A NEW ERA OF SUPPLY CHAIN MANAGEMENT: HOW BLOCKCHAIN TECHNOLOGY IS DRIVING SUSTAINABILITY

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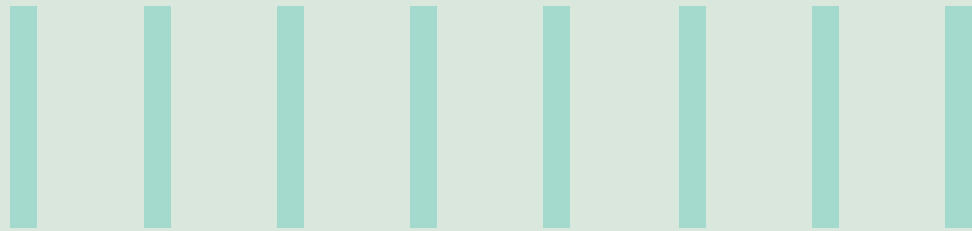
The need for sustainable supply chains

Environmental, social, and governance (ESG) goals are increasingly important for businesses of all sizes. To achieve the Sustainable Development Goals (SDG), businesses will need to integrate efforts to protect the environment, promote social responsibility, and improve good governance. There is a widespread agreement that immediate action is required to safeguard the environment by cutting air pollution, GHG emissions, and conserving natural resources, while also promoting sustainable practices. In addition, there is increasing awareness among businesses to operate in a socially responsible way by promoting fair labor practices, protecting human rights, and giving back to the communities in which they operate. Businesses also recognize the need to be transparent and accountable by promoting good governance practices. This helps to build trust among customers and stakeholders and build a world that is resource efficient, stable, inclusive, and prosperous.

Businesses have a long history of involvement in corporate social responsibility (CSR) activities. The need now is to collaboratively progress towards the common Sustainable Development Goals (SDGs) to ensure a sustainable future for the planet and the businesses. Businesses that focus on ESG goals also have the opportunity to gain from the indirect benefits, such as improved brand reputation, reduced risk, and improved innovation. The success of ESG goals depends on collaboration. When stakeholders work together, they can achieve a critical mass that will drive real change.

Food, construction, fashion, fast-moving consumer goods, electronics, automotive, professional services, and freight contribute over half of global emissions, according to a World Economic Forum study. Product use and manufacturing, as well as food production, account for another 45%, while shipping makes up 3%. Plastic waste production is also a major environmental problem. Around 400 million tons of plastic waste is produced each year, with nearly half coming from packaging. However, only 18% of plastic waste is recycled globally. The other 82% is either landfilled (40%) or leaked into the ocean (32%).

Government legislations have been gaining momentum around the world. Governments and international organizations have introduced new regulations and policies to guide and promote sustainable practices and reduce the negative environmental impacts. Increasingly, businesses in various industries and regions are required to comply with these regulations. The UK and EU are implementing new regulations to reduce plastic packaging waste.

In addition, the promise of circular economy strategies to decrease resource use and global greenhouse gas emissions by almost 40% is quickly gaining attention.

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1. Net-Zero Challenge: The supply chain opportunity | World Economic Forum (weforum.org)

2. Supply chains can be a climate game-changer. Here's why | World Economic Forum (weforum.org)

3. Ships Don't Lie: Blockchain and a Secure Future for Global Shipping (csis.org)

4. 25 Jaw-Dropping Plastic Waste Statistics in 2023 - The Roundup

Blockchain powered sustainable supply chain

Sustainable Supply chain is essential for businesses that want to be environmentally and socially responsible. By prioritizing environmental, social, and governance (ESG) goals in their supply chains, businesses can contribute to a more sustainable and equitable supply chain that benefits all stakeholders, including customers, employees, suppliers, communities, and the environment.

Creating a sustainable supply chain could be complex and challenging. There are many factors to consider, including supply chain complexity, limited transparency, supplier engagement and compliance, traceability and verification, cost considerations, changing regulations and market demands, data collection and measurement, and fostering a sustainability-driven organizational culture.

Recent work in supply chain management has focused on the current challenges around traceability and sustainable development. Lack of visibility across the supply chain is the root cause of many challenges, including counterfeit products, compliance issues, delays in preventive actions, product shortages, product certifications, and quality control. These supply chain challenges ultimately affect the end-consumers, with millions of people affected by foodborne diseases each year, according to the Centers for Disease Control and Prevention (CDC). This is a significant public health burden that is largely preventable. This also adds to regulatory mandates, audit, and compliance overheads.

This paper explores blockchain technology's role in supporting sustainability by enabling easy access to trusted information aggregated across the supply chain.

A plethora of benefits from blockchain technology

A distributed ledger technology (DLT), blockchain allows users to record and verify transactions securely and transparently. Blockchain powered supply chain ecosystems offer great potential for sustainable development with the benefits they promise:

Increase visibility and traceability: It enables the creation of transparent and immutable records of transactions and data across the supply chain. This brings in trust, accountability, and allows stakeholders to gain better visibility into the materials, and their origins, ensuring responsible sourcing, fair labor practices, and environmentally friendly production methods. That's why Walmart introduced a traceability platform in their stores to regain trust after an incident that upset its consumers. This platform shows the consumer the source of the product making them more comfortable with the purchase.

Improve efficiency: Blockchain can streamline supply chain processes by automating and digitizing documentation, reducing paperwork, and eliminating intermediaries. This efficiency leads to cost savings, reduced waste, and improved resource utilization. In addition, optimizing supply chain operations contributes to environmental sustainability and resource conservation. For example, almost 400 000 trees are cut down annually to print bills of lading alone and can be saved with blockchain .

Enable circular economy and waste reduction: Blockchain can streamline process data collection, reconciliation and sharing in circular economy by enabling the tracking and tracing of individual products throughout their lifecycle. This visibility allows for better product returns management, recycling, and waste reduction. In addition, by encouraging the reuse and repurposing of materials, blockchain helps minimize environmental impact and supports a more sustainable and circular approach to production and consumption.

Enhance collaboration and trust-building: Blockchain's decentralized nature promotes collaboration and trust among supply chain participants. A secure and transparent platform facilitates information sharing, encourages cooperation, and helps build partnerships focused on sustainability. As a result, collaborative efforts enabled by blockchain can drive collective action and innovation toward sustainable development goals.

Blockchain makes an impact on real-world scenarios

Blockchain technology has many applications that enable organizations to meet regulations, standards, and voluntary commitments.

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5. What are the benefits of a circular economy? | World Economic Forum (weforum.org)

6. Walmart & Blockchain: New Era of Supply Chain Management (changelly.com)

1: Cradle to Cradle PLM (Product Life Cycle Management)

Cradle to cradle PLM involves considering the environmental impact of a product at every stage of its lifecycle and designing products to maximize reuse and eliminate waste. This can include tracking the use of environmentally friendly materials, the design of products for disassembly and recycling, and the waste generated during manufacturing.

Shipping major Maersk is creating a Cradle-to-Cradle Passport for their ships to enable helpful disassembly and recycling information at the planning and design phase[1].

Unilever used SAP GreenToken in a pilot project in Indonesia to track the sustainable sourcing of over 188,000 tons of oil palm fruit, enabling near-real-time tracking, verification, and reporting of the palm oil's origins and journey through its long and complex supply chain.

Blockchain technology will prove to be an efficient tool to manage product life cycle events for a tokenized asset across diverse stakeholders, enabling them to understand better the materials and products they use. For example, a new application of the technology, Digital Asset Passport (DAP), has emerged as a key enabler by providing information about the environmental sustainability of products and helping consumers and businesses make informed choices when purchasing products. The DAP is a unique identifier attached to a product that contains information about its entire lifecycle, such as ownership, maintenance and charging history, and end of life recycling. Consumers and other stakeholders can learn more about the materials and products they use by simply scanning a QR code or watermark printed on the product. The current manual and paper-based process for managing records and transactions related to procurement, certification, and maintenance can be time-consuming and inefficient. In addition, tracking and visibility of raw material sourcing and emissions can be difficult, and the supply chain often needs more transparency, leading to high costs, errors, and longer delivery times for the asset.

To address these challenges, DAP has several use cases that can improve transparency and reduce costs. One use case is the ability to **provide information about a product's environmental emissions,** helping consumers and businesses make informed choices when purchasing products. The DAP can also **facilitate repairs and recycling** and improve transparency about a product's lifecycle impacts on the environment.

Other use cases for the DAP include **tracking maintenance logs and manufacturing details** of individual parts to assist with scheduled and unscheduled maintenance and enable predictive maintenance. The DAP can also maintain the integrity of digital design files, reconcile royalties in **additive manufacturing,** and track the **digital twin** of physical parts on blockchain to provide real-time information about their journey across the integrated value chain, ensuring improved parts authenticity (anti-counterfeiting).

In addition to these benefits, the DAP can also provide significant business value. For example, it can maintain an immutable history and proof of authenticity of the asset, provide a complete chain of custody of milestones and events, and create a tamper-proof auditable system of records. The DAP can also optimize reconciliation efforts across sourcing, shipment, and production, reduce overheads and the cost of recalls/replacements, and reduce data breaches.

Several regulations and consortiums are also driving the adoption of the DAP. For example, the Battery Passport regulation requires every industrial or electric vehicle (EV) battery on the EU market with a capacity of over 2 kWh to need a battery passport. In addition, the Corporate Sustainability Reporting Directive (CSRD) requires companies to digitally 'tag' the reported information, so it is machine-readable and feeds into the European single access point. The Global Battery Alliance is also working to promote using DAPs to improve battery production and disposal sustainability.

Ford in partnership with Everledger launched Battery passport pilot to enable responsible recycling of EV batteries[b]

7. Ships Don't Lie: Blockchain and a Secure Future for Global Shipping (csis.org)

8. Maersk introduces Product Passports to improve the recovery and reuse of shipping steel | Knowledge Hub | Circle Lab (circle-lab.com)
   [a]https://www.unilever.com/news/press-and-media/press-releases/2022/sap-unilever-pilot-blockchain-technology-supporting-deforestationfree-palm-oil/

Demonstrating success: DAP in action

For a leading solar inverter manufacturer, DAP was used to track production events, maintenance records, and the authentication of each device when there were upgrades to the certificates.

2. ESG Impact Visibility

ESG (Environmental, Social, and Governance) Impact Visibility is the ability to measure, report, and manage the impact of a business's activities on the environment, society, and its governance practices. However, there are a few challenges in improving transparency.

Limited visibility into GHG emissions, wastewater, water usage, and chemicals in the extended supply chain hinder achieving ESG impact visibility. This is also commonly referred to as scope 3 emissions. Companies are required to understand the full impact of their business activities, including those beyond their primary operations. This makes managing and mitigating risks associated with environmental and social impacts difficult. Another challenge is the need for tamper-proof recording and reporting of ESG data. Data integrity is critical to building trust in sustainability reporting. Ensuring the accuracy and reliability of data is an issue in the absence of robust data governance practices and standardization. Finally, the high audit and compliance cost is associated with ESG reporting. Companies need to provide auditable and verifiable data to demonstrate compliance with ESG standards. The lack of integrated and accountable data adds to the complexity and cost of compliance.

There are a few use cases for overcoming the challenges when implementing ESG Impact Visibility.

Carbon Emission Tracking: To achieve this, companies must measure their emissions, reduce them, and offset any remaining emissions. DLT and shared ledger technology can enable emission traceability across the end-to-end value chain and build a trusted ecosystem. Continuous monitoring is essential to achieve substantial emission reductions. Carbon offsetting is a way to compensate for any remaining emissions by funding an equivalent carbon saving elsewhere.

Incentivization/Tokenization: Stakeholders can be incentivized for the right behavior, and individuals, companies, and suppliers can be rewarded with crowdfunded financial rewards in return for sustainable actions. Tokenization of green bonds, green tagged loans, and green investment funds are trying to incentivize positive behavior.

Sustainable sourcing ensures that organizations work with vendors who follow fair labor practices and comply with health and safety regulations. Blockchain and DLT technology can provide transparency, trust, and security to demonstrate responsible sourcing. Additionally, the technology can help track the Sustainable Development Goals (SDG) set by the UN General Assembly in 2015, such as climate, social issues, and clean energy, and generate Corporate Social Responsibility (CSR) reports following the Global Reporting Initiative (GRI) standards.

Implementing ESG impact visibility can create significant business value. It can help reduce risks associated with environmental and social impacts, enhance brand reputation, and improve stakeholder engagement. It can also provide a competitive advantage by demonstrating a commitment to sustainability and creating opportunities for innovation and growth. Furthermore, it can help reduce compliance costs and create efficiencies through better data governance practices.

SABIC (Saudi Aramco's chemical firm) plans to implement digital product passport pilot solution to track direct and indirect CO_2 emissions including 'Scope 3' emissions in its supply chain ecosystem to start with, followed by tracking data for future recycling .Consumer products giant Unilever uses blockchain technology to ensure that the palm oil used in its products comes from sustainable plantations and boosts supply chain transparency.

There are several regulations that businesses must comply with, such as the EU Green Deal, EU Packaging Levy, EU Conflict Minerals Regulation, German Supply Chain Act, French Duty of Vigilance Law, UK Modern Slavery Act, European Climate Law, and UN sustainability goals. Compliance with these regulations can lead to faster realization of sustainability goals, reduced audit costs, enhanced brand value, and compliance with global standards.

To further advance sustainability efforts, there are several consortiums such as The Carbon Call, Green X Digital, Smart Freight Centre, Climate Chain Coalition, Climate Change - Under2 Coalition, Climate & Clean Air Coalition, VDA (German Automotive Consortium), and TFS (Together for Sustainability) that are working towards sustainability initiatives.

Demonstrating success: ESG Impact Visibility in action

A goal for an international agency focused on food and security was to streamline the process of measuring, reducing, and sustaining the carbon and water footprint of the final product in the banana supply chain. By tamper-proof recording and sharing this information, integrating with stakeholder systems, and ensuring consistency and accountability, the project successfully tracked carbon and water emissions against tracking milestones like electricity and fuel consumption, fertilizer usage, logistics, and storage. Such data can be analyzed to gain insights, and regulators can measure and help organizations sustain improvements.

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9. https://www.ledgerinsights.com/sabic-circularise-blockchain-product-passports-emissions/

b. https://www.ledgerinsights.com/everledger-ford-blockchain-ev-battery-passport-recycling/

3. Circular Economy

The circular economy (an extension of cradle-to-cradle PLM) is a model that moves away from the traditional linear supply chain and instead focuses on maximizing the reuse and recycling of resources to reduce our reliance on the finite resources we extract from the earth. For non-biodegradable materials this can be achieved by designing the products or services to promote sharing, improved maintainability which in turn would improve product life, reuse, refurbish or as a last resort recycle.

But the road to a circular economy is riddled with challenges. A significant one is the lack of coordination between agents, resulting in inefficient recycling and high production costs. The recycling ecosystem lacks traceability, which leads to information irregularity, poor governance, and a lack of accountability. This could result in market failure and speculation.

To handle these challenges, businesses can utilize blockchain and DLT to create a more transparent and efficient circular economy.

In a recent development, Audi has launched Material Loop as part of which it has partnered with 15 organizations to use recycled components in new auto manufacturing.

Track the recycling ecosystem: by utilizing blockchain, stakeholders in the ecosystem can have a tamper-proof and transparent recording and sharing of information. This enables them to achieve better visibility of their supply chain, leading to better resource utilization, reduced costs, and improved environmental outcomes. Example, a plastic recycling ecosystem that connects plastic waste suppliers, recyclers, polymer manufacturers, and consumer goods companies into a closed-loop system could improve the traceability of plastic waste and increase the proportion of recycled and renewable polymers. Coca-Cola Africa has also pledged to make all of its packaging recyclable by 2025, using blockchain technology to track and trace recycled materials throughout the supply chain.

Marketplace for reused/repaired/recycled items: With a shared and transparent platform, consumers and businesses can more easily exchange used items, reducing waste and conserving resources.

Waste management tracking: By tracking the entire lifecycle of waste, from collection to disposal, businesses can gain a better understanding of how to optimize their processes, reduce waste, and minimize environmental impact.

Implementing blockchain in the circular economy brings environmental benefits and provides business value.

Companies can distinguish themselves from rivals and boost their brand image by increasing transparency about the percentage of recycled materials they use in production. In addition, compliance with global standards and regulatory requirements is also facilitated by utilizing blockchain technology.

Plastic Bank, a waste management pioneer, relies on blockchain technology to trace plastic waste from the point of collection through the entire recycling process. Its goal is to collect 1 billion kilograms of ocean-bound plastic waste by 2025, twice that of the 2023 collection[3].

Regulations such as the Eco-Design for Sustainable Product Regulation, End of Life Vehicles Directive, the UK's Resource and Waste Strategy, and the Ellen MacArthur Foundation's New Plastics Economy Global Commitment emphasize creating a sustainable circular economy. The sectors most impacted by these regulations include plastic packaging, electronics, and automotive.

Consortiums such as the World Steel Association, Circular Economy Club, The Circulars Accelerator, PACE (Platform for Accelerating the Circular Economy), and Circular Economy Club work towards developing solutions and fostering collaboration among stakeholders to promote a circular economy.

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10. Optimizing the circular economy: Coca-Cola and BanQu

   * Ellen MacArthur Foundation: How to Build a Circular Economy

11. Blockchain Is Revolutionizing the Waste Management Industry. Towards a Circular Economy: A Case Study by Carbon Copilot (linkedin.com)

c https://www.ledgerinsights.com/audi-materialloop-recycling-blockchain/

4. Credentialing/Certification

A key challenge in discharging sustainability and environmental responsibility has been verifying and tracking the sustainability credentials of products and services, particularly in global supply chains. This is where the use of provable credentials issued by environmental agencies or nonprofit organizations helps.

The idea behind provable credentials is simple: environmental agencies or nonprofit organizations can issue digital certificates that others can access and verify on the network using blockchain technology. This creates a decentralized, tamper-proof system for tracking the sustainability credentials of products and services, from raw materials to end-of-life disposal.

However, a significant obstacle to the widespread adoption of provable credentials is that certification processes have traditionally been done offline through paper certificates. This has led to lower confidence in the accreditation process, as well as higher audit costs for businesses seeking to verify sustainability credentials.

Several certification programs that use provable credentials to track sustainable supply chains have emerged. One example is the Cradle to Cradle Certified® Products Program, which certifies products that are safe, circular, and made responsibly. Similarly, BREEAM by Bre Group provides validation and certification systems for sustainable built environments. At the same time, the Circular Economy Institute evaluates and certifies the supply chain, input materials, product lifecycle, and end-of-life handling of products.

Other certification programs, such as MSCI, Robeco, Refinitiv, and Morningstar Sustainalytics, use ESG research to identify industry leaders and laggards according to their exposure to ESG risks. Meanwhile, EcoVadis provides sustainability ratings, and ISCC provides certification related to the circularity of products, carbon emissions, and offsetting certification.

The benefits of using provable credentials to track sustainability credentials are numerous. For businesses, provable credentials offer a way to reduce audit costs and improve the integrity of certificates. Meanwhile, for consumers, provable credentials provide a transparent, real-time way to verify the sustainability credentials of products and services.

Amazon has made it easier for shoppers to locate sustainable products by featuring Cradle to Cradle Certified®. In addition to Amazon, giant retailers like Walmart, The Home Depot and Walgreens are adopting this certification Shell, Philips launched a pilot in partnership with Circularize, for sustainability certification to validate sustainability data for its completeness and reliability.

Demonstrating success: ESG Impact Visibility in action

Implemented Blockchain based project accreditation platform for a leading international NGO working on rights-based forest protection worldwide, provisioning environmental certification for sustainability in agriculture. The implementation was able to facilitate transparent transfer of funds and certified measurement of impact between the donors and beneficiaries for green projects.

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12. Cradle to Cradle ® | MBDC

[d]https://www.ledgerinsights.com/blockchain-chemicals-platics-sustainability-circularise-shell-philips/

Conclusion

The urgent need for sustainability in supply chain management cannot be overstated. Blockchain technology is a promising solution for promoting the due diligence required in the supply chain sustainability. Blockchain technology can help organizations reduce environmental impact, promote fair labor practices, and meet regulatory requirements by enabling transparency, traceability, and accountability, across the supply chain. Therefore, organizations must embrace sustainable practices and adopt innovative technologies such as Blockchainto ensure a sustainable future for generations to come. Blockchain technology can be integrated with IoT, AI, Analytics to further enhance the solution. It's time to act.

Authors

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Sanal J. Nair is a Principal Consultant at Infosys Blockchain Service line in India, with over 17 years of experience in IT and consulting, focusing on blockchain, digital ledger technologies, and supply chain management. He has a proven track record of developing and delivering innovative blockchain solutions for clients in the retail, logistics, and engineering sectors.

In his current role, Sanal works closely with clients to understand their business needs and develop tailored blockchain solutions that meet those needs. He also works with clients' development teams to implement blockchain solutions and integrate them with existing enterprise applications. Sanal is passionate about using blockchain technology to solve real-world problems, and he is committed to helping clients adopt blockchain technology to improve their businesses.

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Bandeep has about 12 years of experience across solution consulting and delivery with over 5+ years of experience in Blockchain powered supply chain initiatives across multiple industries viz Manufacturing, Retail/CPG, Logistics & Hi-Tech. She has worked in multiple Blockchain solution implementations (client/internal), provided consultation to clients in their journey to adopt Blockchain to streamline their existing operations. In the past she has worked in delivery and presales initiatives for projects in mobile/wallet banking domain

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