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# HOW CLOUD TECHNOLOGIES HELP MANUFACTURERS DRIVE SUSTAINABLE PRODUCT DEVELOPMENT

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E-BOOK

# INTRODUCTION

## The Gaia Hypothesis–Everything on Earth Is Connected

During the early 1970s, environmental philosopher James Lovelock theorized that interactions between the Earth's living creatures and their inorganic surroundings produced and maintain the climate and biochemical conditions that allow life to exist on Earth. This idea evolved into the Gaia hypothesis, named after the ancient Greek Earth goddess.

Humans are also part of that interaction, dependent on the oceans, air, and forests for our existence in the same way as every other living thing on the planet—a superorganism. As inhabitants of the planet, we all have a moral obligation to preserve the Earth for each other, animal life, and future generations.

Scientists and environmentalists around the world agree that the planet's climate requires immediate action to avert a catastrophe.

### What Is Sustainable Innovation?

Sustainable innovation is the act of continuously improving your products, processes, and workforce to create a brighter, more sustainable future—for your customers, your employees, and the environment. Sustainable innovation supports growth and profitability by facilitating product reuse and circularity and making business operations safer and more efficient.

# SUSTAINABLE INNOVATION DRIVES BUSINESS GROWTH AND HELPS MEET DEMAND

The shift in consumer buying, where more consumers are willing to pay more for environmentally conscious products, underscores the need for manufacturing companies to enhance their commitment to responsible business practices using technologies that support more sustainable product design and development. Companies across industries have started to lead with purpose, including leveraging the circular economy as a greater opportunity to drive growth and competitive agility.

Global production is a major source of waste, pollution, and greenhouse gas emissions that have a detrimental effect on the environment by accelerating climate change and deforestation. Consumers, investors, government, and employees continue to put additional pressure on manufacturers to lessen the environmental footprint of their operations and products as the effects of climate change are becoming widely recognized.

The growing volume of waste from consumer electronics products is making global headlines and ultimately influencing consumer buying behavior. Customers and companies alike seek electronic devices that are built with environmentally conscious materials, offer a low carbon footprint, and can be recycled or disposed of safely with minimal impact on the environment.

Today's leading product manufacturers are responding by adopting a greener approach to product development using modern cloud solutions like product lifecycle management (PLM). Cloud services are inherently more sustainable than on-site IT infrastructure. Public cloud data centers consume energy more efficiently and they can consolidate energy demand from multiple organizations.

## External Forces Creating Urgency

- **Environmental Regulation Agencies:** Increased taxes, penalties, and restrictions from environmental regulation agencies
- **Environmental Sustainability:** Rising consciousness around environmental sustainability and the circular economy (from customers/consumers, employees, and investors)
- **Higher Costs:** Higher costs for water, energy, and raw materials due to resource scarcity
- **Employee Skills Gap:** Growing employee skills gap across the manufacturing industry
- **Natural Disasters:** More frequent and disruptive natural disasters due to climate change
- **Deforestation:** Deforestation due to the need for paper and global expansion

Making sustainability a key consideration early in the product lifecycle can create a significant downstream impact. Organizations that prioritize sustainability in this way are realizing a variety of business benefits such as faster growth, improved margins, greater shareholder value, reduced environmental impact, and increased brand trust.

The greatest challenges to implementing sustainability practices are rarely in software technologies but in business cultures that resist change.

# GLOBAL ENVIRONMENTAL INITIATIVES

## SDG, a Blueprint for a More Sustainable Future

In September 2018, the United Nations launched the SDG Media Compact, an initiative marking a new drive to advance awareness of the Sustainable Development Goals (SDGs). The SDG Media Compact began with 31 founding media and entertainment companies and has grown into a powerful alliance of over 200 members around the world, spanning 160 countries on five continents, with a combined audience of about 2 billion people worldwide.

The Sustainable Development Goals are the blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including poverty, inequality, climate change, environmental degradation, peace, and justice.[1]

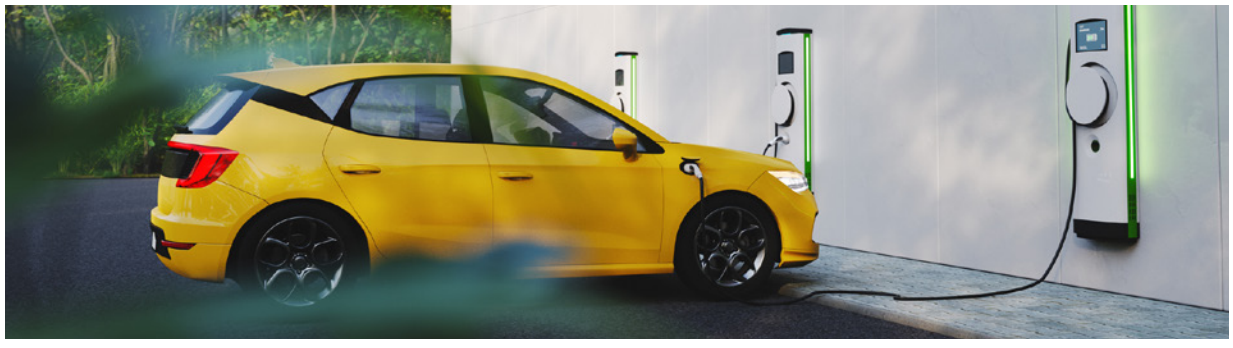
## Net Zero, U.K.'s Answer to Zero Emissions

On June 27, 2019, the United Kingdom (U.K.) became the first major economy in the world to pass laws to reduce all greenhouse gas emissions to net zero by 2050. By 2040, all new cars and vans should be almost zero emission vehicles, positioning the U.K. at the forefront of the design and production of such vehicles.

By 2040, the U.K. will stop selling new conventional gasoline and diesel cars, as stated in the NO2 strategy. By that time, the government anticipates that most newly sold cars and vans will be entirely zero emission vehicles and that all new vehicles will have a significant amount of zero emission potential.

The government's goal is to be the first generation to improve people's health and quality of life throughout the U.K. and leave the environment in a better state. By promoting clean energy, lessening the U.K.'s reliance on imported fossil fuels will shield consumers from global price increases.

Now that the European Union (EU) and many other countries have decided to follow suit, net zero has been accepted as the optimum course of action to save both humans and the planet from the effects of rising global temperatures.



**What Is Net Zero?**

Net zero means cutting greenhouse gas emissions to as close to zero as possible, with any remaining emissions re-absorbed from the atmosphere, by oceans and forests for instance.

**Why Is Net Zero Important?**

Science clearly shows that to avert the worst impacts of climate change and preserve a livable planet, global temperature increase needs to be limited to 1.5˚C above pre-industrial levels. Currently, the Earth is already about 1.1˚C warmer than it was in the late 1800s, and emissions continue to rise. To keep global warming to no more than 1.5˚C as called for in the Paris Agreement—emissions need to be reduced by 45% by 2030 and reach net zero by 2050.

**17 Sustainable Development Goals**

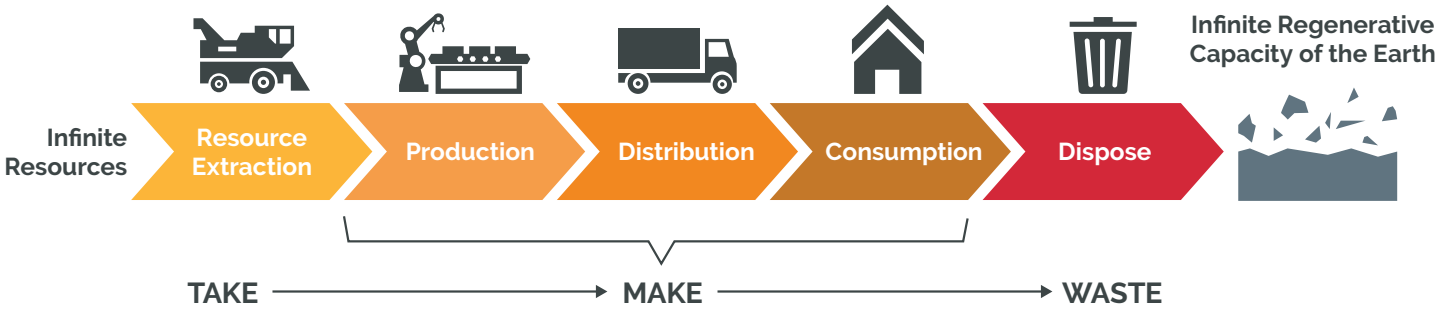

*Source: un.org

# LINEAR AND CIRCULAR ECONOMIES

## Linear Economy

In a linear process, resources are taken from the Earth and used to manufacture products, and then discarded as waste. When visualized, a linear economy resembles a flat line. Value in the linear economy is created by mass production and the selling of products.

However, the tendency of a linear economy toward wasting valuable materials is a significant problem on a planet with finite resources. A linear economy exhausts raw materials and energy, which results in $CO_2$ emissions—worldwide, 85% of energy comes from non-renewable sources.[2]

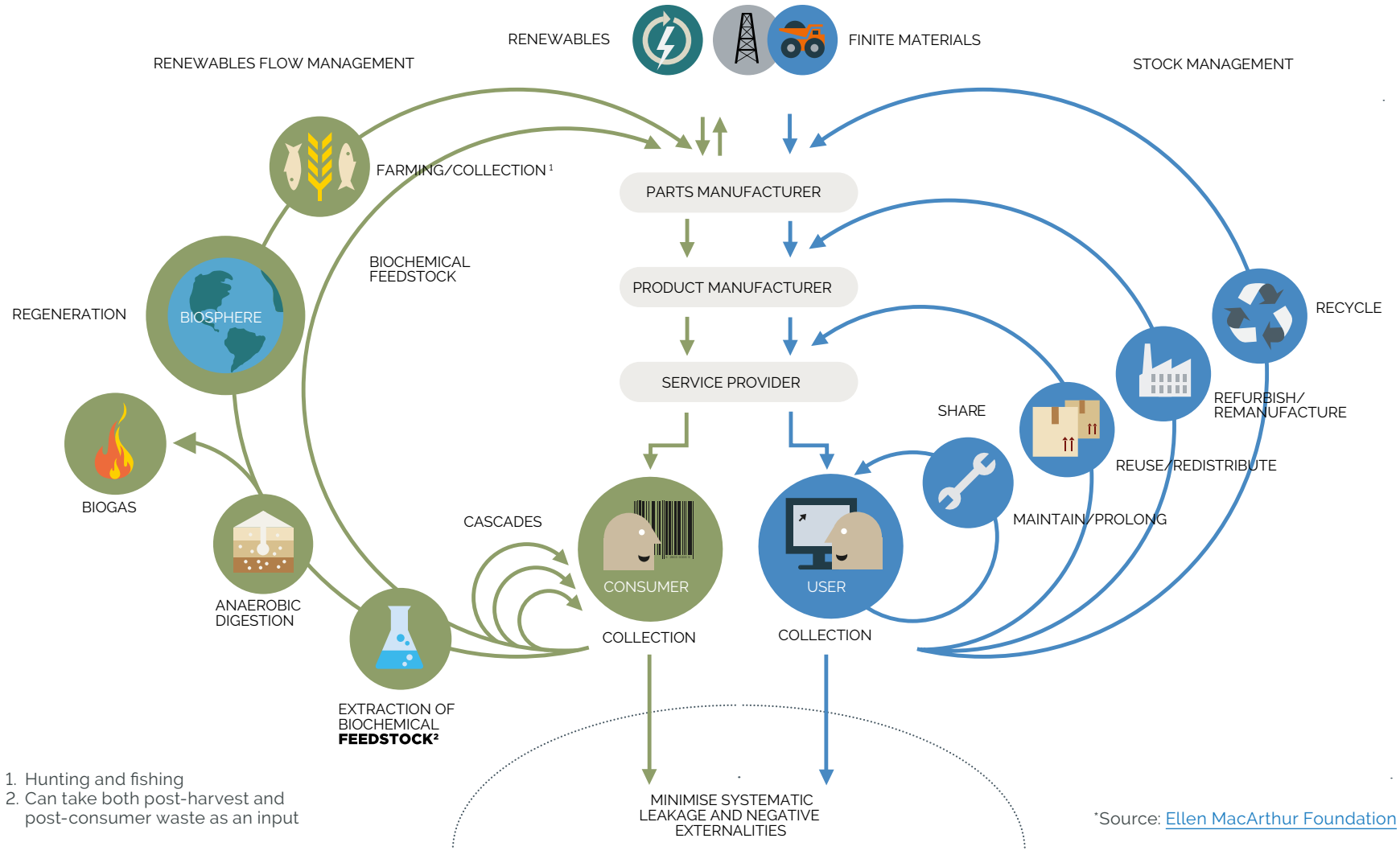



## Circular Economy

In a circular economy, the initial production of waste is stopped. The circular economy is a framework, a continuous flow of materials categorized by two main cycles—the technical and biological cycles. Within the technical cycle, products and materials nearing the end of their useful life are kept in circulation through processes such as reuse, refurbishment recyclability, remanufacture, and recycling. In the biological cycle, the nutrients from biodegradable materials are returned to the Earth to regenerate nature.

The circular economy provides three important principles:

1. Elimination of waste
2. Circulation of products and materials
3. Regeneration of the natural environment




1. Hunting and fishing
2. Can take both post-harvest and post-consumer waste as an input

*Source: Ellen MacArthur Foundation

## PLM's Function in the Circular Economy

A circular economy offers the chance to innovate new business models and rethink what we mean when we say something is a product, a service, or a product-as-a-service (PaaS) because it is an invention in and of itself. Adopting a more circular way of thinking requires having different expectations for information technology solutions, such as PLM, that support the implementation of these new business models' commercial strategies.

### What Is Product-as-a-Service (PaaS)?

Product-as-a-service is a business model that provides a service in areas that were traditionally sold as products. A service model provides ongoing interaction with customers including support. Services may also offer the ability to exchange a product on a regular basis for a different or newer model.

**Example:** Solar panels that are sold as a service to owners of a building or home.

# BUSINESS AND ENVIRONMENTAL BENEFITS OF THE CIRCULAR ECONOMY

A circular economy gives companies a stronger sense of corporate social responsibility (CSR) that they can put into practice and measure. Aiming to promote reuse and decrease waste in manufactured goods, the circular economy is a restorative and regenerative process. By managing finite stocks, a circular economy maximizes resource returns, protects and enriches natural capital, and reduces system risks.

Companies will be able to transition to a circular product development model with the support of PLM's role in developing a sustainable circular economy. With PLM in place, the end of a product's life is when the product is used and returned to the manufacturer to be recycled or refurbished. PLM's role in supporting a circular economy benefits the organization and society.

## Benefits to Your Organization:

- **Increased efficiency:** Sharing real-time information with every stakeholder involved in designing and building products allows teams to optimize designs and streamline manufacturing approaches. This leads to faster and more efficient product development.
- **Improved collaboration:** A connected PLM infrastructure in the Cloud allows for better collaboration between different teams and departments, as all product-related information is stored in a central location and can be accessed by authorized personnel. Decision-making and communication across the organization can both benefit from this.
- **Enhanced visibility:** A PLM system gives management a clear and comprehensive perspective of the product development process by serving as a single source of truth for all product-related information. This can assist in locating bottlenecks and potential improvement areas.
- **Reduced risk:** Keeping the complete product record in a controlled and centralized location reduces the risk of data loss or inconsistencies. This can also help ensure that the product is developed in accordance with regulatory requirements and organizational standards.
- **Increased competitiveness:** A comprehensive PLM platform can help companies bring new products to market faster, with fewer errors, giving them a competitive advantage in their industry.

## Benefits to Society:

- Promotes innovation and infrastructure
- Responsible consumption and production
- Reduces carbon emissions and footprints
- Reskills the employees and the organization

# TRANSFORMING PRODUCT DESIGN FOR CIRCULAR ECONOMY

Product design has traditionally meant "design for manufacturability" for manufacturers. The typical product model has always been to introduce products at their lowest possible cost and not worry about what happens at the end of the product's lifespan.

Designing for circularity considers the entire life of parts—from design to production to service to the end of life, with a focus on reusability that helps to achieve a "value circle" that benefits all stakeholders.

With organizations focusing on circular economy and sustainability, PLM aligns better to reflect the needs of a globalized economy where resources are circulated and nature is regenerated. A PLM system can capture and carry information about how a component or a part can be repurposed for a second or even third life. Likewise, information on how the product can be disassembled and remanufactured, and what the recyclability options are for different materials, is valuable for the downstream economy.

As manufacturers transition from the traditional approach of selling their products toward offering their PaaS, the need for a digital backbone like PLM is even more critical.

## Sustainable Product Designs With Dematerialization

Many commercial artists use thumbnail sketches, a quick rendering, or series that help the artist plan and visualize their final artwork. Similar in concept, a manufacturing engineer can input their idea along with design goals such as parameters, materials, performance needs, spatial requirements, or cost constraints into the generative design computer-aided design (CAD) software. In turn, the CAD software creates hundreds of alternative and intricate designs that offer lighter or stronger part(s) variations that can be transformed into a prototype.

Generative design offers engineers and designers multiple working variations instead of a single solution, allowing the engineer to choose a design that works best. From aerospace to consumer goods, engineers are using generative design to consolidate multipart assemblies into single-part products in addition to reducing the amount of material used. This helps reduce the number of materials and can simplify the overall manufacturing process by reducing downstream assembly.

Likewise, the automotive industry uses generative design to help consolidate multiple part assemblies into one, which means fewer components are warehoused in inventory and helps to streamline supply chains. With generative design, manufacturers can achieve faster prototyping to reduce waste and improve time to market.

## Lightweighting Uses Fewer Materials, Lowers Costs, Saves Resources

Engineers have been searching for ways to reduce component and assembly weight for decades to produce greener and more cost-effective products, especially in the automotive and aerospace industries. Lightweighting removes weight from a component or assembly. Producing lightweight products means using fewer materials, lowering costs, and saving resources.

Designers and manufacturers lightweight products in one of three ways:

- **Substituting materials:** Replace heavier materials with less dense and/or stronger materials and components. With the right design, heavy materials like metals can be replaced with plastics or ceramics.
- **Optimizing designs:** Another method of reducing weight is to implement different technologies to enhance a current design.
- **Eliminating materials:** Components can frequently be eliminated from assemblies while still meeting structural, flammability, and thermal criteria as production methods and materials advance.

Some key benefits of lightweighting include:

- **Material savings and reduced environmental footprint:** Lighter parts often have lower material costs than their counterparts and typically require less energy to manufacture.
- **Greater fuel efficiency:** While lighter components are frequently desired in engineering, they are particularly useful in the production of automobiles, where a 10% weight reduction can result in a 6-8% increase in fuel efficiency.
- **Expanded material options:** In many circumstances, product teams' options are constrained by the density and weight of a desired material. Materials that might not normally be suitable for a certain application can have their capabilities expanded by intelligent lightweighting techniques like latticing.
- **Improved performance:** Using lightweighting in conjunction with strategic design decisions can enhance part performance.[3]

*Source: PTC.com

## Integrating PLM in the Product Design Process

To generate and prioritize designs that employ recyclable materials and/or less material while preserving performance, product designers can turn to CAD platforms with cutting-edge AI-driven capabilities like real-time simulation, generative design, and lightweighting. Even slight weight reductions can have a significant impact on operating performance and costs, which are the primary sustainability measures.

Making such designs reusable and connected throughout the value chain and integrated into the development process will be greatly supported by PLM. Connections between CAD and PLM solutions enable supply chain visibility early in the design process. This not only helps designers source the correct buy parts that are more sustainable and meet environmental compliance regulations, but also enables collaboration with extended product teams to accelerate new product development processes. Companies can become more efficient by creating and leveraging PLM best practices between teams through design reuse and collaboration.

# ENVIRONMENTAL COMPLIANCE IN THE U.S. AND EUROPE

Manufacturers are driving new products to market every day that impact our lives in various ways. While these products aim to enhance our quality of life, they also influence the environment.

As more manufacturers develop sustainable products by simplifying parts, recycling, or refurbishment recyclability, they must also navigate environmental laws. The Environmental Protection Agency (EPA) sets and implements environmental legislation, funds and conducts research, and guards against serious health threats to people and the environment. The European Green Deal outlines how Europe may become the first continent to be climate neutral by 2050. Reaching this target means creating a clean, circular economy, restoring biodiversity, and cutting pollution.

Compliance regulations vary by region and industry. A U.S. medical company will differ from a European automotive company, yet both must ensure that they are globally compliant if they want to sell their products on international markets.

The following regulations pertain to products that are manufactured, imported, or sold in the EU market.

- **REACH–Registration, Evaluation, Authorisation and Restriction of Chemicals**
  REACH mandates an assessment of chemical qualities, identifies the dangers to human health and the environment that go along with them, and ensures that information is shared with suppliers and downstream consumers in the EU market. The REACH standard's main goal is to encourage the gradual replacement of the most hazardous compounds.
- **WEEE–Waste from Electrical and Electronic Equipment**
  The WEEE regulation is the prevention of waste from electronic and electrical equipment near the end of life. Electrical waste is made up of an intricate variety of substances, some of which are dangerous. Products may produce dangerous (hazardous) compounds including lead, mercury, and cadmium during use; collection, treatment, and disposal of such waste can have serious negative effects on the environment and human health. Modern electronics also include rare and expensive materials that, with proper waste management, can be recycled and utilized again.
- **RoHS–Restriction of Hazardous Substances**
  The goal of the RoHS regulation is to reduce the risks that come with the management of electronic and electrical waste to both human health and the environment. It prohibits the use of specific dangerous compounds in electrical and electronic equipment (EEE) that can be replaced with safer substitutes. Heavy metals, flame retardants, and plasticizers are among the prohibited compounds. The regulation encourages the recycling of EEE because less harmful materials are included in EEE and its waste-derived components. It also guarantees that importers and producers of EEE operate on an even playing field in the EU market.

## Conflict Minerals Roll-up Report (CMRT)

According to the Dodd-Frank Act, businesses that export goods to the U.S. are required to file a comprehensive roll-up report on the conflict minerals status of their suppliers. The Conflict Minerals Reporting Template (CMRT), and the related statements and policies from each supplier, must be compiled into a single CMRT form because it is common for a single commodity to come from hundreds, if not thousands, of suppliers. The customer can comprehend high-risk suppliers in their supply chain thanks to this roll-up, which is an information exchange between a supplier and a customer.

## The Conflict Minerals Rule

It's important to note that the rule does not prohibit conflict minerals from being used in products. Instead, the rule mandates that the reporting entity publicly disclose how the conflict minerals are used.

Conflict minerals are:

- **Tantalum**—derived from columbite-tantalite
- **Tin**—derived from cassiterite
- **Tungsten**—derived from wolframite
- **Gold**, or any other minerals or derivatives

Common uses of these minerals/ores:

- **Columbite-tantalite** is a metal ore from which tantalum is extracted. Tantalum is used in electronic components, including mobile telephones, computers, video-game consoles, and digital cameras, and as an alloy for making carbide tools and jet engine components.
- **Cassiterite** is a metal ore used to produce tin. Tin is used in alloys, tin plating, and solders for joining pipes and electronic circuits.
- **Wolframite** is the metal ore used to produce tungsten, which is used for metal wires, electrodes, and contacts in lighting, electronic, electrical, heating, and welding applications.
- **Gold** is used for making jewelry and in electronic, communications, and aerospace equipment.

## ISO 14001:2015 Standard Helps Improve Environmental Performance

To improve an organization's environmental performance, ISO 14001:2015 outlines the specifications for an environmental management system. An organization looking to manage its environmental responsibilities in a methodical way that supports the environmental pillar of sustainability is expected to apply ISO 14001:2015. The ISO standard helps organizations manage their environmental responsibilities in a systematic manner that contributes to the environmental pillar of sustainability.

An organization can use ISO 14001:2015 to assist in achieving the objectives of its environmental management system, which benefit the environment, the organization, and interested parties. The expected outcomes of an environmental management system consist of the following, by the organization's environmental policy:

- Environmental performance improvement
- Compliance obligations being met
- Accomplishment of environmental goals

ISO 14001 helps organizations:

- Demonstrate compliance with current and future statutory and regulatory requirements
- Increase leadership involvement and engagement of employees
- Improve company reputation and the confidence of stakeholders through strategic communication
- Achieve strategic business aims by incorporating environmental issues into business management
- Provide a competitive and financial advantage through improved efficiencies and reduced costs
- Encourage better environmental performance of suppliers by integrating them into the organization's business systems [4]

# CLOUD PLM AS A LONG-TERM GREEN BUSINESS STRATEGY

As new products continue to grow in complexity, and green compliance and international regulations become more stringent, there is too much at stake for manufacturers to rely on manual processes or legacy systems. Manufacturers are discovering the benefits of using cloud PLM, and quality management system (QMS) solutions, to streamline processes when it comes to executing sustainability efforts.

Sustainable product development involves designing and manufacturing a product to minimize its environmental impact during its entire lifecycle. This is achieved by (but is not limited to) reducing the carbon footprint of manufacturing processes or using recyclable materials.

To meet sustainability requirements, PLM software streamlines design, development, product record management, and information sharing. It can promote advancement while lowering production expenses. Using PLM, companies can create a long-term sustainability strategy in addition to adhering to environmental standards.

Engineers can easily evaluate and optimize product content from a variety of sources, including bills of materials (BOMs), design specifications, and parts lists as well as enabling internal and external teams to provide product development updates, submit ideas, and receive feedback in real time. This information can then be compared to the overall green requirements for the product as well as early development criteria for any applicable regulations.

## Cloud Solutions Are Greener

A green cloud is an approach to cloud computing that aims to reduce energy consumption and environmental impact when deploying digital devices and systems. Data centers around the world have racked up enormous energy consumption numbers. Operating a data center requires a significant amount of water and energy.

In addition to powering the IT hardware, energy is utilized to cool the buildings and prevent data systems from overheating. With that, scrutiny over the environmental cost of data centers and the digital technologies that these infrastructures power has understandably increased.

Most data centers use a closed-loop system for cooling which consumes both water and energy to maintain the pumps and infrastructure. The need for a more sustainable approach is one of the reasons cloud service providers (CSPs) are moving to a cloud-native approach.

With cloud services being more environmentally friendly than on-site IT infrastructure, public cloud data centers can aggregate energy demand from several enterprises, which improves resource management. They also offer stable pricing structures and consume energy more effectively.

Cloud computing can help boost energy efficiency:

- **Less hardware:** Organizations don't need their own hardware to power software and applications if they move their on-premises IT systems to the Cloud. A cloud hosting company can handle equipment management on behalf of enterprises, hosting and deploying IT infrastructure more effectively and at a larger scale.
- **High-density storage:** High-carbon equipment is required to power servers 24/7, resulting in enormous energy consumption and greenhouse gas emissions. Cloud computing is a more effective way to run software and applications since it requires less physical infrastructure to execute heavy workloads and store vast amounts of data.
- **Consolidated demand:** Organizations can run numerous applications on the same server and even safely share server space with other organizations to save energy consumption by working with a cloud hosting provider to manage their IT infrastructure. As a result, deploying software and applications requires fewer physical servers overall, and resources may be shared via the network.


## GREEN TECH INNOVATION

The *green* or *clean technology* movement is driving the development of green products to reduce the negative impact of human activity on the environment. Green tech companies that are developing complex products comprised of electrical, mechanical, software, and IoT (Internet of Things) components also need to meet environmental regulations. Taking a smarter approach to product development ensures efficiencies in designing and developing high-quality products. PLM helps clean tech and alternative energy companies manage complex product development processes stemming from emerging technologies.

### PLM helps clean tech companies address key challenges such as:

- Accessing siloed mechanical, electrical, and software design records
- Collaborating with distributed teams and supply chains
- Enforcing efficient and controlled product realization processes
- Managing information to meet evolving global industry and compliance regulations

### Key challenges Arena addresses for green tech companies:

- Eliminating silos and confusion around the latest design revision
- Establishing cross-functional design collaboration during new product development
- Designing and testing complex embedded electronics with a high rate of change

### PICARRO GAINS VISIBILITY, TRACEABILITY, AND CONTROL WITH CENTRALIZED PRODUCT RECORD

#### Product Development Challenge

Managing complex product information for the development of gas analyzers while meeting environmental and quality systems compliance.

#### Solution

Product and quality teams can easily collaborate within **Arena PLM** to make sure changes and new releases are completed in a timely manner.

#### Impact

**Cloud solution** makes all product information readily available to a global team. This saves countless hours by empowering users to access and process information efficiently. Also simplifies quality and environmental compliance.

# BUILDING MORE SUSTAINABILITY INTO PRODUCT DEVELOPMENT WITH ARENA PLM

Arena helps manufacturers design and produce products more sustainably. Arena's cloud PLM software brings product information, people, and processes together into a single platform for more efficient product design and development, so your business can improve its efficiency and sustainability practices.

Arena provides a structured approach to managing the entire product record and meeting evolving product requirements. By combining components, files, drawings, and the complete BOM into a centralized cloud-based system, teams have access to the most current and accurate product information on hand.

Arena PLM lets extended teams and supply chain partners easily create, share, and approve product designs and gain greater visibility into any changes that impact production with revision controls and automated engineering change processes.

Arena helps manufacturers become more sustainable and more circular by:

- Streamlining environmental compliance processes to get more environmentally conscious products to market
- Managing information for RoHS, REACH, WEEE, conflict minerals, ISO, and other environmental compliance requirements
- Integrating into component databases like SiliconExpert and Octopart to source sustainable parts
- Enabling real-time collaboration between internal teams and supply chain partners to ensure design for manufacturability
- Eliminating design and latest-build confusion to reduce costly scrap and rework or production delays

## Create Value, Integrate Sustainability Into Your Innovation Strategy With Arena

Product companies can reduce the environmental impact of their physical products with a cloud-native solution like Arena that drives sustainability across the entire product lifecycle—from engineering to quality, to supply chain, to manufacturing.

Arena provides a centralized product record to help reduce design errors and scrap, enable global collaboration, provide visibility into the environmental impact of their product components, and accelerate time to market. Companies must adopt systems and processes to meet environmental initiatives to help our planet be more sustainable and to remain competitive.

We all have the power to create a more sustainable world. At Arena, we're taking action to make a positive impact on the environment and the communities we're a part of while developing solutions that help customers advance their product sustainability initiatives. Learn how Arena can help your company achieve efficient and sustainable product development practices. Get Demo

## References

1. https://www.un.org/sustainabledevelopment/sustainable-development-goals/
2. https://www.altenergymag.com/article/2019/07/what-is-the-future-of-non-renewable-resources/31346
3. https://www.energy.gov/eere/vehicles/lightweight-materials-cars-and-trucks
4. https://www.iso.org/standard/60857.html

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