the available recycled supply can be helpful.

On the other hand, **if the impact is greatest in the material itself, it may be worth looking into the recipe.** For example, for cement, there is sand, water and some other ingredients. If you define in which ingredients the most waste is generated, you can look into alternative ingredients to remove or reduce the amount of waste.

So, these are just some examples, and Dassault Systèmes can enable companies to make these materials more circular.



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How can companies make more **sustainable sourcing** decisions earlier in product development? How does this impact the rest of the product lifecycle?

Sustainable sourcing is the first step toward circularity. To achieve this, companies need to align their sourcing strategy with their ESG and sustainability goals globally. There are opportunities to easily achieve this by buying low-carbon energy, procuring energy efficiency technologies and deploying them into different production sites, purchasing waste and byproducts from other companies and organizations, and then using them as raw materials. We can also acquire or buy carbon credits and other sustainability assets.



Karim Fradj
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Here are some real-life examples of companies that succeeded in incorporating those practices into their operations. We have, for instance, IKEA. IKEA is participating in councils like the FSC in order to make sure that they are sourcing their raw materials in a sustainable way and also investing in programs that promote reforestation and biodiversity.

We have, for instance, Patagonia. Patagonia's recycled materials initiative, Worn Wear, encourages their customers to buy used clothes and, therefore, reduce the demand for new products.

We also have the Unilever initiative, RSPO, where they aim to achieve 100% sustainable palm oil sourcing.

What's the unexpected value of simulation in developing new and sustainable materials?

How can companies tap into this?



Mel Creasey
SIMULIA Business
Development
Consultant,
Dassault Systèmes

Innovating with new sustainable materials is not easy. This is not a trivial task, and companies need to quickly understand how a new material might behave throughout its entire lifecycle, from the initial conversion of that raw material into a packaging structure all the way through to the recycling and disposal of that product, or reuse, if that's the actual intent for the pack solution.

Any new material needs to be capable of satisfying a complex range of business and consumer requirements. With the right effort, these design requirements can be understood and satisfied with the use of simulation. Simulation greatly helps companies select the right materials and helps with concept creation, design development and scale-up. However, this is only possible if the material's behavior itself is really well understood. This requires some effort to create good material performance.

When new and sustainable materials can be accurately modeled, this creates value opportunities in many

ways. First of all, it allows design teams to understand the structural performance of a new pack design early in the design development process. It also creates the opportunity to simulate and understand the effects of real-world variation throughout the entire value chain: For example, variation in the raw material ingredients themselves or in the manufacturing process, and how this might affect material quality behavior and performance downstream. Variations through the factory, supply chain and distribution channels can be understood, and environmental factors like temperature and humidity – all these can affect material behavior and, ultimately, packaging performance. Being able to simulate and understand each of the above means that companies can quickly and confidently scale up new innovations to be deployed into diverse markets, supply chains and diverse environments, where they can be certain that the material and the design are going to perform as expected and meet consumer expectations while satisfying business environmental targets.

Whilst simulation is continuously advancing and developing, I think it's important to acknowledge that physical testing of the final design is still a key step in the process. But increasingly, this is becoming more of a validation step rather than a learning step, where potentially unwanted or unforeseen risks might be realized. Simulation brings information and a level of understanding and confidence that is simply not achievable without it and ultimately helps companies to develop packaging innovations using new sustainable materials faster than ever before.

Should materials be **standardized** to make recycling easier, for example, using **less sophisticated polymers** and **mixed materials**? How can functionality be maintained?



Mel Creasey
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Recycling processes can benefit from standardization and harmonization of materials in waste streams. By taming the complexity of material selection and design, companies can streamline recycling processes, which increases efficiency and yield.

However, standardization is not the only challenge in recycling. Some packaging materials are not recyclable or may not be commercially viable for recycling. Companies are increasingly looking to replace these materials with easier-to-recycle alternatives. Meanwhile, the reprocessing industry continues to see investments in developing sophisticated solutions for detecting, sorting and processing waste materials. These efforts mean significant advancements are being made toward a circular economy.

Modeling and simulation play a critical role in developing new, more sustainable materials by helping companies replace problematic materials such as metalized plastic films, thermoset plastics and plastic-coated paper with eco-friendly, recyclable alternatives.

Keeping packaging materials in the loop is crucial to achieve zero waste. Companies need to design with recyclability and reuse in mind from the outset, show that the materials used can be efficiently recycled in the markets they're going to be sold in, and ensure that those materials can be easily separated into the appropriate recycling streams. This encourages consumers to participate in recycling and avoid gray waste streams, such as landfills or incineration.

For manufacturers looking for **economical ways to incorporate circularity**, which **tech developments** can help them get started? Share some success stories.



Mel Creasey
SIMULIA Business
Development
Consultant,
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Technology is advancing all the time, and some great developments can support manufacturers when looking to design for circularity.

First, design is a key step towards a circular economy and helps us move from linear processes to a more circular system. For materials, 80% of environmental impacts are determined in the design phase.

Packaging, for example, should be designed to facilitate either multiple reuses or efficient recycling early in the design phase. Lifecycle assessment tools enable design teams to quantify the environmental impact of new packaging concepts across the entire value chain. This helps them make informed decisions about material choices and potential design routes while ensuring circularity is fully evaluated at the right time. I would also highlight that companies can replace some problematic materials through molecular modeling of new sustainable materials. This is a crucial technological advancement in reducing plastic packaging and improving recyclability.

One of the biggest challenges in the packaging industry is moving away from laminated plastic flexible packaging to more environmentally friendly flexible materials such as paper while retaining product quality through moisture and oxygen protection. Significant research and development efforts have been made to innovate with new coating barriers to solve these problems. Modeling these new materials continues to be an important capability for companies to create solutions.

Regarding success stories, there are many companies that have successfully developed new coating solutions. They're already producing paper-based flexible packaging materials that have amazing barrier performance and are easy to recycle. The development of these new coatings have been greatly facilitated by the advancements in molecular modeling technology.

How can we use **sustainable building materials** without breaking the bank?



Remi Dornier
Vice President,
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Industry,
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I think the first approach is to leverage biomass. I often hear about projects to capture carbon. I know of very interesting materials today that capture carbon: These are trees, and trees capture carbon when they are growing. We can make good use of this in construction. Today, we see more and more initiatives to replace concrete with these materials.

I wanted to highlight one of our customers called Piveteau Bois. Piveteau Bois has a very interesting model: It owns a forest that it has responsibly used for 50 years. It takes some trees from the forest and maximizes the use of those trees. It uses all the scraps for heating. The low-quality wood material is used to make bardage (weather boards) – what we call façade – and so on, and the high-quality materials are used to make construction materials. And we have been helping to make the next generation of materials called cross-laminated timber. This material is able to replace concrete slabs inside the factory and inside the buildings, and we help improve productivity of the line by 15% using the virtual twin experience inside the factories.

Another example is the function of materials. If you take a façade element of a building, it is aesthetic; it contributes to the shape of the buildings and it's to view the outside.

Today, we have an example from China, where customers such as CNBM and CSADI – one of the biggest architecture and engineering institutes in China – are designing net-zero towers that are energy-positive and have some façades that generate energy. How did they do that? They engineer a new material, which is a photovoltaic glass panel that's able to generate power. Here, we doubled the functions of the material, and this is very interesting since we are able to move toward more energy-positive towers.

Last but not least, we cannot focus only on the building itself – we have to focus also on the sub-components of the building. So sub-pieces, and for that, we have many SOLIDWORKS customers today, such as Assa Abloy, who are working on locking systems and improving their subsystems. So, they try to reduce the quantity of materials used to decarbonate and find the best alternatives. Today, it's also very important to work on the sub-assembly's level.

How can companies be more circular through their **packaging strategy**?

When it comes to circular economy or sustainability, one of the first things that pops up in my mind is the packaging strategy. It's because we're all confronted with that in real life. We have all had the same feeling when we receive the wrong parcel or because it's a big box for a small product. So, this easily comes to mind for anybody.

If we think about what can be different, we think about parcels built with recycled products – not only recycled products but also products made from bio-based materials, for instance, wool and algae. These are examples that are already coming to the market.

We may also use parcels with a manual height adjustment that will allow the packer or the operator to get the parcel at the level of each content and avoid using additional filling materials. The use of technology also optimizes the packaging strategy and supports the operator in parcel selection to find the best parcel fitting for the order, depending on the product characteristics of a particular order. This way, they can also avoid having to put filling materials inside.

We can have technology that will help the operator split an order into several parcels to optimize the saturation rate of the parcel, pallets and truck loading. And if we go to the extreme, we can also have industry-setting automated packaging equipment or semi-automated packaging equipment. The carton will be built around the contents of the order and the packer; we don't have to select anything.



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What are examples of **sustainability metrics** that companies must meet? How can they do better?



Diana Goenaga
NETVIBES Strategy
Director,
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Most of the time, companies try to improve sustainability metrics that would benefit economic performance. So this is good news – companies can be both ecological and economical, for example, by enhancing the weight of materials in the product. **Less weight is generally more sustainable, which generates fewer costs for the company and incurs less materials to source.** Another example is by reducing the energy consumed. **If it requires less energy to manufacture many products, it's both sustainable and cost-effective.** So, these are KPIs that are often achieved in the real world.

Companies struggle when sustainability goals are not aligned with economic goals. This is a very difficult situation because people are put in a situation where they have to choose: Must I meet my revenue objectives or sustainability objectives? This is not the impression we want to create for companies because this situation is paradoxical.

So, a good practice is to source locally. **Finding local suppliers is more sustainable than producing a product**

that needs to travel around the globe three times. But, local suppliers may be more expensive than other suppliers at the other end of the world. So, let's put both into the equation. You have the economic imperative, an increased pressure many businesses face. To reconcile business decisions with a sustainability imperative, let's put the cost of non-sustainability in the equation. When you think about it, it's what we did with quality in the '80s and '90s. Companies wanted to make things of better quality, but it was more costly. **When we added the cost of low quality into the economic equation, things started to unravel because having a low-quality product is more expensive.** You'll have unsatisfied customers and scraps to manage, which are costly.

Today, the world is changing. We are realizing that not embracing sustainability will also be costly. **When your company is not sustainable, you will consume more energy. As a result, you will have to manage waste, pay taxes and risk a loss of brand image.** So, add sustainability into the equation.

How are companies responding to **consumers' demand for greener products**? What went well and what could have been done better?

So far, companies have done well in responding to the demand. Almost all successful brands in the consumer goods industry have introduced eco-friendly products in their product line. These brands have launched efforts to reduce packaging, improve energy efficiency and use sustainably sourced materials.

Waste reduction is at the forefront for food and beverage companies. With recycling and circularity initiatives in place, these companies have diverted a portion of their business to fit the circular economy model. You can see sustainability reports from these companies reflecting those changes, but more must be done.

First, companies need to eliminate greenwashing attempts or risk losing consumers' trust. Companies need to continue improving their transparency because there are still issues regarding material sourcing. Then, they need

to make the extra effort to ensure all suppliers, including tier one and tier two, maintain that transparency. Deploy methods to make sure the materials are traceable with transparency across the supply chain while keeping consumers informed.

In the race to source materials to provide greener products, companies must not violate ethical standards and practices. They also need to look into making some of these sustainable products and packages affordable while educating consumers on circularity. Companies have to continue investing in R&D and produce sustainable, innovative products in collaboration with key actors, including their consumers, suppliers and recycling facilities. This is a big task ahead, which is why some have already started on this journey.



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Tell us about the latest **sustainable material** innovations that will bring the greatest improvements for the future.



Kai Zhang
BIOVIA Brand
Marketing Director,
Dassault Systèmes

There are so many exciting, sustainable material innovations in pursuing a more sustainable future. I'd like to highlight a few that have the potential to drive substantial improvements for companies across various industries.

The first one is battery materials. As the world transitions to electric vehicles and renewable energy sources, the demand for high-performance, eco-friendly batteries has surged. Researchers and companies are working on next-generation battery materials that are more energy efficient and environmentally friendly. Battery technologies and materials have improved significantly in the last decade or so, from lithium-ion to lithium-sulfur and from sodium-ion to solid state. New innovations promise longer-lasting and faster-charging batteries, which are essential for electric vehicles, grid storage and portable electronics. **These innovations provide a competitive edge in the energy sector and reduce the carbon footprint for a more sustainable future.**

The second example is sustainable packaging materials. With fast-growing consumer awareness and environmental concerns, CPG companies are under increasing pressure to reduce plastic waste and adopt sustainable packaging solutions. Innovations in this area include biodegradable plastics, plant-based materials and creative designs that minimize packaging while maintaining product integrity. Adopting sustainable packaging materials not only aligns with consumer preferences but also helps companies reduce waste, lower shipping costs and enhance brand credentials.

Another example is the lightweight glass materials currently being developed by our customer, Ardagh Group, a global metal and glass packaging company. Glass is a versatile material used in various industries, from automotive to construction and consumer packaged goods. Recent advancements in glass technology have led to the development of ultrathin, lightweight glass that maintains its strength and durability. This innovation reduces the weight of products, which is particularly beneficial for transportation – ultimately improving fuel efficiency and reducing emissions. Companies incorporating lightweight glass into products can contribute to a greener future while enhancing product performance and market competitiveness.

By embracing sustainable material innovations, companies can reduce their environmental footprint and position themselves as leaders in circularity.



Kai Zhang
BIOVIA Brand
Marketing Director,
Dassault Systèmes

What are **five steps** scientists can take to **speed up** the **development** and **formulation** of renewable materials? Share three stories that have inspired you.

This is a great question. When it comes to advancing sustainable materials, scientists play a critical role in accelerating progress. They can employ a range of cutting-edge technologies to streamline the development and formulation processes. I'm a chemist by training and I've worked in the lab for over 10 years, so I know how challenging it is to innovate new materials and bring them to the market. **We are in a digital world now, and how scientists can innovate better and faster is the question we have always asked ourselves.**

The first step is to model and simulate materials. By creating virtual representations of materials and their properties, **scientists can significantly reduce the time and resources needed for physical experiments, and ultimately, conduct better experiments with fewer resources.**

The second step is to streamline R&D processes through a digital lab where most innovation starts. By transitioning towards digital labs, companies can:

- Simplify data management by centralizing scientific information
- Foster collaboration through real-time data sharing
- Optimize experiment design and planning
- Automate workflows to reduce manual tasks
- Enhance data accuracy and lab efficiency through integration with lab instruments

Moreover, a digital lab ensures compliance with regulatory standards over sample and inventory management – and scales with the evolving needs of R&D organizations. By optimizing these aspects, digital labs allow scientists to focus on innovation and accelerate their research and development.



Kai Zhang
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The third step is next-generation formulation design. To accelerate the formulation development of renewable materials, scientists should embrace next-generation formulation design techniques. New solutions allow for convenient data and materials management and domain-specific calculations to optimize formulations for cost, efficiency, reporting and compliance. Scientists can also use advanced algorithms and data analytics to optimize material compositions and properties to innovate more sustainable formulated products.

The next step I want to talk about is one of the hottest topics in the world today: AI and machine learning – two valuable tools in material science. Scientists can harness these technologies to analyze vast datasets, identify patterns and even predict the behavior of new materials. This accelerates the development and discovery process.

The last step is to utilize an integrated platform for data sharing and collaboration. Collaboration is always key in advancing new renewable energies and materials.

Scientists should use an integrated, global platform that is flexible, open, scalable and agile. This will facilitate seamless data sharing and collaboration among researchers, both within the organization and across institutions.

In summary, these strategies empower scientists to innovate more efficiently and significantly contribute to a sustainable future, from modeling and simulation to the power of AI and collaborative platforms.

How close are we to transitioning fully to **hydrogen fuel**? What are three steps companies can take now to get there faster?

In the short- and medium-term, we see the development of a new electric application where hydrogen is used to feed fuel cells that will power electric engines. In the medium- and long-term, hydrogen is seen to replace kerosene as a fuel for combustion engines.

The three steps companies can take can be compared to the size of the aircraft application. As a first step, if we focus on smaller applications, like eVTOL — electric vertical takeoff and landing systems and aircraft — we know that hydrogen is already improving fuel cells and electric engines. But, these new prototypes must be certified quickly. The **3DEXPERIENCE**® platform can help companies achieve certification faster through dedicated solutions for governance and virtual testing.

A second step will be the medium application for regional aircraft, where the fuel cell is still seen as the best choice to replace the usual propulsion system. But in this case, we need to enhance the performance of the fuel cell and cooling solution. This is a challenge for energy management, which can be optimized through 1D and 3D simulation — capabilities available on the **3DEXPERIENCE** platform to find the best energy split within aircraft systems.

The third step will be the larger aircraft applications where hydrogen is used as a fuel. In this case, we need to develop more hydrogen for long-range aircraft missions. The big challenge is incorporating disruptive hydrogen tanks, where most are seen as liquid hydrogen tanks. To get these massive technologies on board, we can rely on 3D simulation to accurately assess the performance of such disruptive systems.



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What **pitfalls** should companies look out for when **incorporating eco-friendly materials**? How can they overcome them?

Shipbuilding is a century-old industry that follows many rules and regulations. Every ship is classified and certified by a classification society. These societies and companies certify every component of a ship, which is why ship owners, shipyards and ship designers are reluctant to invest in new, innovative materials — because they would have to demonstrate that this new material and component meet the same properties as the existing ones. To do this, they must go through heavy test campaigns like corrosion analysis tests or fatigue tests.

However, some classification societies have invested in certifying new manufacturing processes like additive manufacturing. Thus, classification societies are certifying new critical components — such as propellers or the injection nozzles on the engine — that have shown significant reductions in carbon emissions, thanks to additive manufacturing.



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Give three strategies of how companies can extract, process and transport metals and minerals to **lower their environmental impact** and **retain profitability** for better future-proofing.

Mining companies will need to develop several strategies. First, they will need to develop traceability of resources from the pit to the customer through their transparency. By informing customers where the products come from, companies can build trust and credibility. This helps customers make better purchasing decisions. Take a smartphone as an example. Armed with information on the materials' origin, the customer can say, "I will buy this smartphone instead of the other one because most of the minerals in this smartphone have been sourced more sustainably."

Another strategy for mining companies is to enhance visibility over sustainability KPIs. This will keep companies accountable and ensure they strive to improve, for example, achieving 100% of water circulation or 100% of renewable energies.

The third strategy to put in place is openness to external audiences. In the past, mining companies would provide information to their external stakeholders. Now, companies need to involve them in the decision making process. So local populations, NGOs, and governments need their say in operations because that will allow them to trust that the mining company is doing the right thing for the country and themselves. This will give companies the license to operate, which plays a much bigger role in mining operations.

The ecological impact of materials is talked about everywhere. How can companies **balance the environmental impact** of materials against cost, performance and quality?



**Michel
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First, what do we consider as a sustainable material? The most sustainable materials are the ones that combine multi-level advantages. These materials are extracted close to the processing site. They require minimal energy to be transformed, and they are durable and recyclable.

Unfortunately, all these conditions are very challenging to meet. Material selection often ends up with trade-offs. For example, recycled materials can lead to lower expectations in the new part's performance, also known as downcycling, due to partial loss of quality, including visual aspects, optical qualities or mechanical properties. This is where virtual twins can help assess and understand the impact of materials and identify the best way to gain maximum value for a longer time from a global perspective.

Your entire product lifecycle matters in a circular economy. This requires a rethink on how your products are designed, produced, used and disposed, repaired or recycled.

Read on to learn how to optimize product design for each phase while lowering the environmental footprint.



PRODUCTS

Share a few examples of **industrial waste reduction** practices that are economically viable. How would they impact existing value streams?



Andrea Cagnin
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Let me start by saying that there is a straight connection between waste and resources. The waste could be a resource. The relation between waste reduction and margin increase is straight. Waste shall be disposed of only when there is no other viable solution to transform it into a resource.

For industrial applications, life extension is an easy example of waste reduction. This will increase overall equipment efficiency. An example of this could be an assembly line machine. So, by just upgrading some modules instead of replacing the whole assembly line, the OEM can reduce waste while improving competitiveness with a more performant and modernized line.

When the assembly line is replaced with a brand-new line, the old machine could still be sold to low-tier countries with low-performance requirements. For this use case of secondhand markets, disassembly procedures,

transportation jigs and path traceability would be required to fulfill the reuse operations, considering quality and safety. As you can see, this is an extension of life that reduces product waste.

Lightweight engineering also plays an important role in industrial equipment customer circularity approaches. Designing lighter parts using 3D printing, for instance, will allow OEMs like robot manufacturers, line builders and building equipment OEMs to reduce the amount of raw materials used, but also to reduce part inertia for moving parts, with the consequence of reducing energy costs during the ownership.

The last example that I want to provide is, for me, the most important for industrial equipment: We cannot imagine the amount of spare parts that, every year, are scrapped due to obsolescence in the warehouses. So, industrial equipment customers like building equipment, elevators and specialized manufacturing machinery need to maintain assets for 30 to 50 years.

Having spare parts in the catalog and in the warehouse is key. You can imagine the amount of scraps that you leave behind. So, optimizing spare parts inventory in the warehouses – thanks to real-time monitoring and predictive maintenance, and using standard parts instead of custom parts to increase reusability – makes it possible to save tons of waste while reducing inventory and obsolescence costs.

Is a change in the manufacturing process enough to go circular? Why or why not?



Andrea Cagnin
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Unfortunately, no, because 80% of the product's environmental impact is defined during the engineering phase. During product development, performance is defined, specifically during the engineering phase when it's decided what will be recycled and how. Therefore, it would be complicated to go circular by only changing manufacturing processes.

Nevertheless, a change in manufacturing processes is required to close the circularity loop — being able to refurbish, reuse and recycle and recover parts to reduce material usage. This requires new manufacturing processes to disassemble, test, service and recover raw materials that are not part of the current linear production model.

Take the paper industry as an example. A few decades ago, paper was produced using trees, and not mashed, washed, recovered or recycled. Today, recycled paper is common in our daily lives, thanks to the evolution of manufacturing

processes. Plastic, metal, and other raw materials have the same history, which shows that manufacturing is evolving and will keep doing so.

In the past, the evolution of manufacturing processes was due to cost. Today, manufacturing is driven by an acceleration of raw material costs, scarcity of goods, increased energy costs, environmental regulation restrictions and geopolitical instability. These drivers will push manufacturing processes to lower production costs and resource dependency and comply with regulations, which reduces the effects of geopolitical instability.

In the coming years, products designed for circularity will be automatically disassembled by line machines into recycle, reuse or refurbish streams that could still be used in the next assembly.

How can **data science** help enterprises lower a product's **environmental footprint**?

To be more sustainable, you have to know how to be more sustainable. And most of the companies that I've met, they do not know — and knowing is being able to act.

So, this is where data science can help you, because by connecting the data that you have on your business and your activity, you are going to start to have an overview of: What is your environmental footprint? And this is in a detailed manner. This is how you can identify what the best levers are for you to be more sustainable.

An example of that is when you design a product. You are going to design it virtually. And right there, we can already say on a virtual product, during its conception: This is the



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environmental impact of this product, and it is detailed. It is not only each part of the product; you can identify if it is a frame, the engine or the embedded systems that are having the most impactful environmental footprint. But also, in time, is it the product manufacturing that will be costly? Is it the product usage that will generate a lot of emissions? So this is important — to have a 360-degree overview of how your activity has an environmental footprint and how your product can be changed. And you can identify the best lever on which you can act to optimize your environmental footprint. This can be done for the development of a coffee machine, a plane, a car or a glass. So, for all these products, you can anticipate their impact in a very detailed way to make the best decisions.

What are life sciences companies already doing to solidify their **environmental reputation**?

Share three practices that can be replicated.



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Life sciences companies have a lot of factors they have to balance all at once — the health of the patient, equitable healthcare for society, as well as the health of the planet. And while, certainly, much of the focus is on the health of the patient as well as equitable healthcare for society, there's a great deal of attention that the industry has on the environment that largely goes unrecognized.

Biopharma companies, for example, look at: How can they make manufacturing of treatments greener? Can they use less water for cleaning by scaling out their process? By having that process run several times in parallel? Or by scaling up that process into a larger bioreactor? Or is it more sustainable to use large stainless steel tanks that need to be cleaned? Or is it more sustainable to have smaller batches that utilize single-use materials that don't have to be cleaned?

As we've seen during the pandemic, companies also asked: Can we produce these treatments and vaccines much closer to the patient, thereby avoiding the CO₂ emissions it would take to ship that treatment around the world or to the patients themselves? We've also seen, during the pandemic, the emergence of telehealth and digital

approaches, where patients can get treatment from home without taking a long, time-consuming and CO₂-emitting trip to see their doctor or to visit the hospital.

Secondly, medical device companies are completely rethinking product design. They're very much looking at lifecycle assessment early in the design process: In particular, looking at how they can reduce plastic waste in packaging, as well as how they can increase the use of biocompatible, eco-friendly plastics in the devices themselves.

Finally, both medical device companies and hospitals are re-evaluating how they can reuse, refurbish and remanufacture equipment. This lowers the amount of medical waste that needs to be disposed of. And medical waste needs to be disposed of in a very careful manner that is not necessarily very sustainable. So, if we can lower the amount of medical waste that we generate, we're lowering the amount of CO₂ emissions from putting that not only into landfills but also burning it in certain cases. This also ensures that we're able to deliver healthcare much more equitably to the overall society.

What technology can help **ingrain innovation and circularity** across the entire pharmaceutical lifecycle? Give three examples.



John McCarthy
Business Value
Consulting Senior
Director, Life Sciences
& Healthcare Industry,
Dassault Systèmes

This is an area where scientists and engineers thrive on solving difficult problems. They love to dig into data to explore new approaches and understand how to solve problems differently. By giving them easier access to both technology and data innately, scientists and engineers can address sustainability challenges — and we can help them in several different ways.

First, make data and calculations easily accessible as scientists design manufacturing processes. Access to green chemistry calculations, process mass intensity and alternative green solvents allows scientists to simplify the tasks in their digital lab and find the things they may not have thought of initially.

Secondly, lifecycle assessment tools and data allow scientists to compare different approaches throughout the entire manufacturing process of a drug. This enables chemists, bioprocess teams and engineers to understand: What steps can I take in this complex process for my improvements to have the greatest impact on sustainability? Scientists can compare two ways to make the same product to determine which is more sustainable based on different sustainability metrics and factors.

Finally, learn from other industries. Take the consumer packaged goods industry, for example, where the circular economy has been driven strongly. Look at how these companies are using modeling and simulation to improve the sustainability of packaging. Packaging is often the last thing people think about in life sciences. But, looking at how consumer packaged goods companies deal with primary, secondary and tertiary packaging, we can make huge strides in the amount of waste put into landfills.

What would you tell a CEO who wants to embed more **sustainability practices** into their business? Which companies are on the right track with this?



Kai Zhang
BIOVIA Brand
Marketing Director,
Dassault Systèmes

Sustainability is not just a buzzword but a strategic move for modern companies. Today, I would like to share my point of view on how digital transformation can drive sustainability innovation throughout the organization.

Digital transformation is the key to innovating for sustainability. It's a process of integrating digital technologies into various aspects of your business to enhance operation, reduce environmental impact and create value. Let me explain why this is essential.

First, it is about data-driven decision-making. Digital transformation empowers your organizations with real-time data and analytics. By harnessing this data, you can make informed decisions with sustainability initiatives, track progress and optimize resource usage.

The second point I want to talk about is efficiency and resource optimization. Digital tools streamline processes and resource management, whether it's R&D, productivity, supply chain optimization, energy management or waste reduction. Digital transformation allows you to do more with less, cutting costs while reducing the environmental footprint.

The last point I want to make here is about innovation and product environment. Digital technologies enable innovative product designs and services that align with sustainability goals. For instance, creating products with longer lifecycles or offering digital solutions to reduce physical resource consumption.



I want to mention a couple of companies here as examples. The first one I want to talk about is Nippon Shokubai, a global leading specialty chemical company. The company aims to reduce carbon dioxide emissions by 30% by 2030 and to achieve carbon neutrality by 2050. Nippon Shokubai needed a more efficient, accurate way to acquire, analyze and integrate data from lab experiments, modeling and performance evaluation. By leveraging our modeling and simulation tools, Nippon Shokubai coupled computational methods with its lab analysis to discover more efficient catalysts and electrolytes. Nippon Shokubai's researchers have been able to expedite their product development and improve process efficiency significantly.

The second example I want to talk about is one of the largest pharmaceutical companies in the world. The company has been trying to improve productivity and accelerate product development. By implementing BIOVIA ONE Lab solutions, the company tripled process development projects without new headcount and gained 60% efficiency improvements in scientific and engineering analysis, which resulted in more than \$50 million in annual operational savings globally.

As you can see, digital transformation isn't just a technical operation. It's a strategic move toward a more sustainable and resilient future. It empowers your organization to innovate, reduce costs and lower environmental impact. By prioritizing digital transformation, you can lead your company into a new era of sustainable business practices, ensuring long-term success and contributing to a better world.

As we work to meet environmental targets, what can companies do to make products last longer?

Clearly, consumer behavior is changing. We are more careful about the products we buy. We want to reduce our own impact. Companies at the forefront of changing consumer behaviors anticipate this. Meanwhile, pressure from regulations and investors is pushing companies to propose durable products with more reliable components, built in a more modular way to be upgradable, repairable and ready for multiple lives.

You've probably heard about Fairphone. Fairphone is a well-known company because it's building phones with a modular design. But I'd like to mention another company called Crosscall. This is a French company that builds rugged smartphones and tablets with a five-year warranty,

including their battery. It sells to professionals from fire departments, the police, the army, and also to outdoor activity lovers, like some of you. At Crosscall, the supply chain has very strict standards. The company sets intensive torture tests to ensure that the products will fulfill their mission. It ensures software upgrades, and it listens to customers with dedicated programs. It is confident enough to propose refurbished products with a 12-month warranty, as Back Market does.

By the way, Back Market says that a refurbished smartphone saves 91% of raw materials, 86% of water and emits 91% less CO₂ than a new one. Isn't that a good reason to reconsider our next purchase?



**Michel
Monsellier**
Solution Experience
Director, High-Tech
Industry,
Dassault Systèmes

What initiatives are companies taking to significantly **reduce e-waste**? How can they uncover further **value** in the supply chain?



**Michel
Monsellier**
Solution Experience
Director, High-Tech
Industry,
Dassault Systèmes

In 2021, e-waste represented an incredible amount of the weight equivalent to 144,000 Airbus A380s. Can you imagine the parking lot?

Companies that have succeeded in fully cutting out e-waste are still exceptions. They represent the tip of the iceberg with a circular approach, designing waste from early product development stages so that nothing ends up in landfills or incinerated. All products retain some value at the end of life, but uncovering value remains a challenge for companies. Minimizing e-waste production requires companies to rethink their business model.

How can companies move toward circularity? Here are three ways:

1. **Product lifecycle analysis is the first step to gain visibility with clear metrics to take action.** This will feed eco-designs with tangible inputs.
2. With simulation, companies can identify the best option before producing a physical unit. **Simulation is meaningful at the product design stage and also for defining the assembly process that considers reparability, disassembly, refurbishing and recycling.**

3. **Supply chain collaboration is a major element of the equation.** Suppliers have to be onboarded as trusted partners in the global effort toward circularity.

You may have heard about the European project called EECONE — European ECOsystem for green Electronics. This project gathers 48 European entities, businesses, research centers and universities to propose practical ways for achieving a zero-waste electronic industry — by addressing chips, circuit boards and final products. Dassault Systèmes is involved in the EECONE project, leading the tools and metrics aspects together with the French Alternative Energies and Atomic Energy Commission (CEA).

How does a **single, connected virtual environment** help stakeholders deliver products with a **minimal environmental footprint**?



Delphine Gondoin
Business Value Consultant
Senior Manager,
Infrastructure, Energy & Materials Industry,
Dassault Systèmes

The demand for minerals and metals is skyrocketing due to the world's growing population and the energy transition supply chain. In parallel, mining resources are depleting while mining operations are becoming riskier and less profitable.

Mining companies need to reduce risks to maintain operations and profitability – the economic pillar of sustainability. How can they do that? They need to:

- Increase their knowledge of orebody to have a more targeted extraction
- Reduce operating costs and improve margins by resolving inefficiencies
- Enable visibility and traceability to build trust with external stakeholders for their social license to operate
- Lower the environmental impact for the company and the local populations

All these approaches will result in a large amount of data. Companies need to transform that data into knowledge so they will need powerful computational power and closer collaboration. These capabilities are the foundations of virtual twins in a single, connected virtual environment. All of this, in turn, can shorten the time to first ore – the average time between the discovery of a site and production – which is essential to achieve a circular economy.

What's the **ROI** of embedding circularity into all **stages of product development**?

The return on investment from including circularity in the different stages of product development can vary based on the following factors: Company size, industry, product type and the circularity strategy deployed.

However, there are common benefits of including circularity in product development:

1. Cost savings from using and reusing different raw materials with less waste management



Karim Fradj
ENOVIA Senior
Industry Process
Expert,
Dassault Systèmes

2. New revenue streams from secondary markets and from adopting new business models like service-based models
3. Enhanced brand reputation while avoiding paying all kinds of different fees by being regulatory-compliant

Companies are ready to embed **circular practices**, but how can they get going? What three areas will be good starting points?



Jean Benoit Bensoussan
Business Strategy Specialist, Marine & Offshore Industry, Dassault Systèmes

Today, over 95% of shipping's carbon emissions occur in operations during fuel combustion. Moving forward, the industry will consider the whole shipbuilding lifecycle. This will mean taking into account the impact of the raw materials, especially steel, and all the different components of the ship design – and the building processes until recycling. This is why circular economy principles should be built into every stage of the ship lifecycle, from design to construction and operation to recycling.

First, reduce and reuse materials during the ship design, using the lifecycle assessment (LCA) solution from Dassault Systèmes to assess different scenarios at the early concept stage.

Another quick, impactful solution is to demonstrate the lifetime extension of your assets, which can be done with LCA. We see more ship owners facing pressure from charters to operate clean ships. However, sometimes, it's wiser to show that you can extend the lifetime of your asset rather than scrapping it too early.

Finally, leverage predictive maintenance with IoT solutions to operate the ship at its optimal condition.



Remi Dornier

Vice President,
Architecture,
Engineering &
Construction Industry,
Dassault Systèmes

How can circularity be built into building designs? What are the benefits of 'Design from Supply'?

To deconstruct buildings, we must act early during the design phase, not during demolition. It starts at the conception and engineering phase, where engineers need to understand what is available on the market to design a building.

'Design from Supply' means that you want to design from the stock or you want to design from what is available, either reused or repurposed material, as well as material that we will be using inside your building. So, to achieve such an approach, you need to understand the stock available. There is a very interesting initiative that incorporates virtual twin practices to design a detailed model of the construction building so that you get the list of procurements, which is connected to the circular marketplace of supply.

So then, you can understand what's available locally in new regions and improve the circularity of the project. But this comes with its challenges. For instance, what do we do with all the constructed materials today? Are there territories available to store these? These are interesting questions we'll be following up on in the coming decades.

Which areas of the **product lifecycle** should companies pay special attention to and why?



**Carlijn
Goedhart**
DELMIA
Sustainability
Industry Process
Expert Specialist,
Dassault Systèmes

That area should definitely be the manufacturing phase, but let me explain further after saying this.

In the circular economy, we have to keep circulating our materials, products and materials to stop using virgin materials and eliminate the concept of waste. By doing that, our materials become more valuable, which means there is only room for purpose-driven products — products that add value to our lives.

Coming back to the question, the answer would be the early asset manufacturing phase, but it differs per product. We should apply lifecycle assessments to know which phase has the biggest environmental impact.

For example, aircrafts generate the most pollution in the usage phase, while electronics, like your mobile phone, have the most impact in the manufacturing phase — which is the case for most of our products. This is only the tip of the iceberg.

We often talk about energy and CO₂ emissions in the manufacturing phase. It's the hidden impact that we should look into. It's about land use or water usage. For example, watching television has much less impact than the materials that must be extracted and mined to manufacture all these components. So, companies can make a huge difference by improving their manufacturing processes. At the same time, customers have a lot of power to decide whether to buy these products.



Hrishikesh Mohan

Technical Director,
Consumer Packaged
Goods, Home &
Lifestyle and Retail
Industries,
Dassault Systèmes

Companies want to **reduce the environmental impact of manufacturing goods**, but it's said that PLM alone is not enough. Why? And what else do companies need to have in place?

PLM, or product lifecycle management, is a valuable tool companies use to manage their products from design to manufacturing to distribution to consumers, ultimately adding to the end of life.

Sustainability is concerned not only with the product lifecycle but also with the environmental impact of the users or the consumers, the industries, the economies, the environment and so on. **Companies need a broader view of the environmental impact**, which PLM systems often fail to consider, including the whole lifecycle cost and the product's ecological footprint.

To take a more holistic approach to sustainability, the PLM system needs to be tightly integrated into the lifecycle assessment (LCA) tool. This means the system gives you the environmental impact on the decisions you make while in the design process. **Research shows that decisions at the design stage influence 80% of the product's environmental impact.** So, suppose the decision makers can access supplier information from the PLM system. In that case, this can change the operations or how the product is made and distributed to the consumer until the product's end of life.

So PLM systems, the core of product lifecycle management, need to incorporate all the sustainability information from various sources, including your supply chain and operations.

Why are cities and regions expected to be pivotal in the **circular economy agenda**?

Cities are the key drivers of the circular economy. Today, urban areas represent 3% of the earth's surface but generate 70% of greenhouse gas emissions. Also, two-thirds of total energy demands and 50% of waste generation come from cities. Globally, cities strive to achieve sustainable development goals (SDGs) to become more inclusive, safer, resilient and sustainable.

The circular economy is a significant lever to achieve more carbon-neutral activities. In circular cities, everything operates within an interconnected network of systems designed to eliminate waste and pollution, circulate products and materials and regenerate nature.

Cities and regions are at the center of key decisions – and are essential in ensuring the circular economic model becomes pervasive. Necessary governance must be in place to create incentives, set up regulatory frameworks, simulate innovation and generate information.

To implement the circular economic agenda, cities and regions can intervene in four key steps. The first step is to promote the circular economy. Cities can become role models by implementing circular economy initiatives.

To do so, they need a clear strategy. Cities also need to establish goals and targets to raise awareness.

The second step is to facilitate connection and dialogue. Cities need to establish multi-level governance to develop a circular economy policy and foster local circular economy networks. This will facilitate stakeholder collaboration and initiate behavioral changes and exchanges between the different actors.

The third step is to enable appropriate governance conditions. Cities and local public actors need to define a regulatory framework to mobilize new financial resources that will develop their capabilities for obtaining different sources of finance and supporting local innovations.

And the last step is to encourage innovative approaches. The circular economy has been characterized by practices that focus on economic connections between industrial actors. A revolution is underway with digital transformation because the collection of standard data on all resources and all elements of the chain will support this sharing economy – and the use of digital platforms will facilitate the collaboration between stakeholders and the creation of new economic relationships.



Ismail Hamoumi
Business Value
Consultant
Specialist, Cities
& Public Services
Industry,
Dassault Systèmes

Your business constitutes a significant sector of the economy, and your actions have an extensive effect on our ecosystem. Explore how you can shift from linear to circular value networks — and make strategic decisions that benefit the bottom line and the planet.

ENTERPRISE



How can companies influence consumers' way of living through **design**?



Anne Asensio
Vice President of
Design Experience,
Dassault Systèmes

Typically, everything that companies deliver is a value proposition for the customers. That's the name of the game — that's what a company does. The quality and the differentiated value that they promise and propose, that's what makes companies successful.

But most customers today are also fully aware of the situation and the state of the planet. Right now, we feel a disconnect. We feel the struggle to change our behaviors, change the way we interact with the goods and change the way we operate on a daily basis.

How do we do that?

First of all, it's probably by understanding our impact on the environment, and how we do so is by stopping and proposing a new addiction, because today, we're addicted to an innovative and intensive way of living that is exhausting the planet. We need to shift — to shift to a more circular economy model, where stakeholders keep in touch with the assets' value and we maintain the state of the world.

There are two real positions. Customers, sometimes they believe in solutions, in engineering, but experts can't find solutions. So they're feeling powerless in a way, thinking that there is no way to change. And they just freeze completely. So this is what design can do. It proposes a new narrative. It proposes scenarios that bring value for behavioral change.

And I would like to say that it's probably the most important, the world of design. We can say circular design and circularity — it starts with design. To be regenerative or restorative, it starts with the way we design the product, how we design the system and the services, and the way we experience and interact with all of those goods and whatever fashion, vehicles and so on.

So the only way is to shift the narrative and also to shift in a way that you give contribution and access to people to act, engage and make the change. And to make the change, they need tools. They need to grasp the digital transformation and the capability to actually act at the crossroads of design and science. And that's what we would love to do at Dassault Systèmes.



**Anne
Asensio**
Vice President of
Design Experience,
Dassault Systèmes

Consumers want products that can transcend generations. Why are **durability** and **longevity** important factors for companies to consider?

The general audience, including us, faces climate change, biosphere stress and environmental issues. Well, whether we are too optimistic or believe only in techno engineering models, they are a third avenue. The third avenue is to change our relationship with our surroundings. I'm a designer, and I believe that an ethical and aesthetic approach could be a helpful avenue, a new approach for maintaining and providing a better quality of life.

We barely understand that the change we are entertaining right now is for a very short period if we compare it with the time we operate as humanity. We have a lot of knowledge and know-how – vernacular knowledge from craftsmanship, the power and knowledge of the hand. And I believe that, as a designer, we need to reconnect materials and digitalization and understand matter – not just how it works on a molecular level, but also how we can operate matter through assembly and construction.

This way, we can also imagine new shapes and new languages with artificial intelligence, combining a creative, artistic view and solid scientific simulation and representation of those inherent characteristics of materials.

How can we discover organisms and living organisms as biomimicry to define new models and data models to keep our interactions with this biosphere sustainable and safe? Products can transcend durability and longevity by understanding how we establish that relationship. Designers are good at articulating that knowledge and craftsmanship. We know that because it's the value of our culture and heritage. And it's interesting to place those kinds of low-tech capabilities at the heart of the most high-tech possibilities. Then, we can get high-quality luxury goods. For example, luxury goods companies can leverage cosmetics and high-tech and develop something desirable to shift customer behaviors.

Sustainable mobility is key to building **better cities**. What are five important **innovations in mobility** that companies can tap into now?



Christophe Montjault
Business Strategy
Director, Transport
& Mobility Industry,
Dassault Systèmes

Today, the main challenge for a better life in cities is to fight against pollution. In order to do that, we see five innovations.

The first innovation is the **transition toward electrification of the vehicle**. We see already some cities that have **banned internal combustion engine cars from their towns**.

Secondly, reducing traffic by **developing micro-mobility solutions like electric bikes or electric scooters**.

Third, **developing autonomous shuttles in connection with public transportation that is already in the transformation toward electrification**.

Fourth, **developing mobility as a service**: For example, being able to easily rent a vehicle when I need it and adapt it to my needs. It could be a bicycle, a family car or a van.

Fifth, **extended shared mobility offers**: For example, car sharing as the owner of a car in order to share my car with other passengers, but also as a passenger looking for a car for a defined trip. It's also carpooling that will facilitate the sharing of the vehicle.

Finally, this is the first time in the automotive market that there has been such a transformation: Traditional OEMs are facing new competitors and startups, so they will have to adapt in order to define a new business model to generate more revenue.

How are companies mitigating the **impact of mining**? Share three examples that have inspired you.



Delphine Gondoin
Business Value
Consultant
Senior Manager,
Infrastructure, Energy
& Materials Industry,
Dassault Systèmes

Mining companies today are making a lot of effort. They are talking a lot about how to be more sustainable and how to mitigate their effect. So, the first big effort that they're making is how to minimize their footprint. Indeed, if we are to open 60,000 new mines, we have to be very mindful of the footprint of the land surface that's going to be occupied. But also, as we're getting closer to vulnerable sites, human settlements, underneath the ocean and within spaces of cultural or environmental significance, we need to think about minimizing that footprint.

So, the first thing that can be done, for example, is to think about the rehabilitation of the site and how to leave the site as close to what it was before, when the mine closes. So, I can give the example of New Caledonia. When a nickel mine shuts, the land that's left behind is quite barren and very rich in metals. But in New Caledonia, they have found out that there are plants that are endemic to the area growing in heavy metal soils. As they grow, they enrich the soil with nitrogen, which will help future generations of plants, but they also gather, in their leaves, metallic compounds that can be used for the pharmaceutical industry.

Another example that we can give is about water quality. So, another example, in this case, could be: There is a uranium mine in France that shut its operation, but they left in place their water treatment facility, which was an ion exchange resin treatment plant. It is still in place to ensure that the water reaching the local town remains below 0.67 Becquerel — which is a fairly low level of radioactivity, even lower than the natural water around the area because it is a granite-rich area.

Another example that we can quote to mitigate the impact of mining is the development of collaborative hubs where mining companies, even competitors, have pulled together resources and efforts to solve the challenges that they're facing today. To minimize the risk mentioned earlier, they have put in place either intellectual or physical resources, and shared their plant or rail infrastructure or ideas and solutions to solve a problem. The ICMM centralizes that very well, and there are, today, a few collaborative hubs that are appearing.

To meet the IMO's zero-emissions roadmap, shipping companies need to invest in less polluting technologies. How can they balance both **circularity** and **profitability**?



Jean Benoit Bensoussan
Business Strategy Specialist, Marine & Offshore Industry, Dassault Systèmes

Well, when I think about success stories that have inspired me, there are three companies that come to my mind. First is Chantiers de l'Atlantique, together with another consortium, Très Grand Mat Carbone, who have been developing and building Solid Sail to be installed on commercial ships and passenger ships. We see today ship owners investing in wind-assisted propulsion. It's becoming a competitive advantage for companies to show their clients and customers that they're able to offer reduced greenhouse gas emissions in transport or shipment.

The other company that comes to my mind is Beneteau. Beneteau has committed to transporting its motorboat product lines on a sailing ship. It appears that sometimes it is better to transport your goods on smaller ships because

they will call into smaller ports, rather than big ports where there are long waiting times before you're able to berth and you're faced with heavy bureaucracy. And this obviously leads to saving time and money.

The last company that comes to my mind is Syroco. Syroco has been leveraging technology development on its sailing ship prototype in order to build a virtual twin platform to help ship owners model the energy performance of their ships. By doing this, the company is showcasing how its business model of data analysis and simulation can support ship owners in their sustainability goals.

What industry changes are happening now in the aviation value network? Why is a **cooperative ecosystem** important today, and how can companies achieve this?

Today, the change we are seeing is clearly the expansion of the aviation value network to other sectors and industries. Collaboration, which is needed to accelerate the development of sustainable aviation, is important to develop new systems that are the cornerstone of these industries.

For instance, we are seeing partnerships that are being reinforced in these new themes, like Airbus and Renault on the electrification topic, or Aéroports de Paris with Air Liquide on the hydrogen airport infrastructure. Or again, Airbus, Safran and Suez on the recycling topic, have connected through the startup Tarmac Aerosave.

Clearly, collaboration between companies is really crucial because it empowers innovation. Because as we know, batteries, for instance, are really the cornerstone of a lot of industries, such as aviation and automotive applications. This is why partnerships like Airbus and Renault, just to quote one of them, are crucial, because we know that the technology behind them is shared across multiple industries.

This is also important because circularity is, by definition, a matter of a lot of stakeholders, and it's a definition of a holistic way to define the new way of designing a product from its first stages until the end of life. So this is also part of the definition of circularity to handle with a lot of industries.



Lisa Belkhichane
Business Value
Consultant
Specialist, Aerospace
& Defense Industry,
Dassault Systèmes

Elaborate on **cradle-to-cradle systems (C2C)** where construction waste is **recovered, reused** or **recycled**. How can companies maximize their returns with C2C systems?



Remi Dornier

Vice President,
Architecture,
Engineering &
Construction Industry,
Dassault Systèmes

Today, construction waste represents approximately 40% of waste generated worldwide. Governments are enacting more restrictive laws to enforce material reuse. So, we observe rising initiatives to reduce waste, for example, reusing deconstructed concrete to decarbonate the slab — or sourcing and inserting bio-source components into the slab to create decarbonated materials.

Ultimately, the best waste is no waste. At Dassault Systèmes, we use virtual twins to optimize all the company's construction projects. Thanks to virtual twins, we can cut or drill, not on site, but in the factory. Through our customer Bouygues Construction in Bangkok, we've been working on installing concrete walls that are cut, adapted and drilled in the factory. These improve safety and reduce scrap while saving 15% of materials.

How can manufacturers refurbish, upgrade, quality-test and reuse parts from medical equipment? Share success stories from the life sciences and healthcare industry.



John McCarthy
Business Value Consulting
Senior Director,
Life Sciences & Healthcare Industry,
Dassault Systèmes

In the past, we reused medical devices more frequently than in the 50s and the 60s. Today, medical device and med-tech companies provide service and repair options to their healthcare customers. And recently, they've expanded on these offerings.

We work with many leading providers of endoscopes. Endoscopes are long, flexible devices with cameras that allow doctors to look inside the body with minimal invasion, whether through laparoscopic surgery in the gut or by looking into the lungs.

Recently, the FDA has worked with leading providers of endoscopes to find ways in which those devices can be reused and safely cleaned or disinfected and reused within a hospital setting. These leading endoscope manufacturers are looking at balancing the patient's safety from infection control while determining the best approach to utilize a single-use endoscope, either from a safety or sustainability perspective. Both approaches have their benefits. Sometimes, cleaning is more

effective. Other times, single use is more effective from a sustainability perspective. It may seem paradoxical, but in some cases, the cleaning process uses more environmental materials, such as water solvent systems, to produce a single-use device.

Secondly, we work with Stryker, a company with a huge array of products for the healthcare system – everything from wheelchairs and stretchers that go into ambulances to robots and knee replacements that go into patients. Its unique offering is the ability to refurbish and remanufacture several high-capital-cost hospital equipment. The company can often remanufacture and refurbish these devices at 60% of the original price to the hospital, which usually costs millions. Now, not only does this provide sustainability from an environmental perspective, but it also provides sustainability from the cost and affordability of healthcare. The hospital doesn't have to spend another 10 million on a new piece of medical equipment. It's able to pass those savings on to patients and provide healthcare at more affordable prices.

Finally, non-profits are also taking advantage of the refurbishing and remanufacturing of medical equipment. Non-profits can purchase refurbished equipment at much lower costs through Stryker. What's important for non-profits is that they can bring advanced medical devices and treatments to different parts of the globe in a more accessible and equitable fashion – focusing on the equity of our sustainability goals for healthcare.

Why is collaboration key in the **circular economy strategy** for cities and regions?

Collaboration is essential in a circular economy because it involves commitment and coordination between various stakeholders, such as governments, businesses and non-governmental organizations. Collaboration supports knowledge-sharing technologies and best practices and boosts the effectiveness of implementing solutions. However, the key issue is to establish effective collaboration. Stakeholders need to structure a common semantic to collect and share their inventory of resources.

Here are some key dimensions to take into consideration when a local government supports the implementation of circular economy principles:

1. Stakeholder engagement and motivation can secure common aims, incentives and frameworks of conditions. These are required to build synergies at the right scale.
2. Tailored communication methods can convert actors toward a circular economy model. Gathering stakeholders' comments, perceptions, information, advice, experiences and ideas can advance discussions and co-creation.
3. Co-decision and co-production — fundamental to the economic principles of the circular economy — are part of stakeholder engagement. These are characterized by a balanced share of power over policy or project decision-making processes.

Ultimately, every stakeholder has a natural place in the circular economy model.



Ismail Hamoumi
Business Value
Consultant
Specialist, Cities
& Public Services
Industry,
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How is the **circular economy** transforming the logistics sector today?

Most companies are focusing on sustainability, so I'd say the circular economy is accelerating a trend already in place. These actors are reinventing the way they think of operations from design to execution. By looping the supply chain and circular economy, companies can cut the rising cost of raw materials and cope with volatile availability.

Looping the supply chain also creates less waste while helping companies reduce their environmental impact. So, we may see more linear supply chains evolving into circular ones, and we may see this in different initiatives.

For instance, manufacturers refurbishing their discarded or old products may extend the life duration of equipment or even assets. Look at trucks, metals and equipment, pieces of automation, and buildings — we are seeing a lot of actors re-engineering old buildings

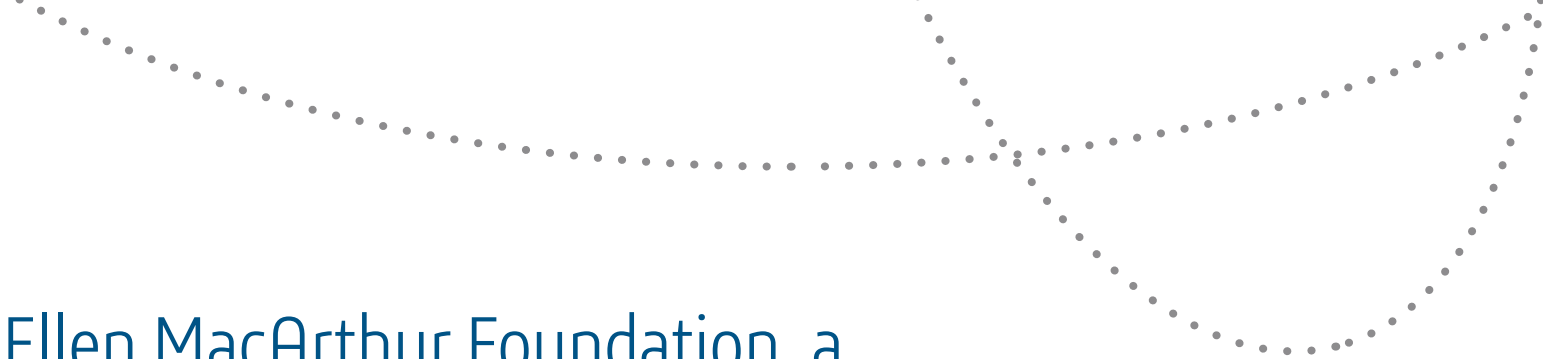
and changing the layouts to ensure the usability of the buildings and the assets, as well as transforming their current assets into more frugal warehouses.

And we should not forget that the greenest buildings are potentially already created. But if we need to create new ones, we must use more sustainable raw materials or products. For instance, the new cement generation for slabs generates 20% less carbon emissions than the previous generation. They also use recycled products.

Think about transforming operations on planning sites to increase the usability of resources and equipment. Also, consider how technology can help and support this circular economy improvement. For instance, setting up sensors in tires will help reduce fuel consumption and extend the lifespan.



Yann Pithon
Business Value
Consultant Expert,
Business Services
Industry,
Dassault Systèmes



According to the Ellen MacArthur Foundation, a key opportunity in the circular economy is **creating new value chains** and **optimizing material flows**. How can companies incorporate this?



**Carlijn
Goedhart**
DELMIA
Sustainability
Industry Process
Expert Specialist,
Dassault Systèmes

The main answer is collaboration. In the circular economy, we have to keep all products and materials in the loop. Then, you'd have the outputs, which are no longer waste but are the inputs of another process step.

For example, we have a large-scale customer in the automotive industry. It changed its processes to use the scrap or the product for its intended purpose, which made the scrap more valuable. Think of a bumper, for instance. The company can reuse it as a bumper for the next car rather than recycle or downcycle it into another plastic product.

If we make this bigger and scale it, we make a value chain that should be built upon collaboration, trust and transparency. At Dassault Systèmes, we can enable companies to optimize their sourcing strategies. But if the suppliers are not open about the quality and amount of recycled materials, success is futile.

Dassault Systèmes has been optimizing material flows for years. But until now, it was mainly for separate companies. Now, it's about linking these companies to each other. And we are in talks to build that value chain. The value chain's benefits are keeping components in the loop longer while optimizing waste on a much larger scale — such as water, materials and energy.

How can companies successfully create reverse flows to **foster product reuse and recycling?**



**Carlijn
Goedhart**
DELMIA
Sustainability
Industry Process
Expert Specialist,
Dassault Systèmes

We can start by making a distinction between biological and technical materials. Wood is an example of biological materials. Wood can cycle between the economy and nature, so we don't care much about reverse flows. So, I would encourage people and companies to use more of these materials.

As for technical materials, these are slightly different because they cannot cycle back into nature like steel or plastics. For the reverse flow, a solid network of reverse logistics must be in place on an operational level.

Dassault Systèmes can help simulate these concrete logistics reverse flows by optimizing frequent routings. We currently do this with leading companies, but the reverse flows are limited.

Think of the empty bottles in the supermarket. So, consumers get deposits when they buy the bottles at the supermarket. And then, these bottles can be brought back into the truck that goes back to the warehouse, but that always fits. What happens when the volume scales up and becomes larger? Then, the logistics puzzle becomes more complex.

And it's not only for supermarkets but also electronics, furniture and fashion. So suppose that people hand in their second-hand clothes at the shop, then the reverse flows become more interesting. Dassault Systèmes enables companies to deal with these reverse flows, and we have proven that we can do that without extra costs.



Andrea Cagnin
Senior Business
Consultant,
Industrial Equipment
Industry,
Dassault Systèmes

How is the **transition to the circular economy** impacting business models today? Share three ways for companies to embrace circularity from an enterprise level.

Before answering the 'how', let me answer the 'why'. So why do companies need to move to circularity?

The first reason is to comply with regulations, mainly to reduce fines and disposal costs. The second reason is to reduce material costs driven by increasing goods scarcity and product costs. The third reason is to improve the brand image since customers are increasingly attentive to environmental matters – this is key to growing revenue and increasing market share.

Now, let's move to the 'how'. To embrace circularity, companies need to adopt an end-to-end approach. The scope of product assessment must be extended from solely manufacturing to a cradle-to-cradle point of view. It's essential to design products to maximize the recyclability and material recovery rate at the end of the product lifecycle.

Modularization and modernization techniques help in reducing end-of-life waste. So, costs should be kept as low as possible while keeping other equipment efficiency as high as possible throughout the product lifecycle. System of systems help understand the iterations within

different systems and the trade-offs in sustainability and operational matters.

Everything is driven by regulators to push OEMs into embracing circularity directives like ROHS, and WEE waste from electrical and electronic equipment. Digital passport regulations are pushing OEMs to reduce hazardous material usage and track them all along the product lifecycle.

Dassault Systèmes is assisting in transforming an operational business model to a product-as-a-service business model, mainly to reduce CAPEX. This change has a major impact on product development since OEMs own the asset during the whole ownership phase. Hence, OEMs need to reduce service costs by working on spare part costs, maintenance costs, downtime and asset efficiency.

You can see that the trend for OEMs was to sell the machine at the lowest price possible while selling the services during operations at a high price. Now, OEMs have to work differently, which is a complicated and different approach.

Share three ways of how companies can **influence its value network** to speed up the circular economy transition.

Companies are trying to build cross-industry networks in a circular economy to have interconnected supply networks. Those supply networks will allow them to manage resources according to the 3R strategy: Reduce, reuse and recycle. To achieve this, companies need to:

- Influence the value network from the beginning by incorporating circularity aspects into their designs
- Focus on customer engagement and education around circularity
- Set up clear KPIs for whatever partnership they build to incorporate circularity



Karim Fradj
ENOVIA Senior
Industry Process
Expert,
Dassault Systèmes

Circularity extends beyond the creation of new products. How can companies **monitor** and **optimize the carbon footprint** of their businesses after manufacturing?



Diana Goenaga
NETVIBES Strategy
Director,
Dassault Systèmes

To be more sustainable, we must create new ways of doing things while managing existing products and processes. Systems in operation are crucial to improving our environmental footprint. To do this, it's important to know what's happening through monitoring. This is where data comes into play.

Armed with data science, we can observe and learn how things will optimize the global systems in operation.

And this is key: If factories run, they must not run for nothing. Factories have a huge environmental footprint, but we can optimize, for example, a factory producing glasses or parts for a given industry. Factories produce scrap and substandard parts, which we can reduce by improving quality.

Another example is all the cars we use for transportation. We do not have to own the car, but we can rent it. So if there are breakdowns, we will need to repair the car, which might require a part from across the world, or we may need to rent another car. This is extremely bad for the environment.

What we can do with data is observe and learn from those data to detect the weak signals that always happen before breakdowns. This helps prevent those events from happening and to plan scheduled maintenance. This is what we call preventive maintenance. Preventive maintenance is more economical and sustainable for companies because they can mitigate risks ahead.

Another point I want to highlight is that companies have inputs and outputs, but some don't valorize their outputs, such as waste, byproducts or scrap. But other companies could find value in those outputs. It's time to move away from an open and closed lifecycle with things we let go of in the environment and do not valorize. Instead, let's make cycles and connect all those companies through data science to enable circularity.

Gain a circular advantage

The driver of the circular economy isn't scarcity; it's opportunity. By keeping resources economically productive for as long as possible, companies can achieve greater success. And those who get there first will achieve a circular advantage that differentiates them in their market.

“Although the circular economy is indeed a challenge, through the power of technology, we can make it achievable, scalable and profitable.”



– Philippine de T'Serclaes,
Chief Sustainability Officer,
Dassault Systèmes

Backed by deep expertise, experience with today's industry leaders, and involvement as a member of the Ellen MacArthur Foundation, Dassault Systèmes is uniquely positioned to help you turn circularity into a growth driver for your business. The challenges are real. But so are the opportunities.

MEET OUR EXPERTS



Anne Asensio

Vice President of Design Experience

Anne Asensio founded DESIGNStudio, a multidisciplinary team focused on innovation strategy through design experiences, research, management and consultancy. Advocating new technologies and virtual universes, DESIGNStudio collaborates with Dassault Systèmes' clients to transform their ideation and creation processes, and the value proposition for their customers.



Lisa Belkhichane

Business Value Consultant Specialist, Aerospace & Defense Industry

Drawing upon over 10 years of experience in aerospace and defense, Lisa Belkhichane focuses on sustainability in the aviation industry. She holds a PhD in supersonic combustion engineering at the Georgia Institute of Technology, specializing in the development of a scramjet (supersonic combustion ramjet) prototype.



Jean Benoit Bensoussan

Business Strategy Specialist, Marine & Offshore Industry

Jean Benoit Bensoussan drives consulting and pre-sales activities while supporting business development for the marine & offshore industry. Bensoussan graduated from ENSTA Bretagne as a naval and offshore engineer. He also holds an MBA from ESCP Business School.



Andrea Cagnin
Senior Business Consultant,
Industrial Equipment Industry

Andrea Cagnin brings over five years of experience in the automotive industry and seven years in oil and gas. Since 2020, he's been responsible for the development of the IE offer and customer engagement on sustainability.



Mel Creasey
SIMULIA Business Development Consultant

Bringing in over 30 years of experience, Mel Creasey is dedicated to demonstrating the **3DEXPERIENCE®** in packaging development and optimization. He provides support to customers, especially those in consumer packaged goods & retail, to help them grow their packaging-related business.



Remi Dornier
Vice President, Architecture,
Engineering & Construction Industry

With 16 years of experience in the company, Remi Dornier leads Dassault Systèmes' initiatives for the (AEC) industry. He developed his leadership and management skills with multinational corporation clients such as Bouygues Construction, CRDC, SMEDI and CHIDI.



Karim Fradj
ENOVIA Senior Industry Process Expert

Karim Fradj supports Dassault Systèmes customers in their digital transformation journeys, with a focus on quality and sustainability. He holds an engineering degree in electronics and signal processing, as well as a Master's degree in quality management.



Carlijn Goedhart
DELMIA Sustainability
Industry Process Expert Specialist

Since 2021, Carlijn Goedhart has been the sustainability lead for the DELMIA brand at Dassault Systèmes, responsible helping customers become more sustainable. She earned her MSc degree in operations management and logistics (healthcare track) from Eindhoven University of Technology in 2014.



Diana Goenaga
NETVIBES Strategy Director

Diana Goenaga drives the business development of data science experiences by demonstrating how businesses and people can integrate with the power of data and AI. In her previous roles at Dassault Systèmes, she provided corporate strategy on new technologies and lead NETVIBES's AI strategy.



Delphine Gondoin
Business Value Consultant Senior Manager,
Infrastructure, Energy & Materials Industry

With 11 years of experience in her current role at Dassault Systèmes, Delphine Gondoin drives value within the IE&M industry by leveraging her expertise in earth resources and engineering.



Ismail Hamoumi
Business Value Consultant Specialist,
Cities & Public Services Industry

Ismail Hamoumi joined Dassault Systèmes in 2023. His work focuses on developing business and offerings for public sector players in France, North America and South Korea. His past experience includes strategizing and deploying smart city projects. He studied at Sciences Po Paris, the University of Saint Andrews, the London School of Economics and Ecole des Ponts Paris Tech.



John McCarthy
Business Value Consulting Senior Director,
Life Sciences & Healthcare Industry

John McCarthy has worked with leading companies to deliver software-based solutions to increase the pace of innovation for the past 30 years. An accomplished business strategist, he works with clients to understand their scientific, engineering as well as business challenges and identifying solutions for these challenges.



Hrishikesh Mohan
Technical Director, Consumer Packaged Goods,
Home & Lifestyle and Retail Industries

Hrishikesh Mohan is a business-oriented technical professional with 20 years of experience in delivering solutions for various industries. He is currently responsible for providing business and people with **3DEXPERIENCE®** universes to imagine sustainable innovation capable of harmonizing product, nature and life in consumer industries.



Michel Monsellier

Solution Experience Director, High Tech Industry

Michel Monsellier is an expert in software solutions that transform the development of smart devices, ultimately enhancing consumers' lives. He has over 20 years of experience serving diverse clients at Dassault Systèmes across pre-sales, support and consulting roles.



Christophe Montjault

Business Strategy Director, Transport & Mobility Industry

Christophe Montjault helps transportation and mobility companies transform their operations, with a focus on business strategy and sustainability. He joined Dassault Systèmes in 2001 and was previously involved in the development of CATIA V5 software as well as customer engagement.



Yann Pithon

Business Value Consultant Expert, Business Services Industry

Yann Pithon supports the development of solutions for the global logistics sector, tailoring Dassault Systèmes offers to customers' distinct challenges and objectives. He brings extensive expertise in operations and technology through over 20 years of experience in supply chain management.



Kai Zhang

BIOVIA Brand Marketing Director

Kai Zhang has over 15 years of experience in global marketing, R&D and product development. He empowers scientists to innovate better and faster with advanced software solutions. Zhang holds a Ph.D. in Organic Chemistry from University of Pittsburgh and an MBA from Carnegie Mellon University.

Our **3DEXPERIENCE®** platform powers our brand applications, serving 12 industries, and provides a rich portfolio of industry solution experiences.

Dassault Systèmes, the **3DEXPERIENCE** Company, is a catalyst for human progress. We provide business and people with collaborative virtual environments to imagine sustainable innovations. By creating virtual twin experiences of the real world with our **3DEXPERIENCE** platform and applications, our customers can redefine the creation, production and life-cycle-management processes of their offer and thus have a meaningful impact to make the world more sustainable. The beauty of the Experience Economy is that it is a human-centered economy for the benefit of all –consumers, patients and citizens.

Dassault Systèmes brings value to more than 300,000 customers of all sizes, in all industries, in more than 150 countries. For more information, visit www.3ds.com.

