Sustainability Executive Update

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# Rethinking Sustainability:
## A Process Perspective

by Deishin Lee

What does it mean to be sustainable? Recycling, reducing carbon footprints, switching to renewable energy sources? From the business perspective, is it about setting targets to signal commitments to sustainability? Is it about embracing the circular economy, and will doing so actually mean meeting sustainability targets? In this *Executive Update*, we explore taking a process perspective to show how concepts such as sustainability and the circular economy look in the physical world. Making these concepts concrete reveals a singular criterion for achieving a circular economy: *every output generated by every process should have a consumer who uses it productively*. This criterion provides managers with actionable steps and ways to measure their organization's progress toward sustainability.

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So what does it mean to be sustainable? For many, it conjures up the concepts of recycling or reducing carbon footprints or switching to renewable energy sources. Regardless of the precise meaning, sustainability is becoming more top of mind every day.

Indeed, today's businesses and organizations are taking a greater assessment of sustainability and aligning themselves more concretely with the issues surrounding it. In fact, many corporations have set specific targets to signal their commitments. These goals are concrete — such as achieving 100% renewable energy by 2025 — but will companies achieve sustainability by reaching them?

More recently, the notion of a circular economy has been embraced as the way to achieve sustainability. However, a practical question looms: how should firms operationalize the circular economy, and will doing so actually mean they are sustainable?

Taking a *process perspective* can show us how concepts such as sustainability and the circular economy look in the physical world. Making these concepts concrete reveals a singular criterion for achieving a circular economy: *every output generated by every process should have a consumer who uses it productively*. This criterion provides managers with actionable steps and ways to measure their organization's progress towards sustainability.

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# The Process Perspective

Let's start by taking a process perspective of a commonly used definition of sustainability from the Brundtland Commission, a sub-organization within the UN focused on sustainable development:

> *Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*

How do we meet humanity's needs? We organize processes into supply chains that produce goods and provide services. These processes make food and clothing and deliver healthcare and education. To continue providing humanity's needs, we need to maintain — and sustain— the operation of these processes for future generations. This is how the Brundtland sustainability definition looks through a process lens.

At a basic level, every process takes inputs and transforms them into outputs. For example, to make a chair, we take wood, screws, glue, nails, and paint, and organize activities where people and machines transform the raw material into finished products used by consumers. These linear processes, the backbone of our current linear economy, have been identified as the culprit of our unsustainable way of life. But why is a linear process (see Figure 1) unsustainable? That is, what would prevent it from continuing to operate to meet the needs of humanity? Well, a process would stop if it ran out of inputs or if it produced outputs that no one wanted.

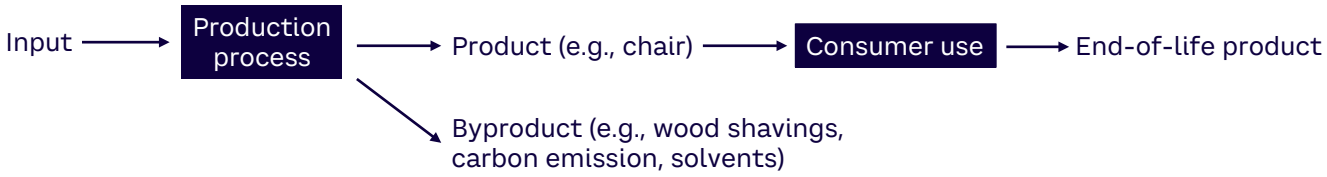


Figure 1. A linear process produces a product and byproducts

Much of the initial concern around sustainability was over running out of inputs: food, water, minerals, and so on. Resources are finite and continued consumption will eventually exhaust the supply.

*Resources are finite and continued consumption will eventually exhaust the supply.*

An equally pernicious problem exists on the output side of the process. Outputs without consumers become waste. Waste in the form of end-of-life products (e.g., plastic bottles, electronic waste) has been the focus of recent attention, resulting in efforts to increase reuse and recycling. However, when we make something, we also generate byproducts — there's no way around it. When we make a chair, we also generate wood shavings and excess glue, along with emissions from machinery and effluents from solvents used in the process. In fact, industrial byproduct waste is an order of magnitude greater than end-of-life product waste. Thus, to achieve any notion of sustainability, we must address industrial byproduct waste as well as end-of-life product waste.

## From Linear to Circular

Shifting to a circular economy is one proposed antidote to our current unsustainable linear economy. Circularity has an intuitive appeal. In contrast to a linear flow that has a beginning and an end, circular flow keeps going — a veritable geometric manifestation of sustainability (see Figure 2). But how do we go from the concept of circularity to execution?

The key revelation is that no material is really waste; rather, material *becomes waste* if it's in the wrong place at the wrong time. Wood shavings are wasted if we're making chairs, but useful as mulch if we're landscaping. To stop wasting material, we need to match it with a process that can productively use it — at the right time, at the right place, and in the right quantity. This is a supply chain problem.

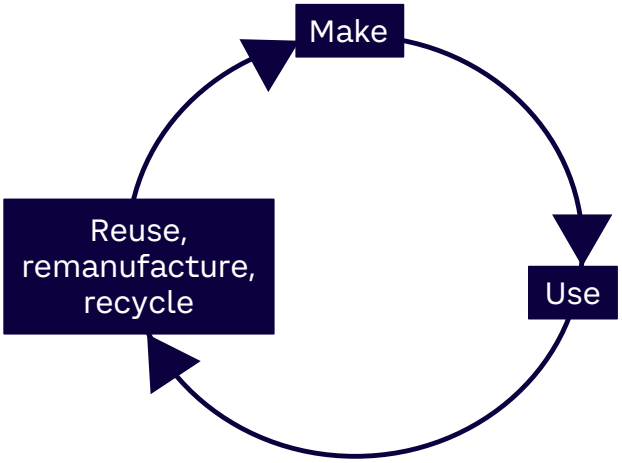


Figure 2. A conceptual notion of sustainable circular processes

## What's Essential for Operationalizing Circularity?

Companies are good at matching supply and demand for products, but it's a different story for everything else that comes out of the supply chain. That's why the shift from the noun "waste" to the verb "waste" is critical because it rightfully frames the scenario not as an inevitability, but as an action choice: to waste or not to waste. This reasoning leads to an actionable criterion for circularity: *every output generated by every process should have a consumer who uses it productively*.

Let's unpack this criterion. First, *every output* must be used productively — including the product and the byproducts (the largest source of waste). *Used productively* means that the consumer values the material and needs it as input for another value-added process. The consumer simply becomes another process turning inputs into outputs. The consumer of the chair product could be a paying customer who uses the chair during work process at the office. The consumer of the wood shavings byproduct could be a landscaping firm. A crucial part of the circularity criterion is that consumers do not necessarily need to be *paying* customers — they just need to

productively use the material (e.g., plants productively use CO2 emitted from factories). We call this party *consumers* as well.

Now, suppose every product and byproduct of every process was used productively. Consequently, an output becomes an input that generates output, which then becomes input. That logically means that there is no beginning and no end. Voilá! We have achieved circularity!

*The circularity criterion is liberating because it does not constrain a material to being recycled right back into its original form.*

The circularity criterion is liberating because it does not constrain a material to being recycled right back into its original form, like an aluminum can that gets recycled back into an aluminum can. Material can be transformed and used productively in many different processes over time. In fact, a *diversity* of processes must be involved so that what is considered waste in one context is valuable in another *different* context. As such, this criterion encompasses both end-of-life and industrial byproduct waste. The connection of different processes through material exchange transforms the linear process in Figure 1 into the ecosystem of interconnected processes in Figure 3. Unlike linear systems that create value by leveraging economies of scale, an ecosystem of interconnected processes leverages *economies of scope*.

We see abundant examples of economies of scope in nature, where a diversity of animal and plant species in an ecosystem thrives by using the waste stream from one species to nourish another. The practice of biodynamic farming mimics diverse natural ecosystems in its design of interconnected processes that holistically produce crop and livestock. Apricot Lane Farms and Polyface Farm, for instance, use circular approaches leveraging economies of scope across many of their farms' activities.

Industrial versions of interconnected processes are also possible and already exist. In Kalundborg, Denmark, for instance, a collection of 13 public and private companies partner to create industrial symbiosis, where the waste stream from one company is used as a resource for another.

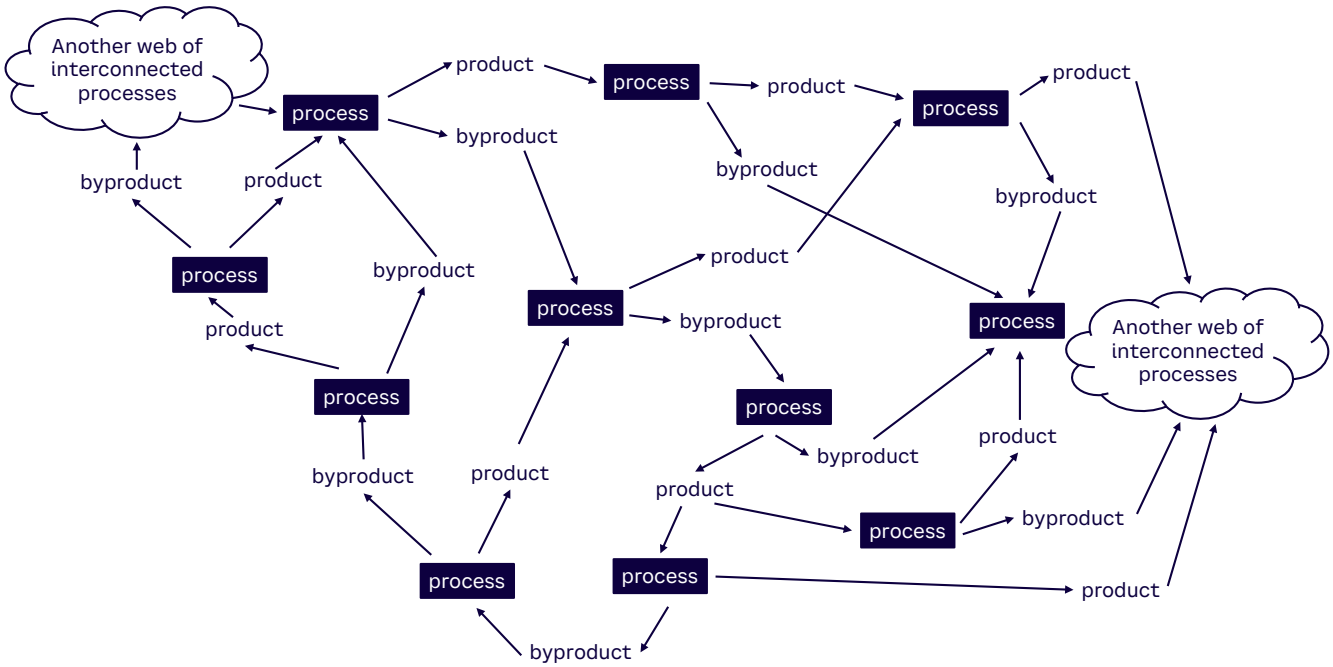


Figure 3. Operationalizing circularity

Organizations worldwide such as the US Business Council for Sustainable Development (UCBSD) and the Centre de Transfert Technologique En Écologie Industrielle (CTTÉI) are facilitating byproduct exchanges among networks of diverse firms. However, industrial ecosystems are not as complete and robust as natural ecosystems. For good reason — designing a web of perfectly balanced interconnected processes is daunting. That's why breaking it down into a sufficient condition for each process makes it manageable; again, for a given process, *every output generated should have a consumer who uses it productively*.

The circularity criterion has practical implications for managers. First, reducing waste streams (byproducts) may not necessarily be the optimal path, as shown by research. Finding a synergistic process that can productively use the byproduct may actually be more sustainable, more profitable, and require increasing byproduct generation. Second, looking for creative sources for input materials — the byproduct stream of a process in another industry — could be more sustainable and more economical. Making these two changes will require more

flexibility in an organization's internal process, along with a mindset shift from directional goals such as minimizing waste and maximizing output to a mentality of *balancing* among different input and output channels.

*For firms to implement the circularity criterion and transition to a circular economy, firms from diverse industries will have to cluster together.*

Ultimately, these sourcing and distribution strategy changes mean that we need to rethink our notion of supply chains. Currently, firms cluster together by industry, aligned by their common market. For firms to implement the circularity criterion and transition to a circular economy, firms from *diverse* industries will have to cluster together. After all, diversity is required for a robust ecosystem — because that's the only way waste can become a useful resource.

## From Circularity to Brundtland Sustainability

The process perspective shows us what the Brundtland sustainability definition looks like in action. It reveals the circularity criterion: again, *every output generated by every process should have a consumer who uses it productively.* As shown in this *Update,* this criterion breaks the daunting task of transforming a linear economy into a circular economy into actionable chunks. If all process owners adhered to this rule, we would achieve sustainability by operationalizing the concept of circularity.

# Recommended Reading

"Academic Impact: Sustainability." The United Nations (UN), accessed April 2022.

Lee, Deishin. "Turning Waste into By-Product." *Manufacturing & Service Operations Management*, Vol. 14, No. 1, 14 October 2011.

Lee, Deishin. "By-Product Synergy: Productively Using Waste in Joint Production Operations." In *Environmentally Responsible Supply Chains: Opportunities and Challenges*. Edited by Atalay Atasu. Springer, 2016.

Lee, Deishin, and Mustafa H. Tongarlak. "Converting Retail Food Waste into By-Product." *European Journal of Operational Research*, Vol. 257, No. 3, 16 March 2017.

Lee, Deishin (ed.) "Driving Sustainability via Technology Strategies." *Cutter Business Technology Journal* (now *Amplify*), Vol. 34, No. 11, 2021.

# About the Author

Deishin Lee is Associate Professor of Operations Management and Sustainability at Ivey Business School, Canada, and a Cutter Consortium Fellow. She focuses on innovative operational and supply chain models that use raw material resources more effectively to reduce waste and improve environmental sustainability. Ms. Lee has studied the optimization of joint production operations of firms that sell their waste streams and food supply chain operations that rescue surplus crops for the food security network. Her work has been published in leading academic journals, including *Management Science, Manufacturing & Service Operations Management, Operations Research, Production and Operations Management, Food Policy*, and *American Journal of Agricultural Economics*. Ms. Lee has disseminated her research through teaching cases taught in courses worldwide, has presented at leading industry and peer-reviewed academic colloquia (e.g., Aspen Institute's *Business Education Symposium* and *The Alliance for Research on Corporate Sustainability Conference*), and her research has been used to brief policy makers. She also draws upon experience in the telecom industry to inform a stream of research on the management of information and technology in a network environment. Prior to Ivey, Ms. Lee was on the faculty at Boston College and Harvard Business School. She earned a bachelor of science degree in mechanical engineering, a master's of science degree in mechanical engineering, and a master's of science degree in management, all from the Massachusetts Institute of Technology, and a PhD in operations, information, and technology from Stanford University. She can be reached at dlee@ivey.ca.

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