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The Sustainable CTO

The Road to Tech Positive for Manufacturing

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Foreword

The rise of the smart factory signaled a new era of efficiency, adaptability, and data-driven decision-making for the manufacturing industry.

Step inside one of Intel's semiconductor plants, and you'll see an automated superhighway of wafers traveling between stations, monitored by algorithms. And we're still only scratching the surface of what AI can do.

With growing pressure on companies to reach net zero, how can the manufacturing industry continue this incredible growth trajectory while reducing its environmental impact? Looking forward to Industry 5.0, the focus will be on layering sustainable, human-centric practices on top of smart factory technologies. But with companies all at different stages in this journey – and 2050 creeping ever closer – we can't afford to put sustainability on hold.

As organizations look to align their digitalization and sustainability agendas, technology plays a complicated role. On one hand, the increasing adoption of transformative tech – such as automation, robotics and AI – brings ever-increasing amounts of data. With this comes the need for more computing power and an expanding carbon footprint. And yet, without the insights this technology provides, companies will struggle to reach net zero.

According to 77% of senior IT leaders in the manufacturing sector, technology innovation will play a significant role in their whole organization's transformation to a sustainable business. Tech leaders see a factory of the future that is smart *and* sustainable, and they believe they are in the best position to lead the way.

Eight in 10 senior IT leaders in the manufacturing industry aspire to become a sustainability leader in the business: a **"Sustainable CTO"**. Although sustainable production is now a minimum expectation for businesses, performance still takes priority. The CTO faces the challenge of selling the benefits of sustainable features to the business and, ultimately, to customers.

The CTO may be driving the digitalization effort, but if we are going to unlock technology's true potential as a force for positive change, we need everyone at the C-Suite table to be working toward this goal. Industry-wide collaboration and innovation will also be essential. No single company, or country, can combat climate change alone; it is only by sharing learnings that we will shape the 'tech-positive' factory of the future.

Todd Brady
Chief Sustainability Officer & Vice President, Global Public Affairs at Intel

About this Study

The Sustainable CTO is based on independent, global opinion research among 2,020 business leaders from organizations with a minimum turnover of $500 million. Research participants were based in organizations across 22 markets and 11 different sectors. This included 217 representatives from the manufacturing sector.

C-suite decision-makers were split into three groups:

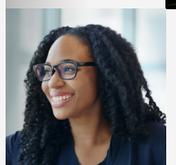
- **Senior IT leaders** (job titles including Chief Technology Officers, Chief Information Officers, Heads of Infrastructure and Vice-Presidents/Directors/Heads of Product)
- **Chief Executive Officers (CEOs)**
- **Chief Sustainability Officers (CSOs)**

The sectors studied: TMT, Financial Services, Healthcare and Life Sciences, Manufacturing, Transportation, Education, Public Sector, Professional Services, Retail, Travel & Hospitality.

The concept development and research design were carried out by Intel and Man Bites Dog, with the opinion research fieldwork conducted by Coleman Parkes Research.

The interviews took place between February to March 2023 and were conducted under the ethical research guidelines set by both the MRS (Market Research Society) and ESOMAR.

For the full methodology, please see the global report.



Section 1

The Lean-Green Agenda

The manufacturing industry is in the midst of a digital revolution. To remain competitive, organizations must **maintain a focus on efficiency and productivity**, using data to predict, plan and optimize. However, as automation levels rise, so does the demand for greater computational capacity – leading to increased energy consumption. With sustainability in the spotlight, organizations must ensure their processes are both smarter and greener, harnessing the power of technology to position themselves for success.

Dual Objectives

Organizations face the challenge of **greening their processes while delivering the enhanced computing power** needed to drive transformational technologies and manage ever-increasing volumes of data. Thirty-seven percent of senior IT leaders estimate that their organization's computer processing power will increase by between 11-15% by 2030.

Overall, 72% of C-suite decision-makers say their IT function is currently a big part of the problem when it comes to their organization's energy consumption and carbon emissions. But these advanced technologies could also provide the solution:

77%

of senior IT leaders in manufacturing say technology innovation, including AI, will play a significant role in their whole organization's transformation to a sustainable business.

Tech Zero_

Reducing the carbon footprint of an organization's IT function.

Tech Positive_

Using technology as a lever for the whole organization to reach its net-zero goals and to have a positive overall impact, driving business growth and accelerating innovation.

Reaching beyond tech zero to tech positive will require significant investment – and may lead to an initial surge in emissions – but the organizations that strive for this goal will reap the rewards. Not only will they reduce their carbon footprint, but increase their efficiency, cut costs, and **boost their brand reputation as a company with sustainability at its core.**

Case Study

Enabling Predictive Maintenance for Fan Filter Units

The manufacturing industry is turning to the Industrial Internet of Things (IIoT) and predictive maintenance technologies to reduce factory downtime and boost efficiency.

Partnering with GE Digital, Intel developed a solution to monitor the health of its fan filter units (FFU) to predict maintenance needs and increase uptime. Using sensors to connect each FFU and integrating these with Intel IoT Gateways and edge applications using GE's Predix platform, Intel was able to reduce the amount of data being transmitted across the network while alerting technicians to potential problems in real time. Early pilots found that unscheduled downtime due to FFU failure had been reduced by 300% compared to manual inspections. This increased performance will result in significant energy savings and waste reduction.

Enter: The Sustainable CTO

In an industry that faces constant disruption, manufacturing CTOs must not only keep up but take **a leading role** in the transformation. But what are they prioritizing to achieve a tech-positive status?

The top priorities for manufacturing CTOs currently (according to senior IT leaders)

1. Leading the sustainable transformation of the IT function.
2. Using technology to better understand and serve customer needs.
3. Enabling better storage, utilization and processing of data.

According to senior IT leaders in the manufacturing sector, leading the sustainable transformation of the IT function is currently the top priority for CTOs, ranking higher than the use of technology to better understand customer needs.

Not only is this social and environmental focus key to reaching global sustainable development goals... IT leaders see it as a **growth driver**. Senior IT leaders in the sector see the value in sustainability, with nine in 10 (91%) believing that focusing on sustainability will lead their organization toward developing new products and services, which will enhance their brand.

Optimizing data management is also a key focus in the journey to tech positive, with 79% of senior IT leaders citing the carbon footprint generated by the storing, movement and analysis of their data as a significant concern for their organization.

7 in 10

senior IT leaders in the manufacturing sector say their organization requires a **significant change** or **complete transformation** to transition to a net-zero business. And they believe they are the ones to lead the charge: 79% of senior IT leaders are confident in their capabilities to significantly reduce IT-related emissions. And eight in 10 aspire to become a sustainability leader in the business: a **"Sustainable CTO".**

Moreover, they have the backing of their fellow C-suite members. Eight in 10 CEOs and CSOs believe the CTO often takes a more innovative approach to business growth than other organizational leaders, and

84%

believe the CTO has the potential to become **the greatest driver of sustainability in the organization.**

They've got the vision, so how can manufacturing CTOs deploy technology to build an industry that's smarter and greener than ever before?

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Section 2

Building a Greener IT Function

With access to a multitude of data sources, the Sustainable CTO is well positioned to make key decisions to ensure they are leading their organization to achieve **tech positive**. They must also provide the tools needed to enhance green product development, production efficiency, and overall operational excellence.

Sustainable Sourcing

Supply chains are a key contributor when it comes to carbon impact for manufacturers. To tackle this, organizations must take a proactive approach, seeking suppliers that share their commitments.

57%

of senior IT leaders in the manufacturing sector say their organization currently measures the sustainability of its technology supply chain.

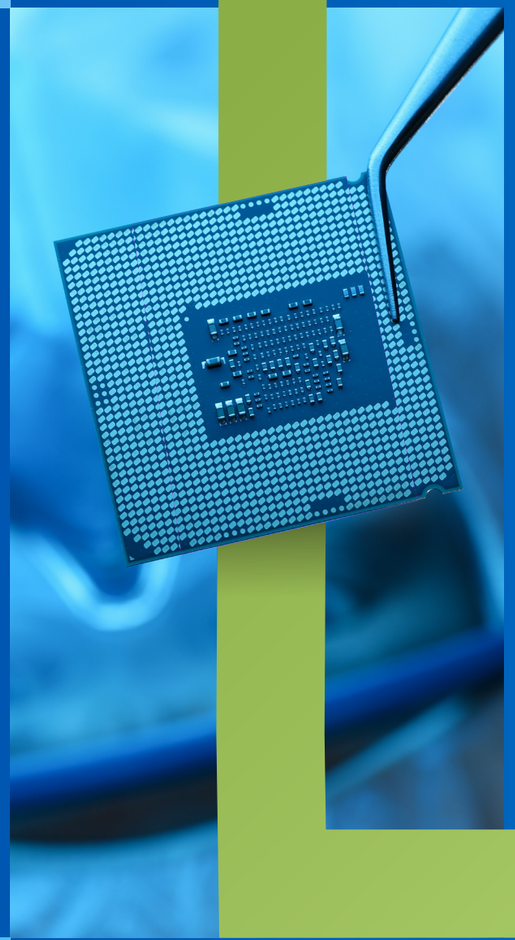
But many companies are going further than just evaluating their supply chain partners, **putting sustainability at the heart of their procurement process.**

8 in 10

senior IT leaders in the manufacturing sector say their organization reviews suppliers and partners through a sustainability lens and will cut ties with those that fail to positively contribute to their targets. Manufacturing organizations are also willing to pay the price for 'greener' supplies; three-quarters will pay a premium for an IT product or service with strong sustainability credentials, compared to a product that is less sustainable to produce and use.

The top three considerations for manufacturing organizations when buying IT products and services:

1. Sustainability in use - reuse / recycling / circular economy
2. Sustainability in use - energy efficiency
3. Employee productivity / business output achieved when in use

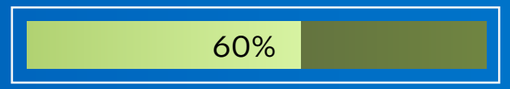


Enhanced Efficiency

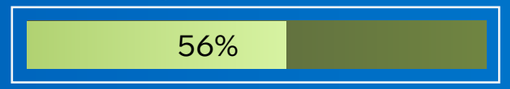
When it comes to making investments to reduce IT-related emissions, **energy-efficient hardware is the focus**, with six in 10 manufacturing organizations investing in this area. This is followed by renewable energy sources (56%); new 'green' technology (53%); and transformational technology like AI, IoT and robotics (50%).

The top five areas manufacturing organizations are investing in to reduce IT-related emissions:

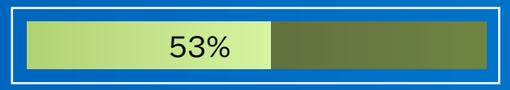
Energy-efficient hardware



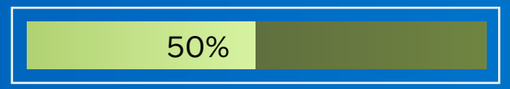
Renewable energy sources



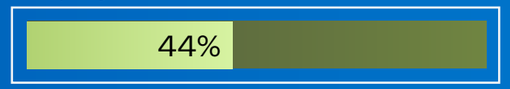
New 'green' technology



Transformational technology, such as AI, IoT and robotics



Recycling hardware



Crucially, investment in these areas will drive progress toward a circular manufacturing industry. Almost half of senior IT leaders (47%) say their organization measures their e-waste; from there, it's not only about minimizing waste but asking how they can extract value from the waste they *do* produce. Innovative technologies, such as AI, have a critical role to play in efficient resource management, waste management and forecasting demand.

The Role of AI in Circular Manufacturing

Resource Management_

AI can analyze energy consumption patterns across the manufacturing process, identify inefficiencies, and recommend energy-saving measures. For example, by integrating AI into industrial chillers, manufacturers can predict optimum temperature controls based on the demands on the station and environmental conditions. Real-time data management can also drive smarter allocation of resources, including raw materials, energy, and labor.

AI-powered predictive maintenance systems can monitor machinery and equipment, predicting potential mechanical failures before they occur. Not only does this slash unplanned downtime but extends asset lifespan.

Supply and Demand_

AI models can identify patterns in customer behavior, incorporating this with other factors – such as historical sales, promotional activities, market trends, and economic indicators – to forecast demand. By predicting demand fluctuations, AI enables manufacturers to adjust inventory levels accordingly, minimizing the risk of overproduction.

Waste Management_

Crucially, AI can facilitate the transition to a circular economy model by enabling better waste management. It can assist in tracking products – whether those are materials or chemicals – throughout their lifecycle to support recycling, refurbishing, and remanufacturing efforts.

Case Study

Transforming Manufacturing Yield Analysis with AI

Intel developed an advanced AI system to improve and accelerate yield analysis. This system utilizes machine learning, deep learning, and image-processing techniques to automate repetitive, labor-intensive end-of-line issue detection. Using known pattern examples, the system detects issues in the workflow; these results are then passed onto yield analysis engineers to determine the root cause and seek a resolution.

By using AI on the production line, manual input is minimized, freeing up engineers to analyze data and resolve issues more quickly. This approach provides over 90% accuracy in detecting baseline pattern discrepancies, leading to a decrease in defects, less waste, and improved factory output.

By demonstrating the value of these technologies, the Sustainable CTO will be pivotal in the move from the 'take-make-dispose' manufacturing model toward a sustainable, circular manufacturing economy.

Conclusion

The Manufacturing Roadmap to Tech Positive

Embracing technology to drive a circular manufacturing economy presents exciting opportunities, but it doesn't come without some challenges. Realizing the potential of transformational technology requires substantial investment and expertise, along with a shift in mindset from immediate gains to enduring sustainability.

There are four key steps IT leaders must take to **drive manufacturing organizations towards a tech-positive future.**

1

Build skills to understand where to optimize

Sixty-three percent of senior IT leaders in manufacturing say that sustainability training for the IT and operations team is one of the most important factors for achieving tech positive. This will help to ensure tech strategies are devised with sustainability front of mind.

2

Get buy-in from the wider business

The success of sustainability strategies will hinge on the organization's commitment level. While there may not be a challenge to get buy-in from the wider executive team, the Sustainable CTO will play an important role in communicating the organization's sustainability goal, and the role of technology in making this a reality. However, it will also be important to set shorter-term goals to drive momentum and ensure sustainability is embedded across all departments, each with a sustainable advocate driving change.

3

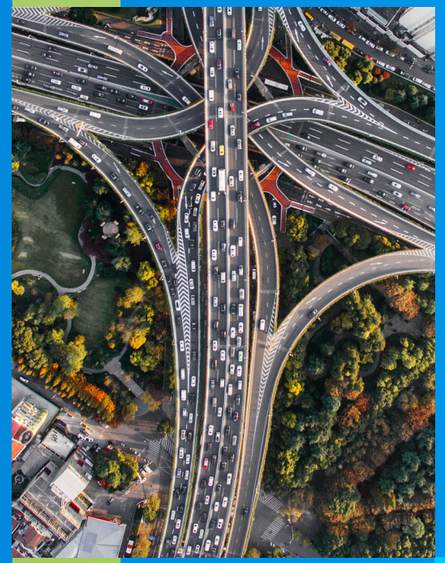
Understand the data and optimize existing infrastructure

Data-driven decision-making will enable manufacturers to optimize resource utilization, minimize waste, and transition toward a more sustainable and circular manufacturing industry. And, with ESG reporting requirements ramping up, organizations must ensure they are capturing and analyzing relevant data in order to track their progress.

4

Plan for solution and software innovation

Tech leaders must be champions of innovation, constantly searching for opportunities to develop greener business models and drive change across the organization. Fundamental business decisions such as becoming fossil fuel free or switching to green chemistries are on the agenda for the Sustainable CTO. But, to make real change, they must look beyond their own operations and foster collaboration across the entire manufacturing industry. This is an opportunity for the sector to come together to find solutions to the tech-positive challenge.



Becoming a Sustainable CTO

As you embark on the path to becoming a Sustainable CTO – please visit our hub for more information: https://www.intel.com/content/www/us/en/environment/sustainable-cto.html

If you would like to join our growing community to share your insights and help the industry explore and deploy best-in-class sustainable technology, please get in touch for more information: TheSustainableCTO@manbitesdog.com

Resources

For more information about Intel's manufacturing solutions, please visit: https://www.intel.com/content/www/us/en/manufacturing/manufacturing-industrial-overview.html

For more information about Intel's sustainability goals and progress, please visit: www.intel.com/sustainability

About Intel

Intel (Nasdaq: INTC) is an industry leader, creating world-changing technology that enables global progress and enriches lives. Inspired by Moore's Law, we continuously work to advance the design and manufacturing of semiconductors to help address our customers' greatest challenges. By embedding intelligence in the cloud, network, edge and every kind of computing device, we unleash the potential of data to transform business and society for the better. To learn more about Intel's innovations, go to newsroom.intel.com and intel.com.

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