ELLEN MACARTHUR FOUNDATION

Building a circular supply chain

Achieving resilient operations with the circular economy

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About this paper

This paper highlights the fundamental contribution that supply chain professionals can make to the transition to a circular economy. It aims to provide a general understanding of how the circular economy and supply chain management fields are related to one another. By exploring the concept of a circular supply chain, the paper illustrates the role of supply chain professionals in operationalising circular economy initiatives within their organisations, as well as the opportunities and challenges they may encounter along the way. The paper also provides initial recommendations for and examples of companies overcoming some of these challenges, based on the experiences of supply chain professionals involved in the research. Additional research into the real-life experiences of such professionals will be needed to gain a fuller understanding of the exact changes needed to their role, and the best practices they can deploy to effectively transition to circular supply chains.

This paper has been developed in collaboration with the Circular Supply Chain Network, a global community of supply chain professionals committed to accelerating the transition to circular supply chains. The content has been informed by a set of interviews conducted in the Spring of 2023, as well as insights gathered from a working group series run with supply chain professionals from the Foundation's Network in June of 2023.

About the Ellen MacArthur Foundation

The Ellen MacArthur Foundation is an international charity developing and promoting the circular economy in order to tackle some of the biggest challenges of our time, such as climate change, biodiversity loss, waste, and pollution. We work with our network of private and public sector decision-makers, as well as academia, to build capacity, explore collaborative opportunities, and design and develop circular economy initiatives and solutions. Increasingly based on renewable energy, a circular economy is driven by design to eliminate waste, circulate products and materials, and regenerate nature, to create resilience and prosperity for business, the environment, and people.

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Foreword
A challenge worth solving

The necessity — and fragile nature — of our global supply chains were made clear during the COVID-19 pandemic. Never before had business leaders, government officials, and the general public been so interested in the logistics and supply of materials and products. The disruptions of that specific period highlighted a fundamental error in the way our supply chains function; namely, the linear style of take-make-waste, where materials are extracted from the earth, used to create the product, and then disposed of after they've served their purpose. In the future, disruptions — from natural disasters, political unrest, and resource scarcity — are only expected to increase, and it's imperative that supply chains are prepared to meet that challenge.

We are honoured that this white paper, developed by the Ellen MacArthur Foundation in collaboration with the Circular Supply Chain Network, leverages the Association for Supply Chain Management's SCOR model as the framework for moving from a linear 'source-make-deliver' mindset to a circular one. As the authors make clear, building a circular economic model is the best way to develop resiliency: ensuring our supply chains withstand and bounce back from inevitable shocks, whether it's disease or disaster or war. But to make a circular economy functional, we need the expertise of supply chain professionals to dissociate consumption from waste, lower costs, and reduce greenhouse gas emissions. There will be challenges, from network design to financial limitations, but the research provides an action plan to address each obstacle as it comes.

Supply chain professionals in partnership with sustainability and compliance professionals must be proactive about making changes to the way our industry functions — for the good of our livelihood and for the planet.

Abe Eshkenazi, CSCP, CPA, CAE
Chief Executive Officer, Association for Supply Chain Management

The circular economy is built on the premise that the planet's materials are not endless. Perhaps no one knows better than the supply chain professional about the ebbs and flows of material availability and the resulting effects on cost and downstream impacts on shortage or surplus.

Even the best-prepared teams with the strongest partnerships and advanced systems can only do so much against the array of disruptions from unforecasted events. Regardless of the cause, the result is a material one — literally. When disruption hits, the impact shows up in inventory: either too much or too little.

Circular supply chains offer a strategy to teams looking for new ways to improve the reliability of supply.

Building a circular supply chain: Achieving resilient operations with the circular economy is a collaboration between the Ellen MacArthur Foundation and the Circular Supply Chain Network to articulate how supply chain leaders around the world are exploring circular operations — finding both successes and learnings. Together, we lay out a foundational guide for supply chain leaders to use in their own explorations into circular operations, which includes the basic principles and approaches of a circular economy, the benefits of a circular economy to supply chains, and the likely challenges leaders will encounter along the way.

The purpose of this document is to bring supply chain communities together around a common understanding of what circular economy means for supply chains, and vice versa, and provide practical examples. By doing so, supply chain leaders can accelerate the transition to a circular economy.

Deborah Dull
Founder, Circular Supply Chain Network

Shining a spotlight on circular supply chains

Shining a spotlight on circular supply chains

Our current economy is mostly linear: we take materials from the Earth, make products from them, and eventually throw them away as waste – the process is wasteful and polluting. A circular economy, by contrast, proposes a different way of generating value by decoupling economic activity from the consumption of finite resources.

Such a paradigm shift has implications for all aspects of business, including the often-overlooked role of supply chain teams.[1] To date, discussions about and efforts to transition to a circular economy have been predominantly focused on the role of circular business models and circular product design. However, as an increasing number of organisations mature in their circular economy journey, the role of circular supply chains in operationalising and scaling such initiatives is becoming distinctly relevant. Supply chain professionals are responsible for the sourcing, movement, and transformation of the 100 billion tonnes of materials that enter the global economy each year.[2] With such oversight, they can be key players in scaling a resilient and regenerative circular economy.

The reasons for exploring the circular economy—supply chain nexus are twofold. First, a supply chain reconfiguration is urgently needed to help shape a more resilient, net-positive future; the circular economy offers a toolkit for supply chain professionals to achieve this. Second, to ensure the success of the circular economy transition, the skills and knowledge of supply chain professionals will be crucially required. This paper is aimed at inspiring and equipping supply chain professionals to begin exploring and acting upon the need for circular supply chains, to fully deploy the circular economy.

The circular economy is based on three principles, driven by design:

- **Eliminate waste and pollution**
- **Circulate products and materials (at their highest value)**
- **Regenerate nature**

Underpinned by a transition to renewable energy and materials, the circular economy is a resilient system that is good for business, people, and the environment.

[1] Montag, L. *Circular Economy and Supply Chains: Definitions, Conceptualizations, and Research Agenda of the Circular Supply Chain Framework.* Circ.Econ.Sust. 3, 35–75 (2023)
[2] The World Bank, *Squaring the Circle: Policies From Europe's Circular Economy Transition*, Washington DC (2022)

Circular economy as a tool for supply chain leaders

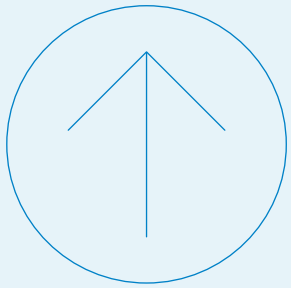
Supply chain disruptions are exposing the vulnerabilities of traditional linear approaches. In today's predominantly linear supply chain configurations, supply chain leaders[3] are recurrently having to respond to disruptions throughout their networks, and are facing record inventory numbers from global bullwhip effects, and challenges in consistently securing inputs. These disruptions have notably been felt after recent events such as the COVID-19 pandemic, the Russian invasion of Ukraine, and other geopolitical or climate change-induced events. In their aftermath, the economic impacts are also consequential. As an example, in 2021, the Eurozone lost EUR 112.7 billion or 0.9% of GDP to supply chain disruptions.[4] In the future, the frequency and magnitude of these shocks are expected to increase, as climate shocks and resource scarcity intensify. Just between 2002 and 2010, commodity prices rose by nearly 150% – and finite materials will only become scarcer and their price more volatile in a resource-constrained world.[5] If no action is taken, companies can expect to lose almost half a year's profit to supply chain disruptions over the course of a decade.[6]

At the same time, expectations on supply chain leaders are growing. As companies strive to reduce their environmental impact and increase resilience while also delivering lower costs and better performance for customers, many are turning towards their supply chains. To future-proof businesses in light of the aforementioned shocks, the search for resilience is being spearheaded by supply chain leaders: 93% want to increase supply chain resilience, and 44% are willing to sacrifice short-term savings for it.[7] At the same time, as businesses seek to meet their climate targets, they are increasingly recognising the impact of their supply chain or Scope 3 emissions. For a typical consumer goods company, the supply chain accounts for more than 80% of greenhouse gas emissions on average.[8] New pressures are adding on top of traditional priorities, highlighting the need for new approaches to supply chains in order to remain competitive.

The circular economy offers a framework for supply chain leaders and organisations to address core priorities, such as decarbonisation, while creating the resilient supply chains of the future. As linear supply chains will struggle to provide resilience to organisations in a resource-constrained environment, a new approach will be required. Supply chain leaders can leverage the circular economy to gradually decouple economic activity from the consumption of finite resources. By doing so, the circular economy offers opportunities for supply chain leaders to reduce their exposure to price volatility, increase material security and availability, and support relocalisation efforts,[9] while at the same time helping meet climate and other environmental objectives.[10]

[3] The decision makers working in a supply chain function; the title may vary per company and may resemble the following: Chief Supply Chain Officer, Chief Operations Officer, Head of Reverse Logistics, Head of Procurement, Supply Chain Strategist, or similar.
[4] Accenture, *From disruption to reinvention: The future of supply chains in Europe*, (23rd May 2023)
[5] Ellen MacArthur Foundation, *Towards the circular economy Vol. 3: accelerating the scale-up across global supply chains* (2014)
[6] McKinsey Global Institute, Risk, resilience, and rebalancing in global value chains (6th August 2020)
[7] Ibid.
[8] McKinsey & Company, Bové, A. & Swartz, S., Starting at the source: Sustainability in supply chains (11th November 2016)
[9] Ellen MacArthur Foundation, *Towards the circular economy Vol. 3: accelerating the scale-up across global supply chains* (2014)
[10] Ellen MacArthur Foundation, *Completing the Picture: How the circular economy tackles climate change (2021); Ellen MacArthur Foundation, The Nature Imperative: How the circular economy tackles biodiversity loss* (2021)

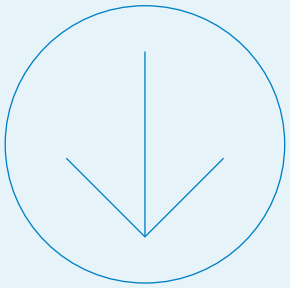
Figure 1. Examples of companies leveraging the circular economy to address supply chain priorities



Increase resilience

Example

Through TerrePower, ***BBB Industries*** extends EV battery life by prioritising maximum value-retention processes, such as reuse and remanufacturing. In doing so, the company aims to decouple the electrification of the economy from finite raw material extraction, while also enabling them to secure material supply, mitigate against material price volatility, reduce external market dependency, and support relocalisation efforts.



Reduce costs

Example

Rheaply enables organisations to make the most of assets that would otherwise remain idle, through their re-commerce platform combining smart inventory management and connected nationwide marketplaces. ***RUSH University Medical Center***, a Rheaply customer, saved over USD 244,000 by reusing just over 1,000 pieces of workplace and office furniture.

Reduce climate impact

Example

Volvo Cars is leveraging the circular economy to achieve their climate ambitions. In 2022, the car manufacturer was able to save over ***4,800 tonnes of CO_2*** by remanufacturing over 33,000 parts.

Supply chain leaders as critical players in the circular economy transition

In order to deliver value in a circular economy, companies will have to rethink their business models, product designs, and supply chains. Whilst all three elements are required for a successful deployment of the circular economy at a business level, the role of circular supply chains in operationalising and scaling such initiatives is becoming ever more apparent:

1. **Supply chain leaders manage materials flows.**
   Each year, 100 billion tonnes of materials are brought into the global economy.[11] All of this is managed by supply chain leaders: purchased, moved, processed, tracked, and invoiced. The skills, knowledge, and data that supply chain leaders hold are crucial for the successful transition from linear to circular supply chains.

2. **Supply chain leaders control an organisation's working capital.**
   Supply chain leaders control the majority of a company's Cost of Goods Sold (COGS); thereby they have financial leverage and decision-making power over many of the foundational choices that determine material and product circulation, from where to source materials to how to manage production by-products and reverse flows.

3. **Supply chain leaders are natural system thinkers.**
   They use their problem-solving and system-orchestrating skills to turn high-level business strategies into daily operations, improve procedures, and bridge siloed teams.[12] This enables them to operationalise circular economy ambitions and create the resilient, net-zero supply chains of tomorrow.

4. **Supply chain leaders have a seat in the boardroom**.
   Supply chain leaders within organisations have risen to hold positions of higher influence: 85 of S&P 500 companies now have a Chief Supply Chain Officer (CSCO) or a similar role.[13] With a mandate from top management to deliver on organisational ambitions, like cost reductions, resilience improvements, or climate goals, supply chain leaders have an extraordinary opportunity to drive change.[14]

5. **Supply chain leaders influence the wider system.**
   Given their connections to other stakeholders, like suppliers, customers, and policymakers, supply chain leaders influence decisions and behaviours across the system and as such can play a catalysing role in advancing the circular economy transition.

[11] The World Bank, *Squaring the Circle: Policies From Europe's Circular Economy Transition,* Washington DC (2022)
[12] Dull, D., *Circular Supply Chain: 17 Common Questions (How Any Supply Chain Can Take the Next Step)* (3rd September 2021); Jennings, E., *The Rising Role of Chief Supply Chain Officer, Supply Chain Brain* (11th June 2021)
[13] Wahba P., *From obscurity to superhero: Chief supply chain officer is now the toughest job in the C-suite*, Fortune (10th November 2021)
[14] McKinsey & Company, Henrich, J., Li, J., Mazuera, C. & Perez, F., *Future-proofing the supply chain* (14th June 2022)

The Butterfly diagram:
How material flows in the circular economy

Understanding the Butterfly diagram can help supply chain teams enter the circular economy discussion and see how this transition will impact their ways of working today. This diagram describes the destination of materials and how they flow through loops of value creation in the economy. Materials can broadly be circulated in two cycles: the biological, and the technical cycle.

Materials that belong in the biological cycle are ones designed to return safely to nature after use, such as food or compostable materials. These materials can be easily decomposed and provide nutrients to the environment, completing a natural cycle.

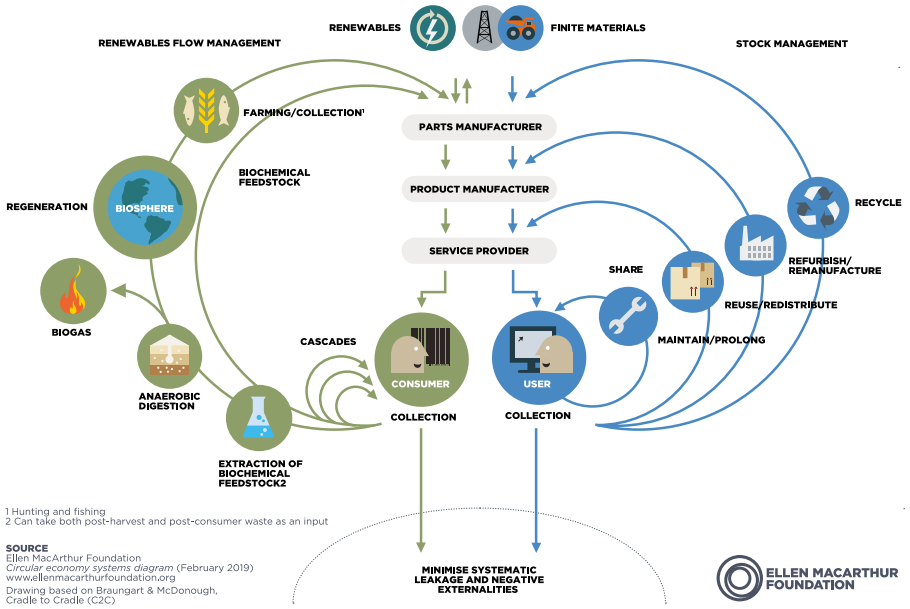
In contrast, materials that belong in the technical cycle are ones designed to be used in long-lasting products. These materials can be reprocessed or redistributed multiple times without losing their value or quality. Examples include metals, plastics, and other materials that can be transformed into new products or components through recycling or remanufacturing processes.

The loops in which these materials can be circulated in either cycle can be large or small, and the size of the loop describes the amount of time, effort, energy, money, and resources it takes to return that product or material to a value chain. The smaller the loop, the more embedded value and energy can be retained – i.e. the greater the economic and environmental benefit.

The loops of the Butterfly diagram are interconnected, symbolising the continuous flow of materials within the circular economy. The arrows in the diagram represent the movement of materials and products between different stages of the supply chain, highlighting the importance of maintaining the value of materials and minimising waste.

A circular supply chain follows these loop priorities, aiming to operate in the smallest loop for as long as possible.

Figure 2. The Butterfly diagram



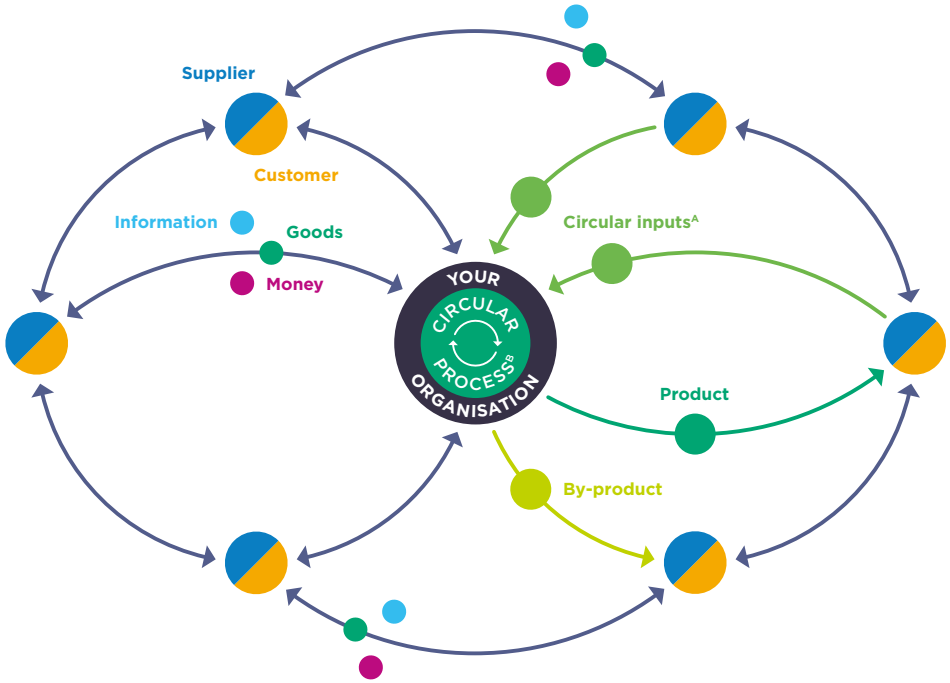
From linear to circular supply chains: Creating a common understanding

From linear to circular supply chains: Creating a common understanding

Traditional supply chains and their processes were configured to support linear 'take-make-waste' models. To transition to a circular economy where products and materials can successfully be circulated within the economy – keeping them out of landfill and the environment – supply chains will need to be rethought; from the way networks are designed, to how inputs are procured, moved, and processed. Doing this in alignment with the material flows advocated by the circular economy Butterfly diagram (see figure 2) will enable the design and management of supply chains oriented at eliminating waste and pollution, circulating products and materials at their highest value, and regenerating nature.

A circular supply chain:[15]

- **consists of a distributed and interconnected network of partners**
- **relies on multidirectional flows of information, goods, and money**
- **delivers and captures value using circular inputs and processes**



[15] This definition builds on the Association for Supply Chain Management's definition of supply chain: "The network of suppliers that deliver products from raw materials to end customers through either an engineered or transactional flow of information, goods, and money."

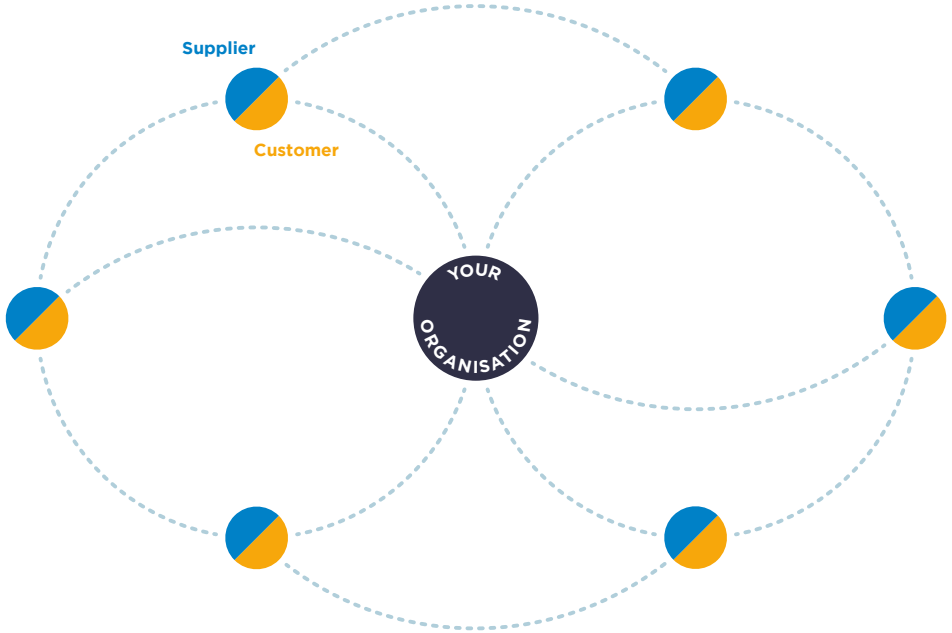
[A] secondary (i.e. non-virgin) and/or regeneratively grown products and materials that can be circulated within the economy or safely returned to nature.

[B] actions done to inputs to allow their (re)introduction to the value chain and the retention of the maximum amount of their embedded value (i.e. maintenance, repair, refurbishing, remanufacturing, and, as a last resort, recycling).

A circular supply chain consists of a distributed and interconnected network of partners

A circular supply chain is a highly connected and dynamic network based on diverse local and global partnerships. Such partnerships can be created with current suppliers and customers, or with industry peers or other system stakeholders (like third parties) in order to best be able to circulate products and materials. In circular supply chains, customers often become suppliers of the finished goods, components, and materials that they have purchased, which are then returned and reprocessed for new value generation by the supply chain.

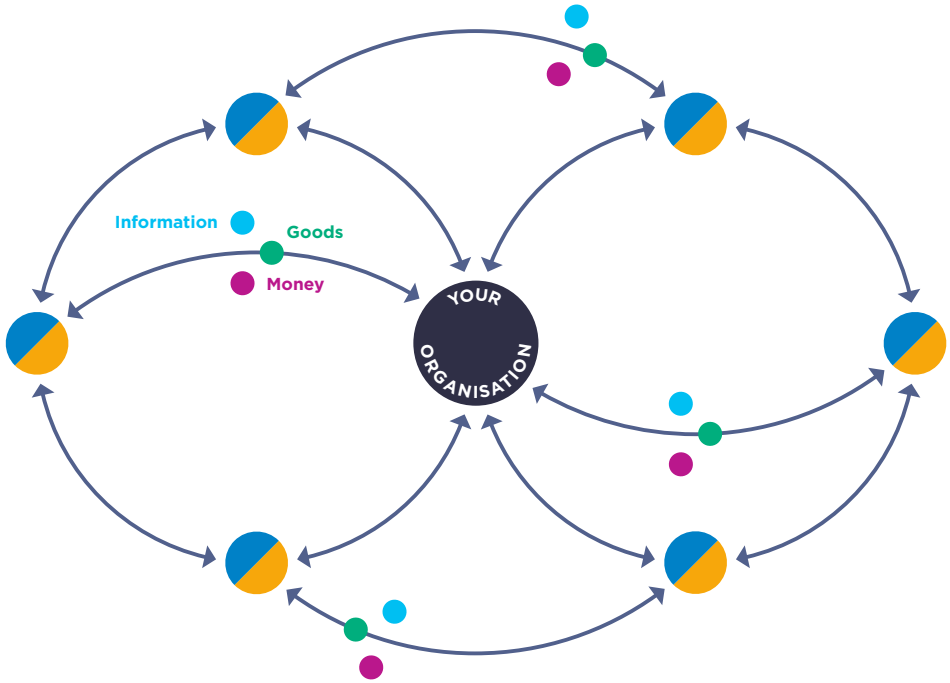
Circular supply chains can be more distributed than traditional networks, requiring a rebalance of the current geographical set-up of networks in order to effectively and efficiently circulate products and materials, whilst building greater resilience and reducing emissions. In some instances, global networks may be able to better react to unforeseen disruptions to local supply chains by providing access to alternative flows of circular inputs. In other cases, a network of local or regional partners might be able to more easily and quickly respond to the demand for circular inputs and processes, enabling cost-efficient and low-emissions circulation of products and materials in local markets. This can minimise the over-reliance on long and opaque networks that span across the globe and are more vulnerable to disruptions, instead helping build resilience and reduce emissions from transport. Such is the case for ***SOJO***, a fashion-tech platform that provides emissions-free door-to-door repair and alterations services to customers via an in-house tailoring studio in East London.



A circular supply chain relies on multidirectional flows of information, goods, and money

To enable and optimise the circulation of products and materials at their highest value, a circular supply chain requires large amounts of data to be exchanged among partners. These exchanges will expand on existing flows – no longer following the traditional linear, forward flows alone – but rather transform into multidirectional ones as new partnerships and ways of engaging with other system actors are formed. In Brazil, ***HP & Sinctronics*** partnered to create a reverse logistics ecosystem able to recover and create value out of HP's end-of-use electronic equipment. As design decisions happen in HP, while reprocessing is carried out by Sinctronics, improvements in cross-company communication have been key in allowing the most up-to-date knowledge on disassembly to be disseminated among all relevant stakeholders.

The need for traceability and transparency along the circular supply chain will increase the reliance on these types of multidirectional flows. This, in turn, will ease the sourcing of circular inputs by helping identify where they are available, as well as facilitating access to information on the material composition and quality of an item. As a result, relevant stakeholders such as users or repair professionals, can use this additional information to decide how to best keep the item, its components, or materials in circulation at their highest value. Ultimately, this can enhance trust among all partners, which can encourage more transformational collaboration towards more ambitious circular supply chains.[16]



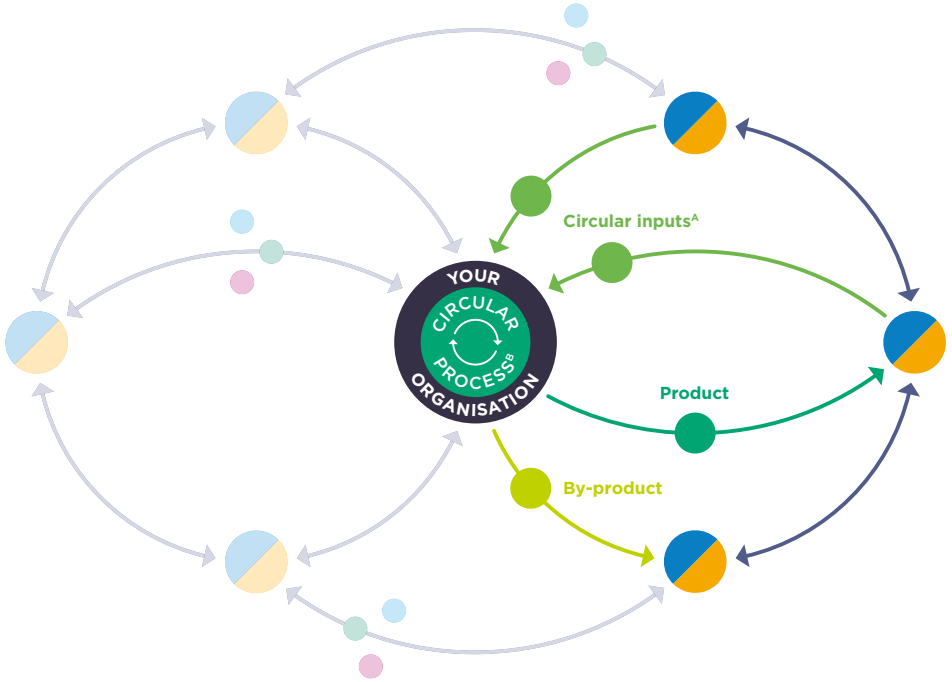
[16] Chatham House & Barrie J., *Supply chain traceability and transparency for a global circular economy* (13th June 2023)

A circular supply chain delivers and captures value using circular inputs and processes

Like in a linear supply chain, the goal of a circular supply chain is to deliver value. However, the inputs and processes used in each, differ.

Circular supply chains use circular inputs, which refer to the products, components, materials, and ingredients brought into a process or product that are either secondary (i.e. non-virgin), and/or have been regeneratively produced (i.e. grown/reared in ways that generate positive outcomes to nature), and that can be circulated within the economy and/or safely returned to nature. ***Dr. Bronners***, for example, after unsuccessfully searching for a regenerative source of palm oil for years, decided to contract and support a network of over 700 smallholder farmers to transition to regenerative cultivation practices. In the US, ***Redwood Materials*** is creating a closed-loop, domestic battery recycling supply chain to decouple the electrification of the economy from the extraction of finite critical raw materials. Compared to the extraction of virgin finite raw materials used as inputs for a linear supply chain, the use of circular inputs allows for material cost savings and improved material security, while simultaneously reducing the environmental impact caused by material extraction.

Circular supply chains also use circular processes, i.e. actions done to inputs in order to allow their reintroduction to the value chain with the goal of retaining the maximum amount of the inputs' embedded value. Instead of discarding or replacing products at the end of their first use phase or once they are damaged or obsolete, circular supply chains leverage reuse, repair, remanufacturing, refurbishment, and, as a last resort, recycling to keep products and materials in use for as long as possible with minimal (re)processing.



[A] secondary (i.e. non-virgin) and/or regeneratively grown products and materials that can be circulated within the economy or safely returned to nature.

[B] actions done to inputs to allow their (re)introduction to the value chain and the retention of the maximum amount of their embedded value (i.e. maintenance, repair, refurbishing, remanufacturing, and, as a last resort, recycling).

Furniture manufacturer ***Ahrend***, for instance, has combined their product design and supply chain capabilities for easy disassembly, repair and upgrades - designing each product from the outset with these processes in mind, while also setting up take-back systems with suppliers and opening a factory to carry out the refurbishment. Such circular processes displace the need for new production and material extraction, while enabling maximum retention of embedded value (i.e. work and energy).

Rethinking inputs and processes can also minimise the generation of process by-products. Once minimised, any leftover by-products are kept in circulation within or across supply chains, to retain their embedded value within the economy, while keeping them from ending up in landfill or the environment. For example, the ***Western Cape Industrial Symbiosis Programme***, Africa's first industrial symbiosis programme, connects companies so that they can identify and utilise unused or residual resources from each other's operations (materials, energy, water, assets, logistics, and expertise). By rethinking by-product streams in this way, businesses are able to generate new revenue streams and reduce operational costs, while reducing the environmental impact of the supply chain.

Managing supply chains in a circular economy through the SCOR model

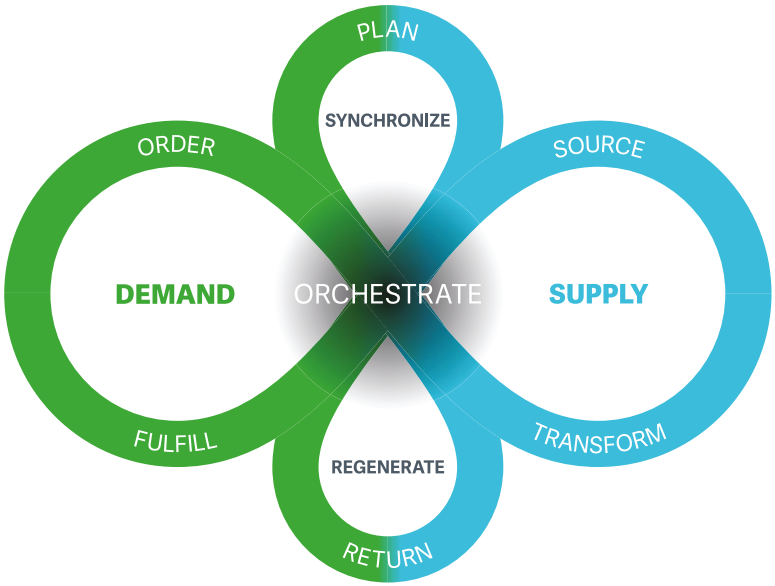
Designing and managing circular supply chains requires a move from a linear 'source-make-deliver' mindset, to a circular one.

The circular supply chain outlined above suggests a transformation in the ways in which supply chain professionals will approach their work. The Association for Supply Chain Management's ***SCOR model*** (see figure 3) showcases core supply chain process areas and provides guidance on how to optimise them. In its latest version, it has been adapted to reflect the shift in thinking from a linear supply chain model to a more synchronous network. The model can be a useful tool to provide a clearer appreciation of how the implications of a circular supply chain will be reflected on specific supply chain teams and processes.

Orchestrate: In the circular supply chain, all 'Orchestrate' activities[17] are assessed and adjusted to ensure they can enable the successful building and management of supply chains fit for a circular economy (see 'Making the shift' section below and ***SCOR-DS OE13 Circular Supply Chain Management***).

Plan: The planning element in a circular supply chain expands beyond demand and supply, to include the reclaiming and circular processing (e.g. repair and remanufacture) of existing items alongside planning new builds. Utilisation will become a key metric for planners, as inventory turnovers may no longer be an appropriate way to measure supply chain success in a model that seeks to decouple revenue from production volumes.

Figure 3. SCOR model



[17] I.e. the creation and management of "business rules and enterprise business planning; human resources; network design and technology; data analytics; contracts and agreements; regulations and compliance; risk mitigation; environment, social, and governance initiatives;...performance management" as in Association for Supply Chain Management, The SCOR Digital Standard (SCOR DS), https://www.ascm.org/corporate-solutions/standards-tools/scor-ds/

Order: As customers purchase circular products and services, attributes in the 'Order' process such as locations, payment methods, pricing, and other order elements may also be affected. Given circular supply chains look to minimise the need for processing inputs, items recovered in the 'Return' process and ready to go back to market (e.g. through reuse) may move to 'Order' without having a 'Transform' step in between.

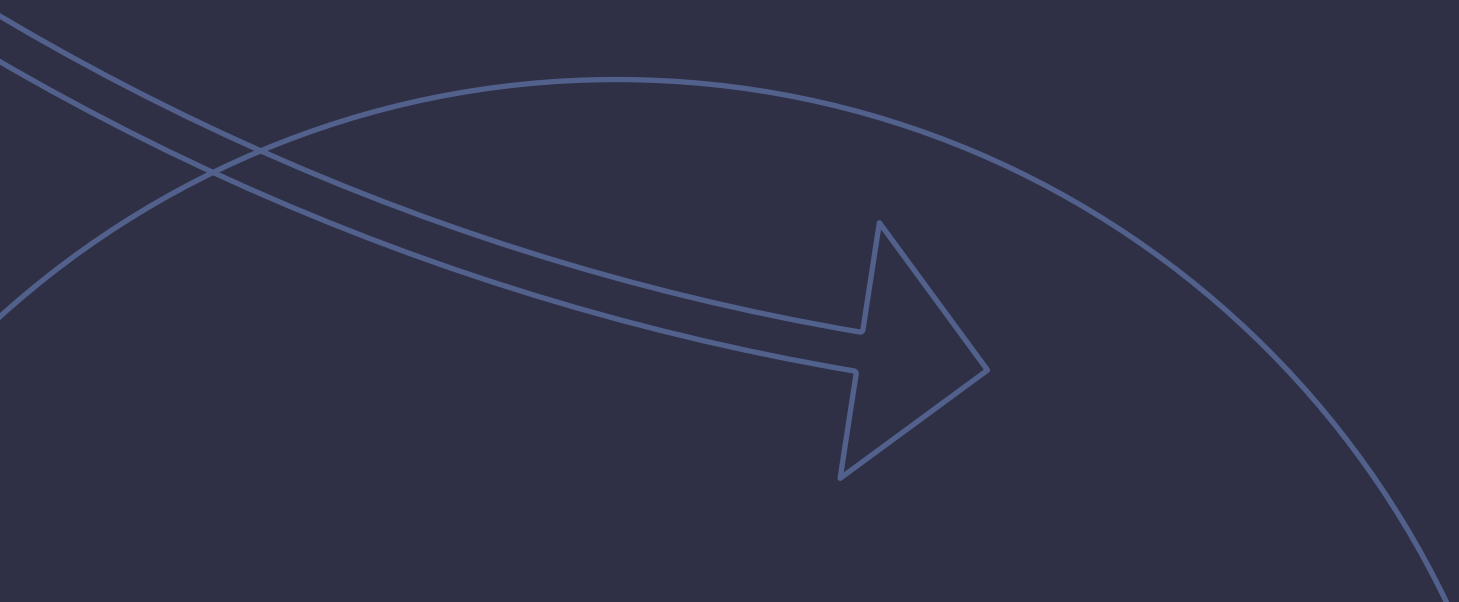
Source: Circular supply chains will source circular inputs; i.e. products, components, materials, and ingredients that are either secondary (i.e. non-virgin), and/or that have been regeneratively produced and can be circulated within the economy or safely returned to nature. Hence, sourcing in a circular supply chain must become more aligned with return processes and more attuned to looking for input availability from the market (either from within a company's own supply chain or from other supply chains in the market). Many teams have already started to source circular inputs, but more can be done to prioritise sourcing higher-value circular inputs (e.g. finished goods) over lower-value ones (e.g. recycled materials).

Transform: In a circular supply chain, 'Transform' is aimed at keeping existing products and materials in circulation at their highest value with as minimal processing as possible. This is achieved by prioritising cleaning, maintenance, and repair over remanufacturing, refurbishing, or, as a last resort, recycling. Material intensity may be measured to optimise the amount of resources needed to process and return an item to a value stream.

Fulfil: Fulfilment networks in circular supply chains are more heavily concentrated towards the market where the item is being used, as keeping products and materials in use with minimal processing is prioritised. In-market reuse, in particular, is a key consideration in a circular supply chain for these processes.

Return: 'Return' becomes a critical process as more companies leverage reverse flows to secure circular inputs. This will involve optimising the recovery of products, components, and materials from customers back through to the supply chain, in order to be able to diagnose their condition, use them as inputs for the 'Transform' process, and ultimately deliver them back to a customer.

Making the shift: Nine focus areas for circular supply chains

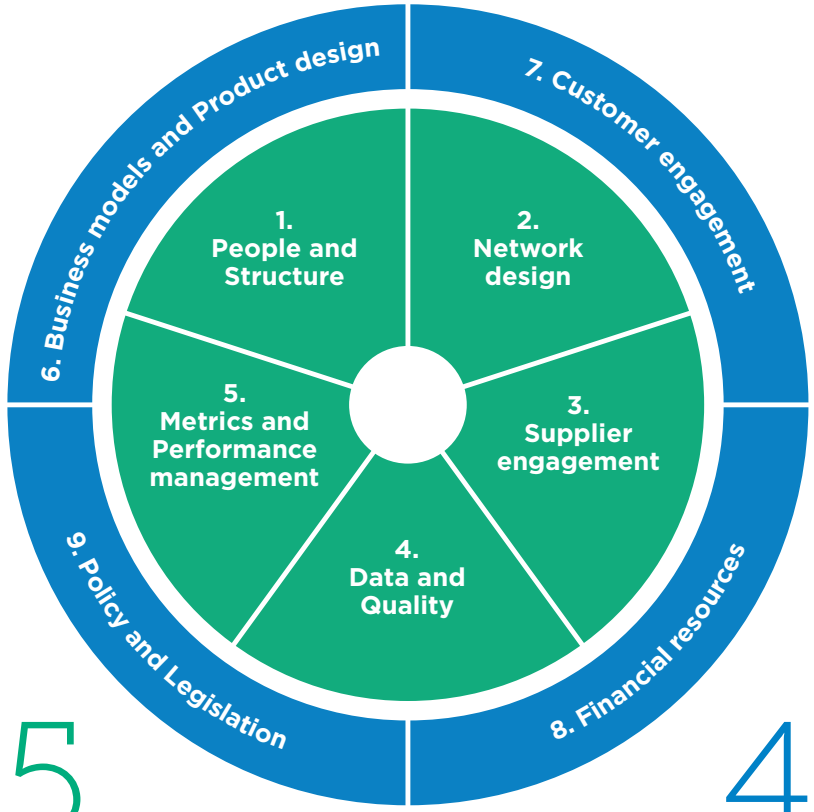


Making the shift:
Nine focus areas for circular supply chains

As with any large organisational transformation, supply chain leaders beginning to explore the design and management of circular supply chains will encounter some internal and external challenges they need to solve to effectively make the transition.

To help supply chain leaders plan ahead and make the transformation from linear to circular as smooth as possible, the following section presents nine areas these professionals will need to focus on to shift to circular supply chains, five of which their departments can directly address, and four of which will require collaboration with other internal and external stakeholders. Some initial recommendations for effectively navigating each area will also be explored.

Figure 4. Nine focus areas for circular supply chains



5
areas supply chain teams can directly address

4
areas requiring collaboration with other teams

1. People and Structure

Key question:

How might supply chain leaders develop organisational structures and equip their teams to enable them to successfully transition to circular supply chains?

Context:

Supply chain teams report challenges in finding enough time during their day jobs to focus on transitioning processes and technologies in the ways needed to create a circular supply chain. There are also challenges around clarity of where the ownership of realising circular supply chains sits, as well as varying degrees of circular economy understanding across supply chain functions. When taken together, the competition on time, gaps in knowledge, and lack of clarity around ownership of the transformation make it difficult for supply chain teams to effectively transform their ways of working.

Recommendations:

- **Rethink and clarify the roles and responsibilities needed across supply chain teams to enable circular supply chains.** To effectively transform the processes of a supply chain from linear to circular, all teams within the broader function will need to be engaged. As such, defining clear roles and responsibilities for how each sub-function (e.g. procurement, manufacturing, logistics) will have to adapt their ways of working will be crucial to ensure the efforts of every team positively contribute towards successfully creating a circular supply chain. New roles might also be needed to effectively drive circular supply chain transformation and operations. In fact, trends of reorganisation and reconsideration of roles to enable circular supply chains are now starting to become visible in supply chains across different industries to try to address these issues.
- **Develop circular economy knowledge and capabilities across internal supply chain teams**. Upskilling supply chain professionals within organisations on key concepts around the transition can be a great way to engage team members on the topic, ensure that collaborations across teams and other partners in the circular supply chain are more seamless as they can share a common understanding, and help highlight the role each team can play in implementing these changes within their organisations. Formal circular economy training programmes, internal workshops, or attendance in conferences can all provide avenues for this capability development, as can pilot projects. Similarly, embedding circular economy language and considerations into the software, frameworks, and metrics (see challenge 5) used by these teams can also be effective in helping familiarise teams with the key concepts needed for the transition, whilst also demonstrating the broad impacts of the transformation on all relevant aspects of the teams' current ways of working.

Case study: **HP**

The Challenge:

HP aims to be "the world's most sustainable and just technology" company, with commitments like reaching 75% circularity for products and packaging by 2030,[18] reducing value chain GHG emissions by 50% by 2030, and achieving net zero by 2040.[19] In order to fulfil this level of ambition, HP recognises the central role of supply chain functions as well as the people and structure challenges that they may face in the transition to a circular model. Those challenges include a varying circular economy understanding across functions, misaligned governance and role structures, or the competition for supply chain functions' time to transition towards processes and technologies fit for a circular supply chain, all while maintaining ongoing operations and delivering on the expectations of shareholders.

The Solution:

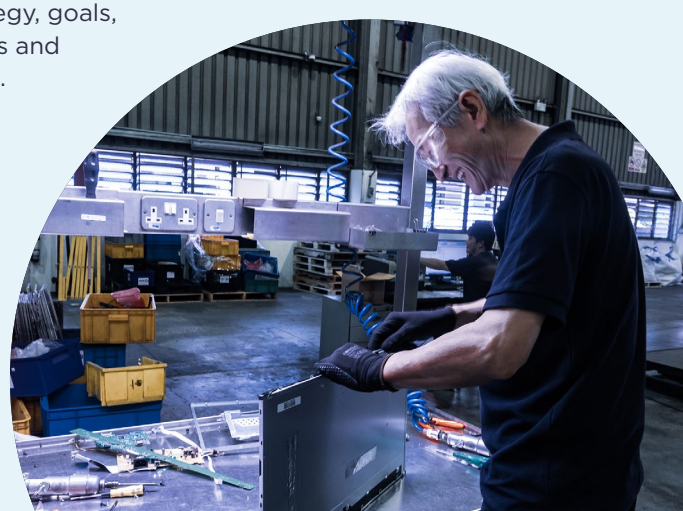
In order to address the people and structure challenges associated with the transition to a circular supply chain, HP is leveraging a multifaceted approach. First and foremost, at an organisational level, HP has defined a clear ***vision*** and bold goals so that all teams can move in the same direction, including supply chain functions. In order to translate the strategy into action, HP is creating new organisations, like a whole new business unit focused on circular products (Renew Solutions) that requires new supply chain infrastructure, capabilities, and processes, and conducting changes in existing ones, such as consolidating supply chain functions focused on returns and take-back in just one team structure. Additionally, HP is working to establish clear and robust governance and role structures, with adequate levels of responsibilities and accountability. To bridge the knowledge and skills gap, the company is providing education and training on circular economy principles, for instance, to ensure that supply chain functions working with vendors and partners are equipped to set new requirements and commitments focused on the circular economy.

The Benefits:

The expected outcomes of HP's actions range from improved company culture with a greater sense of purpose and belonging to increased employee engagement or an enhanced ability to attract and retain diverse talent within supply chain functions. Additionally, the approach taken is aimed at ensuring that HP leads and meets the expectations of all stakeholders engaged in the supply chain, including customers, suppliers, and shareholders, whilst staying ahead of the curve in matters of regulatory and legal compliance, and reputation risk mitigation.

Lessons Learned:

- Align the circular supply chain strategy and actions with the wider company circular economy strategy, to ensure all elements within the organisation (e.g. design, products and solutions offering, logistics, manufacturing, end-to-end finance, organisational structure, and risk management) move in the same direction.
- Acknowledge the importance of thorough risk assessment and mitigation strategies before embarking on the reorganisation.
- Capture learnings and provide spaces for internal feedback to adjust strategy, goals, and plans as the company moves and the macro-environment changes.



[18] Percentage of HP's total annual product and packaging content, by weight, that will come from recycled and renewable materials and reused products and parts by 2030.

[19] Absolute reduction of Scope 1, 2, and 3 GHG emissions compared to 2019. Excludes non-HP paper consumed during product use.

2. Network design

Key question:

How might supply chain leaders optimise network designs to enable cost-effective reverse flows of materials and products at scale, while enabling the maximum retention of their embodied value?

Context:

The shift to circular supply chains can surface new challenges for supply chain leaders around the management and location of the reverse logistics and processes needed to recover and reintroduce used or unwanted products and materials. This is because all key aspects of supply chain networks today – from the types of partnership and ownership structures to the systems, infrastructure and technologies that support them – are primarily built to optimise for forward, rather than backward, flows of products and materials. As such, the process of capturing the value of these items post their first use is challenging, since the network has not been designed for it. Nonetheless, these reverse logistics activities are vital for enabling circular economy initiatives – such as product-as-a-service, take-back schemes, leasing or renting, and remanufacturing or recycling – all of which are increasingly demanded by customers, and thus will require the attention of supply chain leaders implementing circular supply chains.

Recommendations:

- **Optimise the geographical distribution of all network elements.** Exploring different options for the location of supply chain activities and infrastructure (such as plants, distribution centres, or repair centres) can unlock cost-effective and low-carbon solutions for the sourcing of circular inputs. Setting up regional hubs to collect, sort, and process products and materials, for example, can improve the efficiency of supply chain access to circular inputs, help combat potential issues around cross-border legislation, including taxation, that affect the movement of these products, and reduce overall emissions of the supply chain. When combined with new forms of network partnerships that enable decentralised processes, these localised operations can also offer cost-effective, low-carbon solutions for supply chain leaders.
- **Reimagine network partnerships and product and material-ownership structures.** The transition to circular supply chains will require new types of relationships and interactions between different external stakeholders. Competitors might benefit from pooling together resources to create decentralised hubs for taking back or reprocessing similar materials; the by-products of one client's processes might provide valuable inputs into their suppliers' processes or the processes of organisations in completely different industries, such as is the case with ***Kalundborg Symbiosis***. Ownership structures for the infrastructure, processes, and materials, should also be carefully considered and selected in the building of these new partnerships, in accordance with what will deliver the most desired benefits. For example, supply chain leaders can decide to centralise (in the case of large, high-value, low-volume products) or decentralise (in the case of small, lower-value, high-volume products) the take-back, and reprocessing systems (e.g. repair, remanufacture) that enable circular supply chains to help them reach the desired scale of operations. They can also consider whether to run these activities in-house or to outsource them to suppliers or third parties to ensure process cost-effectiveness, and re-evaluate who should own the inventory as materials are recovered and circulated to enable these activities to be carried out most effectively. The optimal choices for these circular supply chain network design decisions will depend on the ambitions (e.g. cost-efficiency, resilience, carbon impact), existing supply chain capabilities within the organisation and existing network, as well as the circular business model and product design adopted, and can offer helpful solutions to support the user.

Case study: **CHEP**

The Challenge:

Currently, CHEP, the world's largest global pallet pooling company, collects their pallets after they have been used and inspects them at their service center, to ensure quality and conduct any necessary repairs before putting them back in circulation. Recently, they noticed that most of their pallets at collection sites are in sufficiently good condition to avoid unnecessary inspections. Hence, the supply chain design and optimisation team at CHEP asked themselves: What if we could avoid the unnecessary flow of sending those pallets into the service centre for inspection?

The Solution:

CHEP is exploring switching from the current 'One-Way Trip' approach to a 'Managed Recovery' one. In the latter, the customer receives CHEP's pooled (shared and reusable) pallets directly from distribution centres and retailers; sorts them using CHEP quality standards; stores the pallets that pass the test; and returns the rest to CHEP for repair before reuse. CHEP plans to leverage Flow Optimisation software to identify potential opportunities for switching service offers from 'One-Way Trip' to 'Managed Recovery'.

The Benefits:

By redesigning their network approach and eliminating the need for sending pallets in good condition back to service centres, CHEP hopes to reduce transportation costs and associated emissions, as well as the energy consumption from their service centre.

Lessons Learned:

- Critically analyse the network design to find opportunities for improvement and move closer to a circular supply chain.
- Carefully select the partners with whom to collaborate in the circular supply chain.
- Strive to increase the circularity and efficiency of the supply chain, without prioritising one over the other.

3. Supplier engagement

Key question:

How might supply chain leaders engage with, support, and incentivise suppliers to adopt circular economy practices and standards?

Context:

Suppliers can either be a source of inspiration or a challenge for supply chain leaders looking to transition to circular supply chains. Suppliers have an essential role in ensuring the quality, availability and traceability of circular inputs (materials and products), made all the more critical in the face of increasing pressure and expectations from customers, policymakers and investors to demonstrate circular performance. The level of power or influence an organisation has over its supplier will impact how much, and in what ways, the former can encourage the latter in the transition to circular supply chains.

Recommendations:

- **Establish and communicate clear criteria and expectations for suppliers.** Supply chain leaders can incorporate circular economy criteria (e.g. around sourcing durable, circular inputs) into procurement negotiations, proposals, agreements, and supplier evaluations. To facilitate the cost-effective circulation of products and materials, new processes, such as those around disassembly, can be incorporated into proposals or requests for proposals (RFPs) for suppliers that may be unfamiliar with such practices today. Creating standardised documentation within proposals that mandate processes like disassembly can also help drive the adoption of circular practices. This way all relevant considerations to enable effective operation of circular supply chains can be formally embedded into the ways in which supply chain partners operate, ensuring that everyone's activities contribute to the common goals. For example, ***Danone*** has established long-term contracts with dairy farmers, helping alleviate short-term market volatility, thereby allowing them to adopt practices that can support regenerative outcomes. Working with the planning team to use circular inputs effectively should start from the S&OP (Sales and Operarations Planning) process through production planning, as supply and demand will vary for material that is scarcer in the current marketplace.
- **Reward good performance and innovation.** Use the clear circular economy requirements set in the supplier qualification processes, as a way to select new suppliers to work with. Explore opportunities for establishing reward systems for current suppliers that demonstrate progress towards building circular supply chains.
- **Provide guidance and support for capacity building.** At the same time as the above, supply chain leaders can work together with suppliers, customers, and policymakers to educate and upskill all relevant stakeholders on key concepts and practices around the circular economy, to ease the adoption of circular supply chains and support in the collective transition.

Case study: **Flex-N-Gate & DS Smith**

The Challenge:

Flex-N-Gate, a leading manufacturer of high-quality parts for the automotive industry – and a long-term customer of DS Smith, an international packaging company – wanted to optimise the space in the trucks that were used to transport the car bumpers from their manufacturing facilities to the car assemblers. They made a request to DS Smith for a new type of packaging that would allow them to optimise the space in the trucks, and if possible, adhere to sustainability criteria. The cost was the key tender criteria with CO_2 emissions reduction also playing a part.

The Solution:

Due to their long-term partnership, DS Smith was able to work closely with key people at Flex-N-Gate to innovate and validate the new packaging solution. They created a new type of box with the optimal amount of material that made best use of the space in the truck. The packaging is made out of a mix of recycled and virgin cardboard and is 100% recyclable.

The Benefits:

The total cost of ownership of this innovative solution was more attractive than the previous one and reduced CO_2 emissions, thanks to a maximised number of products in the truck and the perfect protection of the goods (painted car bumpers that are sensitive to abrasion), avoiding the necessity to produce and deliver replacement products.

The special shape associated with centring devices and a customised pallet also secure the load on each pallet by a perfect stability, delivering great safety conditions to all employees.

Lessons Learned:

- Write your tender based on the performance needs instead of items or materials. This provides the opportunity to innovate without resorting to the usual and previously used solutions. The capabilities of the supplier (ability to innovate, machinery available, quality control) will be key.
- Make sure that your supplier can work closely with the key people and teams in your organisation to test and validate their new solution. That might be more possible in long-term partnerships with established relationships and trust.
- As a supplier, make sure you have proper internal processes to allow the information sharing to come up with the best solution. In the case of DS Smith, they had the industrial design team set up to share relevant knowledge and experience without prioritising one over the other.

The Circular Economy Procurement Framework can offer a useful starting point for reimagining engagements with suppliers in a circular supply chain.

4. Data and Quality

Key question:

How might supply chain leaders deploy adequate technological solutions, or adapt existing ones, to support and facilitate circular flows of information, materials, and products?

Context:

The right kinds of technology systems and information flows can play an essential role in helping circulate products and materials across the supply chain effectively. However, the existing ones today have often been designed and optimised for linear processes and transactions, and as such may not support or facilitate circular activities, such as tracking, tracing, sharing, repairing, or recycling.

Recommendations:

- **Leverage emerging technologies such as blockchain, artificial intelligence, digital twins, or internet of things, to help increase visibility across the supply chain,** ensuring sourcing, quality, and design professionals have enough data to make adequate decisions around circular inputs. It is essential to have clear information about the volume, material makeup, and any potential quality issues with secondary products or materials entering the supply chain as inputs to ensure their suitability for their intended use and to avoid waste. Implementing robust tracking and labelling systems (e.g. DPP) that provide comprehensive, verifiable information about the origin, condition, and history of refurbished or reused goods and components will create greater transparency to enable informed decision-making, ease the access to circular inputs, and promote trust within the circular supply chain. To meet the requirements set out by recent legislation (e.g. UN 38.8, EU DPP), supply chain leaders can also work with a variety of innovators that have entered the market as data and transparency solution providers.

Case study: **Niaga®**

The Challenge:

Niaga® is a solution provider enabling the transition to a circular economy by helping manufacturing partners redesign and produce products such as carpets, mattresses, and furniture panels fit for a circular economy. In their efforts to close the loop, they faced challenges posed by the current lack of data on the ingredient composition of materials and products. The absence of this data means stakeholders like recycling organisations and sourcing professionals do not have enough information on the inputs coming into their operations to determine the best way to keep them in circulation, which leads to lost value capture opportunities as materials can get unnecessarily downcycled or discarded as waste.

The Solution:

To address this challenge, Niaga® developed a scannable discernible marking for products to keep them in circulation in the economy at their highest value, giving them a return route and a digital product passport (DPP) that provides ingredient transparency. By scanning the Niaga® tab on a product, supply chain stakeholders, including customers, can access a landing page with factual, objective, measurable information on product ingredients, components, provenance, and attributes like its CO_2 footprint, recycled content, and recyclability.

The Benefits:

Niaga®'s DPP ensures that supply chain partners have access to product component, material, and ingredient data and, as a result, can select the most appropriate and energy efficient method to keep products and materials in circulation at their highest possible value. As an example, in the Netherlands, where an Extended Producer Responsibility (EPR) system applies to mattresses, Niaga®'s innovation allows for mattress producers to bypass the modulated fee of EUR 5–10 per mattress for waste disposal. This cost avoidance comes from the fact that Niaga®-tagged mattresses can go to a separate stream where a recycler will process them taking into account their material composition and offer the outputs of the process to a supplier as inputs for new mattress components.

Lessons Learned:

- Leverage and test emerging technology like DPPs to improve issues relating to data transparency, material composition and quality, and the multidirectional flow of information in a circular supply chain.
- Whilst requiring effort from supply chain professionals at first, investing time and efforts to bring more material ingredient transparency to the supply chain will provide a competitive advantage for early adopters as legislative requirements come into place and supply chain partners, including OEMs, increase their demand for ingredient transparency.

5. Metrics and Performance management

Key question:

How might supply chain leaders evaluate the performance of circular supply chains and create internal incentives that support the shift to circular supply chains?

Context:

Measuring circular supply chain success with the same metrics as those used for assessing linear supply chains, will not accurately capture the value and positive impacts generated by the transition. For example, in the transition from sales-oriented linear business models to service-oriented circular business models, inventory turnovers may no longer be an appropriate way to measure supply chain health as the circular model seeks to decouple revenue from production volumes. These challenges are also reflected in the performance management aspects of supply chain teams, as incentive systems built on linear metrics can discourage supply chain professionals from transforming their ways of working to adopt circular supply chains.

Recommendations:

- **Rethink and align with sustainability and finance departments on the performance indicators used to monitor, measure, and drive success in a circular supply chain.** A few examples of performance attributes that can help supply chain professionals monitor the success of circular supply chains include:
    - **Circular inputs –** Quantify the amount of products, components, materials, and ingredients brought into a process or product that are either secondary or have been regeneratively produced, in comparison to virgin and finite inputs. Examples of useful metrics to this end include: total weight or volume of circular inputs used; total weight or volume of non-circular inputs used; total weight or volume of circular inputs used against total weight or volume of all inputs used.
    - **Process outputs –** Measure the amount of valuable process outputs generated (including by-products) and track their destination, either as valuable resources in the economy or as waste and pollution in landfill or the environment. Examples of metrics to help this include: total weight of waste generated; generated waste diverted from disposal for reuse; generated waste diverted from disposal for recycling; generated waste diverted from disposal for other recovery options; and generated waste directed to landfill.
    - **Product utilisation –** Assess the amount of time that products are in use and generating value for the customer before requiring circular processing to extend the lifetime of the product, components, or materials (i.e. repair, remanufacturing, refurbishment, or, ultimately, recycling). Examples of metrics to help indicate this include: time a product functions as required until first failure (i.e. technical lifetime); time a product is used until requirements of user(s) are no longer met (i.e. functional lifetime); functional lifetime against technical lifetime (i.e. product utilisation).
    - **Material intensity –** Evaluate the decoupling of circular supply chain processes and value generation, from the consumption of resources like materials, water, and energy. Examples of metrics to help achieve this include: total weight or volume of inputs used against revenues.
- **Make annual performance evaluation and incentives, such as bonuses, of supply chain teams contingent upon circular economy targets and key performance indicators (KPIs), and reward circular economy initiatives.** This approach encourages and rewards behaviours that contribute to the adoption of circular economy principles throughout the supply chain, and can transform the circular economy from a passive consideration into an active driver of employee behaviour.

Case study: **CHEP**

The Challenge:

CHEP, the world's largest global pallet pooling company, aims to become a "nature-positive business" and to "pioneer regenerative supply chains" by 2025. In order to do so, they had to rethink their measure of success at an organisational level as well as at a departmental level. This meant that supply chain teams had to look beyond traditional supply chain KPIs focused on cost and efficiency, to include other measures of success in a circular supply chain and integrate them within the organisation's incentives system.

The Solution:

CHEP created an Activity Based Costing (ABC) model to track circular flows and codify over 30 related KPIs like asset return rates and reverse logistics efficiency. The model provides data to benchmark circular performance, identify improvement areas, and rapidly test solutions. Amongst the 30 KPIs, there are three key metrics to measure CHEP's circular supply chain success:

- Efficient Control Ratio, referring to how CHEP controls the pool vs blue sky in units
- Flow Through Ratio, if those ratios are close to 100%, all the rest goes well
- Cycle Time, referring to how quickly items come back to be circulated again

Additionally, CHEP links organisational circular economy targets to employee incentives through, for instance, tying bonuses to their Asset Productivity target, which refers to how many assets are kept in circulation to prevent the need for new products being injected.

The Benefits:

Tracking circular KPIs has enabled supply chain teams to make data-driven decisions to optimise circular flows to generate more value with less virgin material extraction and waste. Such a circular performance measurement system has proven crucial, for example, for the company's Plant Network Optimisation of empty product flows.

Lessons Learned:

- Develop circular metrics to measure, analyse, and find ways to progress on circular supply chain deployment and operationalisation.
- Tie supply chain employee incentives, like leadership performance bonuses, to circular economy targets in order to embed circular economy thinking into day-to-day supply chain operations and drive cultural change.
- Nominate circular economy champions in each function and country to ensure the circular economy is embedded in the day-to-day operations and processes.

6. Business models and Product design

Key question:

How might supply chain leaders influence business models and product design to ensure the efficient and effective circulation of materials and products in the supply chain?

Context:

The effectiveness of operating circular supply chains can be hindered if the products and materials, and business models generating value from them, have not been designed with the circular economy in mind in the first place (e.g. to enable activities like remanufacturing, repair, or recycling). For example, whether a product has been designed for repairability, modularity, or disassembly, will influence the technical and financial viability of different circular processes (such as repair or remanufacture). Whilst these elements fall beyond the responsibilities of supply chain leaders, close collaboration with teams in charge of business model and product design can ensure that all departments move in the same direction and products and materials get manufactured and circulated successfully at their highest value in a cost-effective manner.

Recommendations:

- **Inform business model and product design process to ensure design for a circular economy.** Supply chain leaders can help improve the design of business models and products for a circular economy by engaging with relevant departments early on. For instance, they might connect with product design around the main challenges when it comes to repairing or remanufacturing products, or with business units on the challenges for effectively incentivising cost-efficient reverse flows through the business model set-up (e.g. product-as-a-service). By sharing their knowledge on the manufacturing technologies available today, as well as the landscape of network partners, supply chain leaders can help ensure the efforts of all these central teams – from product and business model designers to supply chains – contribute towards a broader organisation-wide transition to a circular economy.
- **Connect internal stakeholders with relevant teams in upstream and downstream partners.** Supply chain leaders manage relationships with partners upstream and downstream. They can therefore connect relevant internal and external teams in order to improve the efficiency of designs and the processes conducted by partners in the supply chain. For example, in Brazil, ***HP & Sinctronics*** partnered to create a reverse logistics ecosystem able to recover and create value out of HP end-of-use electronic equipment. As design decisions happen in HP, while reprocessing is carried out by Sinctronics, cross-company communication allowes for the most up to date knowledge on disassembly to be disseminated among all fields of expertise. It also enables Sinctronics to share practical insights with HP, seeking to influence and enhance their design decisions and identify new opportunities to create a closed-loop process between manufacturing and recycling.

Case study: **Philips**

The Challenge:

Philips, a global leader in healthcare technology, aims to generate 25% of revenue from circular products and solutions[20] and is committed for 100% of products meet the company's ***EcoDesign*** principles (of which circularity is a key pillar). In pursuit of these objectives, Philips introduced a rental model for its IPL Lumea, a hair removal beauty device.

However, this circular economy offering posed a new challenge for the company's supply chain professionals: striking the delicate balance between high quality and operational efficiency in collaboration with partners. Lumea devices, as personal care products, demanded meticulous testing to ensure products could be rented out to new customers whilst meeting Philips' rigorous refurbishment standardswith respect to functional, visual and hygienic requirements. Not a single hair or any other form of contamination should remain on the device to ensure that second-life products are #betterthannew.[21] Yet, the Lumea wasn't designed for refurbishment in the first place. Consequently, the yield rate for refurbishment, the availability of refurbished products, and the return on investment were low.

The Solution:

To address the new challenge, Philips' supply chain teams decided to work closely with their network partners. They developed a comprehensive ten-step protocol for approved partners that outlined procedures for inspecting, grading, sorting, cleaning, testing, repackaging, relabelling, recording product data, and releasing the refurbished Lumea devices. Furthermore, Philips provided the necessary test equipment and training, and worked with partners to harvest quality controlled parts, enhance forward-backwards compatibility, and exchange parts. The collaboration involved Philips' supplier quality engineers, who worked closely with partners to ensure that high-quality standards were met and the refurbished devices could be rented out again.

The Benefits:

Choosing refurbished instead of brand new Lumeas reduces the carbon footprint by 78%.[22] Beyond the environmental gains, this model offered insights into product innovation through post-market surveillance, to enable improvements in areas such as scratch resistance. Commercially, this initiative expanded market penetration by offering a broader consumer base access to high-end Lumea devices, including those with tighter budgets, while simultaneously enhancing the rental business model's return on investment (ROI).

Lessons Learned:

- Feedback loops between supply chain and innovation teams are key to making product designs fit for a circular supply chain. In this case, the first Lumea devices were not designed with refurbishment in mind. Through feedback loops between supply chains and innovation teams, the latest Lumea devices are easier to dismantle, clean, and put back in circulation.
- Closer collaboration with network partners in their operations gives valuable information on how to further improve.
- Keep it simple: start small, think big! the circular economy is embedded in the day-to-day operations and processes.

[20] Circular solutions include performance and access-based business models, upgrades, lifetime extension services, refurbished, reconditioned and remanufactured products, components and -systems, and products with recycled plastics content.
[21] Better than New refers to Philips Refurbished Products being Guaranteed Philips Quality, 2 years Warranty, Lower Price, and Less Waste.
[22] Based on LCA using ReCiPe2016 and ecoinvent3.6 database, for a refurbished Lumea S9000 compared to a new one, assuming all accessories, adapter and packaging need replacement. In scope: product-, packaging materials and Philips reverse logistics. Out of scope: chemicals and energy needed for reprocessing, inbound parts and material transport.

7. Customer engagement

Key question:

How might supply chain leaders ensure that customers return products into the supply chain for circulation after the use phase?

Context:

Supply chains will likely also face challenges in ensuring the return of products from customers or end-users after the product use phase to help secure availability of circular inputs in the network. This product return and recovery is crucial for enabling supply chains to capture the value and quality of products and materials, and reduce the need for virgin resources, so addressing it will be key in ensuring the success of the supply chain transition. The common challenges around material competition across industries provide an ever greater impetus for supply chains to address material security.

Recommendations:

- **Work with marketing to provide incentives and convenience for customers or end-users to return products and materials after their use phase.** Explore different options relevant for the desired recoverable products, such as deposit schemes, or sales discounts on new purchases when previously used items are returned. Use these incentives as ways to build trust and loyalty with customers or end-users. Make sure to not only align the incentive system choice and user experience such that it generates value for the customers, but also so that it is well suited for the network design and reverse logistics activities of the circular supply chain to maximise the effectiveness of the product circulation and value capture.

8. Financial resources

Key question:

How might supply chain leaders mobilise adequate levels of investment, support, and responsibility for the deployment of circular supply chain initiatives?

Context:

The transition to a circular economy will require investment in new supply chain infrastructure, both physical and digital, the costs of which, at the beginning might be relatively high before the desired scale of operations is reached. Accessing the necessary capital might pose a challenge, as the way in which finance functions evaluate supply chain investments still largely responds to linear ways of measuring success (i.e. traditional ROI considerations). Building the case to secure appropriate investment will require a shift in mindset and measurement regarding the way that supply chain and finance departments evaluate investments. Certain new metrics will need to be added to ensure circular supply chain activities are appropriately assessed (see examples of new metrics in Focus area 5: Metrics and Performance management), timelines for expected return on investments (i.e. patient investments) will have to be elongated, and non-financial considerations (such as impacts on biodiversity and carbon emissions) should also be included in these investment assessments.

Recommendations:

- **Align on circular economy ambitions and core priorities across Chief Supply Chain Officer, Chief Sustainability Officer, and Chief Financial Officer, or equivalent roles, to ensure adequate resources are available for the deployment of circular supply chains.** This will be crucial to ensure that supply chain teams have the right level of support, sponsorship, guidance, resources, and accountability for trialling and scaling circular initiatives within and beyond the supply chain. For instance, when building reverse flow operations in-house, supply chain departments will have to invest in new technologies to enable circular supply chains (e.g. sorting, remanufacturing, recycling) across the markets in which their organisations operate. For some products, such as EV batteries in the automotive sector that retain a high value in the marketplace, the business case can be quite easily made. For other products, such as smaller vehicle components, it may be harder. Creating a compelling case that emphasises the benefits circular economy initiatives will deliver with regard to supply chains teams' goals and those of other key stakeholders (e.g. resilience, cost-savings, carbon reductions, waste reduction, customer loyalty), as well as a plan on how the team(s) will achieve them, and the specific support needed throughout the timeline will increase buy-in.

Learn how to effectively communicate and present circular economy ideas to internal stakeholders through the ***Make a circular economy pitch in your organisation*** guide.

9. Policy and Legislation

Key question:

How might supply chain leaders inform legislation that affects the movement and exchange of circular materials and products within and across borders?

Context:

Supply chain leaders, especially those operating across national and regional borders, face the challenge of complying with fragmented and sometimes conflicting legislation, including taxation, that affect the movement and exchange of circular materials and products. This can create barriers or incentives for their circular economy activities, such as reuse, repair, remanufacturing, recycling, and sharing, in the current globalised and interconnected economy. The lack of common standards and definitions for circular economy concepts, indicators, and metrics, further exacerbate these challenges, by making it more difficult to align between companies, policymakers, and investors, on what supply chain activities should be sought after.

Recommendation:

- **Engage with policymakers either directly, or indirectly by collaborating with internal public affairs departments or trade and industry associations, to inform legislation.** As those most familiar with the challenges posed by existing legislation, supply chain leaders can inform relevant stakeholders to help create a conducive and consistent environment for deploying and scaling circular supply chains. For example, supply chains leaders, with the help of other relevant parties, can advocate for policymakers to stimulate design for the circular economy by ensuring the sharing of information and tracking through product labels and digital product material passports, which could help in the sourcing of circular inputs.

Policymakers could also be encouraged to manage resources to preserve value by reviewing and harmonising resource classifications and definitions in waste legislation, and to make the economics work by aligning taxation and fee incentives, such as EPR, with circular economy outcomes, to help supply chains capture and recirculate products and materials cost-effectively. Policy investments in innovation, infrastructure, and skills by, for example, supporting blended finance solutions for building physical and digital infrastructure, could also support circular supply chains, while collaboration for system change through building cross-border policy alignment could help remove some of the barriers faced by supply chains today in being able to move circular inputs across regions. These policy actions will be most effective when underpinned by the establishment and adoption of common standards reflecting the principles and goals of the circular economy across industries and sectors.

- **Whilst a conducive legislative environment is developed, supply chains can turn legislative constraints into solutions to advance the circular economy.** Supply chain leaders moving from linear to circular practices currently face legislative barriers that prevent them from, for example, moving used goods across borders or recovering valuable materials from them. However, these barriers can also be seen as opportunities to innovate and create new value by, for example, deploying infrastructure at local or regional levels to enable material circulation. Instead of treating legislation as a blocker, supply chains can use it as a constraint to model against different scenarios that might be possible. For example, if a used product cannot be transported through a border because of a current classification that determines used goods as wastes, then the supply chain can explore alternative options to circulate such products inside the market where it is already located (e.g. through activities like repair, reuse, or refurbishment). This could reduce transportation costs and emissions, create new jobs and skills, and increase customer loyalty and satisfaction.

Glossary

Circular inputs: Products, components, materials, and ingredients brought into a process or product that are either secondary (i.e. non-virgin), and/or that have been regeneratively produced, and can be circulated within the economy or safely returned to nature.

Circular processes: Actions done to inputs in order to allow their reintroduction to the value chain, and that retain the maximum amount of the inputs' embedded value (i.e. repair, remanufacturing, refurbishment, and, ultimately, recycling).

Finite materials: Materials that are non-renewable on timescales relevant to the economy, i.e. not geological timescales. Examples include: metals and minerals; fossil forms of carbon such as oil, coal, and natural gas; and sand, rocks, and stones.

Linear supply chains: Supply chains established and operated to flow materials from the planet, through transformation, to a user, and ultimately to a disposal process (i.e. following a 'take-make-waste' material flow). Products and resources are given one lifetime to add value before becoming waste and/or pollution.

Recycle: Transform a product or component into its basic materials or substances and reprocess them into new materials.

Refurbish: Return a product to good working order. This can include repairing or replacing components, updating specifications, and improving cosmetic appearance.

Regenerative production: A means to provide food and materials in ways that support positive outcomes for nature, which include but are not limited to: healthy and stable soils, improved local biodiversity, improved air and water quality.

Remanufacture: Re-engineer products and components to as-new condition with the same, or improved, level of performance as newly manufactured ones.

Renewable materials: Materials that are continually replenished at a rate equal to or greater than the rate of depletion. Examples include: cotton, hemp, maize, wood, wool, leather, and agricultural by-products. To fit in a circular economy such materials must be regeneratively produced.

Repair: Operation by which a faulty or broken product or component is returned to a usable state to fulfil its intended use.

Reuse: The repeated use of a product or component for its intended purpose without significant modification.

Reverse logistics: Supply chains dedicated to the flow of products and materials away from a user and towards a supply chain for the purpose of maintenance, repair, reuse, refurbishment, remanufacture, recycling, or regenerating natural systems.

Supply chain: The network of suppliers that deliver products from raw materials to end customers through either an engineered or transactional flow of information, goods, and money.[A]

Supply chain leader: The decision-makers working in a supply chain function; the title may vary per company and may resemble the following: Chief Supply Chain Officer, Chief Operations Officer, Head of Reverse Logistics, Head of Procurement, Supply Chain Strategist, or similar.

Supply chain management: The design, planning, execution, control, and monitoring of supply chain activities with the objective of creating net value, building a competitive infrastructure, leveraging worldwide logistics, synchronising supply with demand, and measuring performance globally.[A]

[A] Association for Supply Chain Management, *Supply Chain Dictionary*, Chicago (2022)

Core project team

Ellen MacArthur Foundation

Gaelle LeGelard
Lead, Network Activation

Ilma Stankeviciute
Programme Manager, Learning

Cindy Venho
Project Manager,
Network Activation

Andres Oliva Lozano
Senior Research Analyst,
Network Activation

Laura Franco Henao
Project Manager, Learning

Circular Supply Chain Network

Deborah Dull
Founder

Sophia Passerini
Contributor

Ramatu Abdulkadir
Contributor

Dennis Vegter
Contributor

Brijesh Krishnan
Contributor

Anne Michelle Avolio
Contributor

Sushma Kittali-Weidner
Contributor

Gerald Jackson
Contributor

Dharesha Jhaveri
Contributor

Vivian Tai
Contributor

Ellen MacArthur Foundation contributors

Lena Gravis
Development Manager, Editorial

Joanna de Vries
Editorial Lead

Emily Marsh
Design Researcher

Alex Hedley
Senior Graphic Designer

James Wrightson
Creative Lead

Tansy Robertson-Fall
Senior Design Manager

Acknowledgements

The Ellen MacArthur Foundation would like to thank the organisations who contributed to the study for all their constructive input.

Association for Supply Chain Management
BBB Industries
CHEP, a Brambles company
Flex
HP
H&M Group
Jaguar-Land Rover
Kinaxis
Niaga®
Novo Nordisk
Philips
PVH
Rajby Industries
Rheaply
University of Exeter
University of Bradford
Volvo Cars

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