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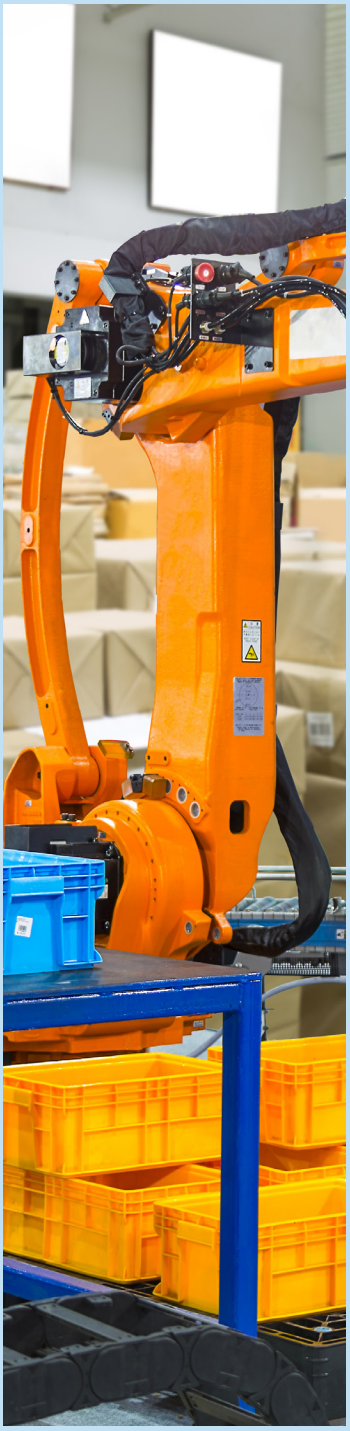

REDESIGNING THE HIGH TECHNOLOGY VALUE CHAIN FOR SUSTAINABILITY

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The HP Elite Dragonfly laptop is the gold standard in sustainable manufacturing practices. More than 80% of its mechanical parts, including chassis, bezels and speaker box, are made from plastic waste that ends up in landfills or the ocean. The high technology enterprise is phasing in recycled materials, and its portfolio consists of several products certified by the Electronic Product Environmental Assessment Tool (EPEAT) of the Green Electronics Council. The ecolabel authority provides independent verification of sustainability criteria across the lifecycle of technology products.

As climate change becomes an existential risk, manufacturers of electric and electronic equipment are closely monitoring their carbon footprint. However, sustainability is a paradox for the high technology industry. On the one hand, it is the driving force of green solutions across industries. On the other, the resource-intensive industry has an outsized carbon and water footprint across the value chain. Even as technology companies set aggressive targets to improve sustainability performance and achieve net-zero operations, manufacturing sustainable products demands effort and action on an industrial scale.

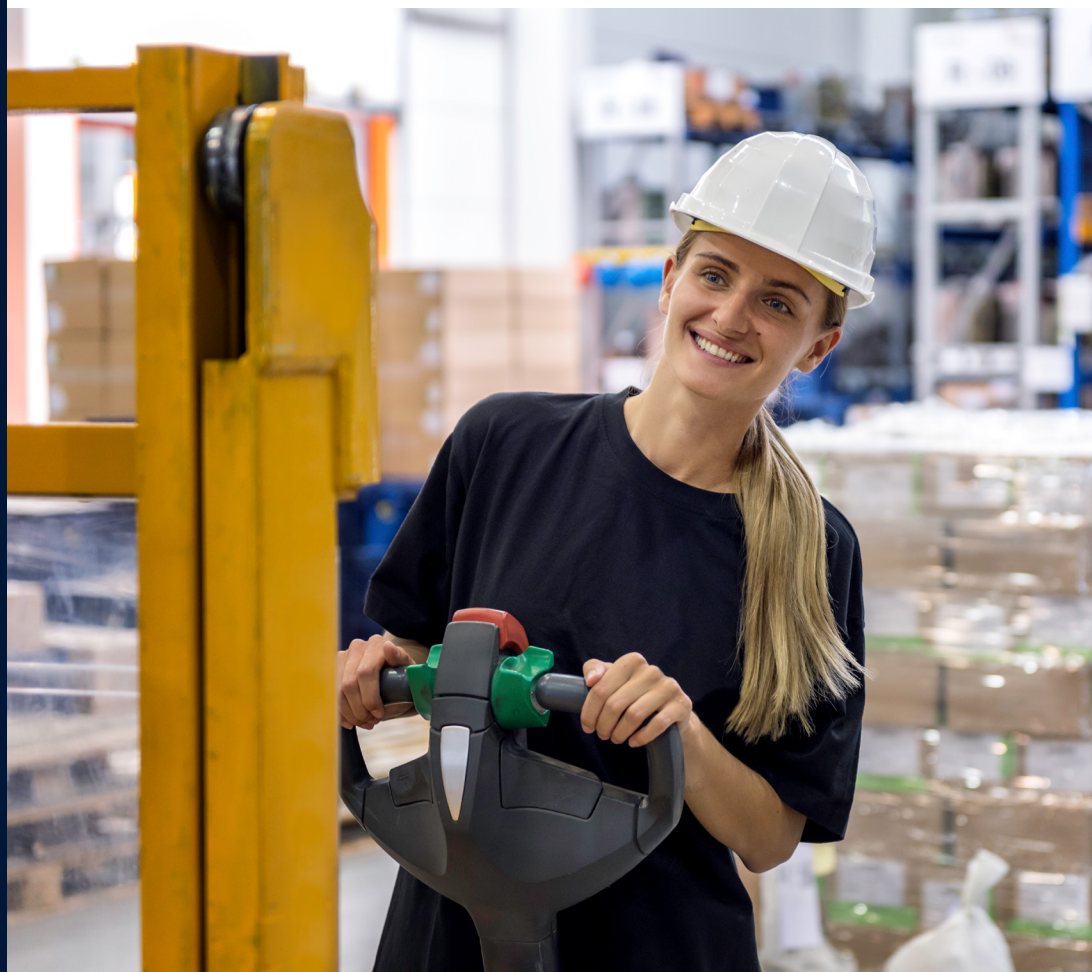
While conventional manufacturing capability spanned quality, cost and flexibility, sustainable manufacturing integrates economic, environmental and social aspects into production systems. Discrete initiatives, such as programs to improve energy efficiency or product longevity, have limited impact. An ecosystem approach incorporating sustainability practices into the value chain is required to transform enterprise capabilities.

Design for circularity

The primary raw materials in industrial as well as consumer electronic appliances are metal and plastic. While mining of metals risks health, safety, labor, and environment issues; a huge amount of fossil fuels and water get consumed to manufacture plastic. High technology manufacturers need to implement ethical sourcing strategies to ensure that raw materials and product components, which are invariably sourced from low-cost destinations are produced sustainably.

At the same time, digital tools help reorient the value chain based on principles of the circular economy – reduce, reuse and recycle. From a design perspective, automation software addresses mission-critical considerations. However, computer-aided design solutions do not address sustainability requirements of devices for high-performance applications and industrial Internet of Things (IoT) or edge systems. Digital twins, artificial intelligence (AI)-driven analytics, and machine learning (ML) models provide a roadmap for sustainable product design and development. Virtual models recreate physical assets and enterprise ecosystems to analyze the usage profile and working as well as end-of-life conditions of devices.

Simulation models abstract root causes of sustainability issues across the product lifecycle as well as manufacturing systems, enabling manufacturers to enhance design and align the roadmap of electronic and electrical products with sustainability outcomes. Further, AI / ML tools address technical requirements of products and manufacturing processes, while also providing visibility into sustainability implications on production, consumption and disposal: is the product robust enough to last? Can resource-intensive and specialty materials be replaced with composites and recycled / biodegradable materials? Is the waste generated by industrial processes reusable? Will sustainable packaging reduce transportation costs? Finally, can e-waste from end-of-life products be recovered, repurposed or remanufactured?



Manufacture for serviceability

Product durability is a cornerstone of sustainability. However, the culture of planned obsolescence and consumerism accelerate the path of high technology products to landfills. By 2050, 120 million tons of e-waste will be generated annually, according to a report of the Platform for Accelerating the Circular Economy (PACE) and the UN E-Waste Coalition. An effective response to the sustainability movement requires manufacturers to modify both production as well as consumption patterns. AI-driven design solutions explore ways to extend the useful life of products, while smart manufacturing systems that align real-time engineering, production and supply chain operations boost efficiency. These systems should be supported with the Device-as-a-Service (DaaS) business model to boost the sustainable quotient across the product lifecycle.

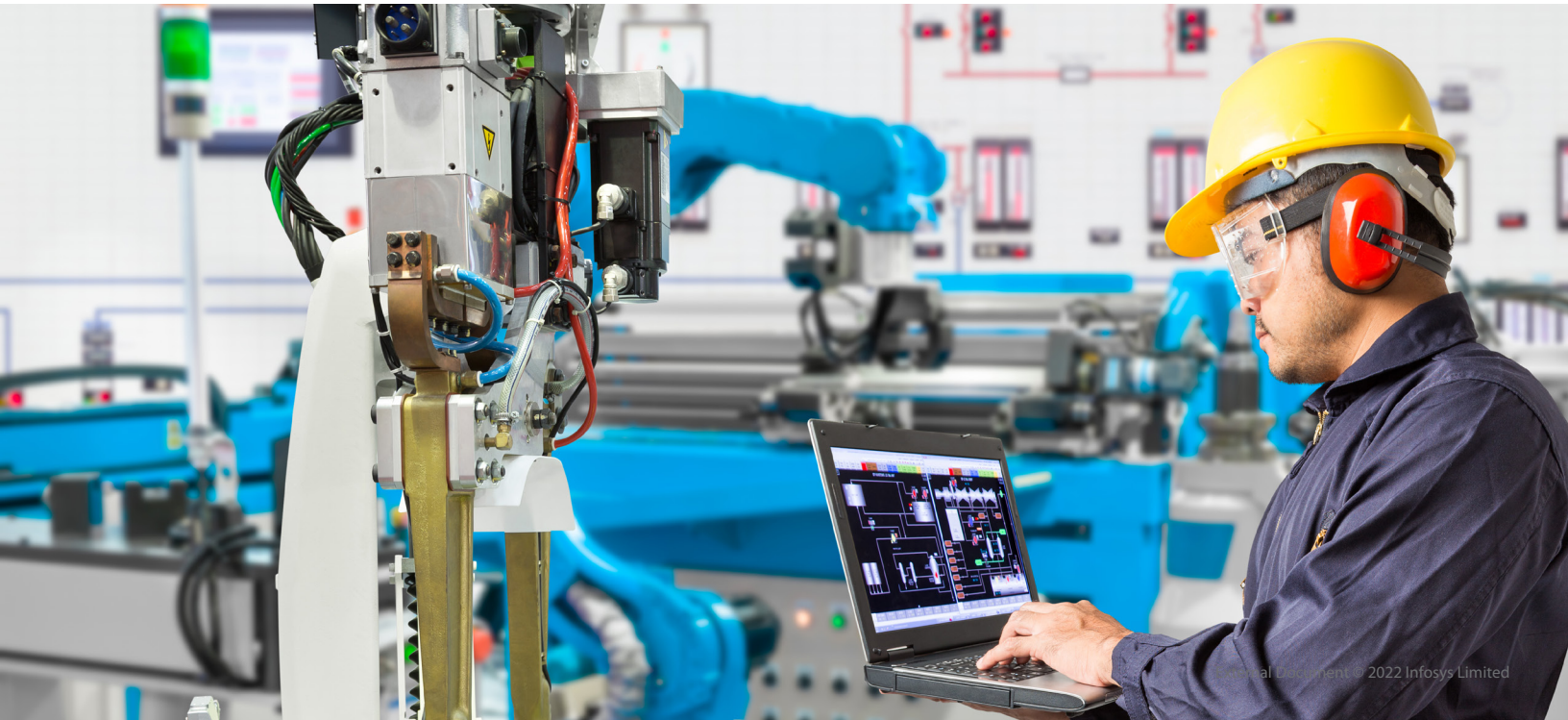
The transformation to a service-oriented business enables technology product enterprises to better serve customers and grow revenue while fulfilling social and environmental goals. The DaaS model bundles physical hardware, IP software, and managed services such as security into paid subscription. On-demand, plug-and-play access to devices allows consumers to avoid capital outflow and save overheads for consumables and operating supplies. At the same time, the subscription-based model empowers manufacturers to maximize device resilience through predictive maintenance programs and prompt support services including software updates.

For products that require outright purchase, such as personal electronic devices and domestic electrical appliances, a fundamental criterion of the design philosophy should be ease-to-repair. The production floor needs to support repairing, refurbishing and remanufacturing. By retaining functionality across the lifetime of a device and its components, manufacturers provide flexibility for consumers to maximize usage before discarding a device.

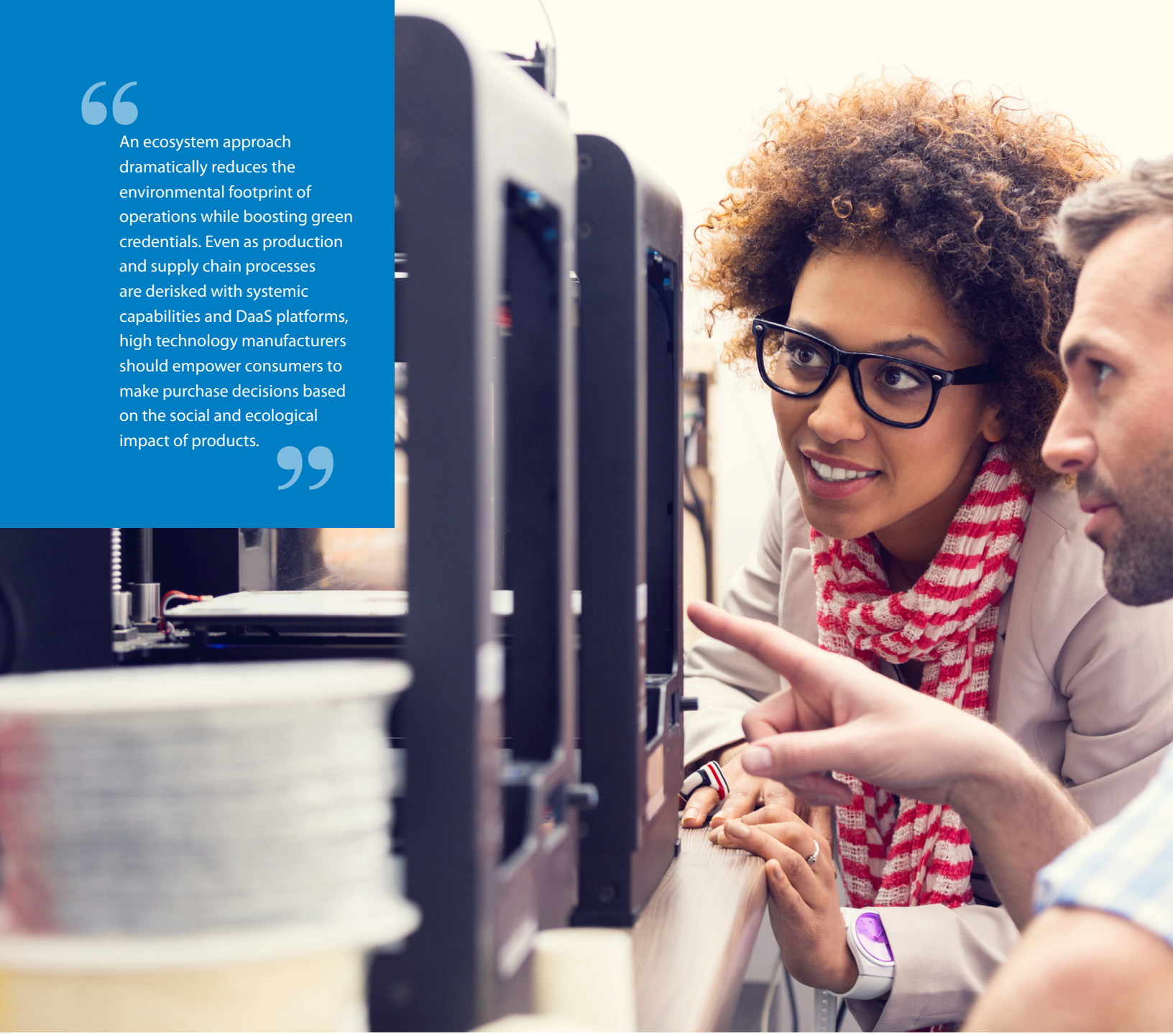
Architect the supply chain for reverse flow

Nearly 35,000 pounds of copper, 772 pounds of silver, 75 pounds of gold, and 33 pounds of palladium can be recovered by recycling a million cell phones, according to the U.S. Environmental Protection Agency. A closed-loop supply chain for seamless multi-directional flow of materials is an imperative for the DaaS business model and integrated end-of-life product strategies. Alongside a service-based transformation, manufacturers of medical and industrial hardware as well as consumer electronics should create a scalable global supply chain ecosystem for device and e-waste management.

Third-party platforms such as Amazon and eBay help consumers return, sell and resell used and refurbished gadgets. Manufacturers can partner with platforms or establish online marketplaces for buyback services. Drop-off points and kiosks can be set up to facilitate repair and ethical disposal. Simultaneously, e-learning modules can be leveraged to enhance the product experience and support consumers to contribute to the sustainability movement. DIY videos on common issues with instructions for rectifying them extend the life of technology products. Similarly, awareness about the reusability and recycling potential prevents owners from disposing of functional, repairable and damaged gadgets.



> An ecosystem approach dramatically reduces the environmental footprint of operations while boosting green credentials. Even as production and supply chain processes are derisked with systemic capabilities and DaaS platforms, high technology manufacturers should empower consumers to make purchase decisions based on the social and ecological impact of products.



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