PAVING THE WAY TO A SUSTAINABLE FUTURE *WITH* GREEN DIGITAL INFRASTRUCTURE

The International Center for Networked, Adaptive Production, Aachen (ICNAP) works closely with the European manufacturing sector by conducting relevant studies about the state of the industry and holding community events for industry thought leaders. Our platform fosters collaboration with an active community focusing on networked, adaptive production, digitalization, connectivity, data modeling, and analytics.

A study by the ICNAP explored the aspects of what it described as 'green digital infrastructure'. The report guides to help manufacturers adopt long-term sustainable production models by making sustainability a key focus of their digital transformation campaigns.

Sustainability is a driving force of the fifth industrial revolution as much as digitalization was for the fourth. However, rather than being competing disciplines, the concepts of Industry 4.0 and sustainability work in parallel, with technology serving as an enabler rather than a replacer.

Since the manufacturing sector is responsible for a fifth of global carbon emissions, enterprises need to adopt more sustainable production models urgently. Furthermore, customers are increasingly likely to base purchase decisions partly on sustainability. As such, evaluating and progressively reducing environmental impact also makes sense from a profitability standpoint.

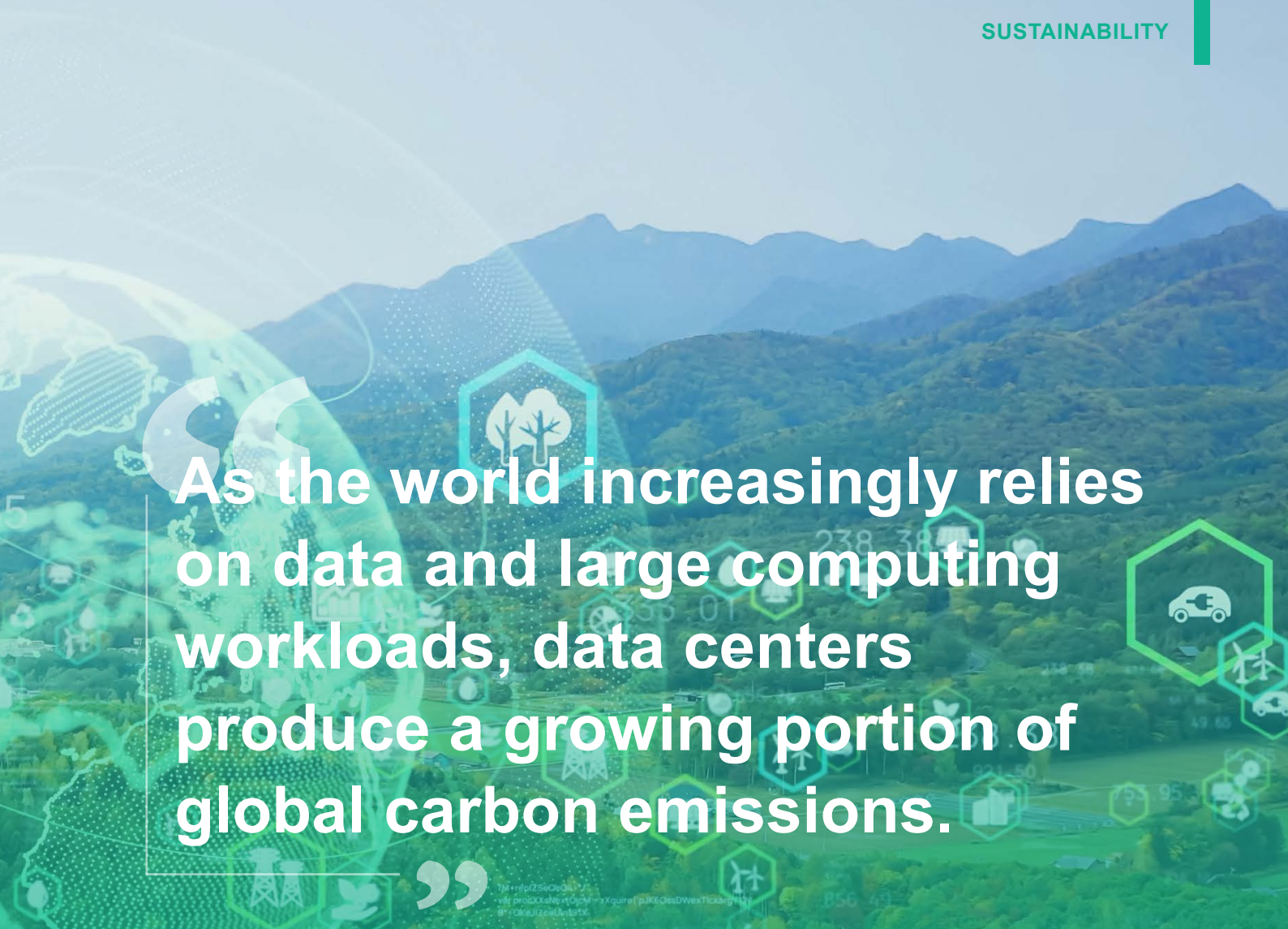
For decades, manufacturers have viewed technological innovation mainly through the perspectives of automation, scaling up, and cutting costs. In the 21st century, we can also add sustainability to that list. After all, modern information and communications technology (ICT) provides many opportunities to make manufacturing more sustainable and profitable.

Here are the key areas of sustainable infrastructure that ICNAP explored in its report:

Tracking sustainability performance

Digital transformation is a critical enabler of sustainable production models. With the help of connected monitoring and analysis tools, firms can identify opportunities for improvement and regulate their systems intelligently and adaptively. Doing so naturally reduces wastage, both in terms of raw materials and energy consumption. However, defining and measuring the right key performance indicators (KPIs) is critical to make this happen.

Environmental sustainability KPIs include carbon footprint, energy consumption, and recycling rate. The challenge for manufacturers is to keep track of these KPIs across the entire value chain. That includes actual manufacturing and logistics, research and development, supply chain management, and what happens to the product at the end of its life.



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Tracking sustainability performance happens over three main stages. The first is implementing a transparent measuring process across the entire value chain. Things like connected sensors and digital dashboards with advanced analytics grant insight into sustainability KPIs. Equipped with this information, manufacturers can identify emission hotspots. The next stage is to set reduction targets, plan the right initiatives and communicate these to all stakeholders along the value chain. Finally, the reporting stage sees stakeholders analyzing the data collected during their emission reduction efforts and adapting their policies to improve their sustainability programs iteratively.

Building sustainable data centers

As the world increasingly relies on data and large computing workloads, data centers produce a growing portion of global carbon emissions. For example, data centers in Germany alone consume over 16 billion kilowatt hours annually, more than the entire city of Berlin. Moreover, data center capacity continues to grow everywhere, making it essential that data centers themselves become more sustainable.

Data centers consume most of their energy for cooling, so implementing more efficient cooling methods, such as liquid and free-air cooling, is essential. Air-conditioned cooling, by contrast, is much more energy intensive. To counter the challenge of cooling massive server farms sustainably, larger data center vendors already use entirely renewable energy, while others use underground reservoirs for water-based cooling. Other possible steps include installing heat recovery systems and implementing eco-friendly building designs.

Another focus of attention is the actual computing workloads themselves. Regularly replacing and upgrading data center hardware can be a viable option. Still, the priority should always be implementing more efficient server utilization with consolidation strategies.

Of course, these practices apply to every industry simply because every business uses data – often a lot of it. Manufacturers should consider these practices whether they are building their green digital infrastructures or looking for a third-party vendor who will provide their data center infrastructure for them.

Implementing green 5G networks

5G connectivity has enormous potential in manufacturing thanks to its high reliability, low latency, and network slicing capabilities. Factory equipment tends to span large areas and generate large amounts of data.

Current fixed-line or previous-generation wireless connectivity options cannot adequately accommodate those demands, especially in the case of edge computing. Fortunately, 5G overcomes the limitations of older technology to significantly improve operations like predictive maintenance and shop floor analytics.

As these wireless infrastructures will play a vital role in the future of manufacturing, it is also essential to consider how they can be implemented sustainably. Using energy-efficient network hardware and components is an obvious first step. Still, it is also important to consider the network architecture itself. For example, 5G supports network slicing, allowing administrators to provide only the network resources necessary for a given workload. Another option is dynamic network management, which adjusts operational parameters based on real-time demand. Together, these practices help reduce bandwidth and energy consumption for a cheaper and more environmentally friendly operation.

Adopting green coding practices

Green digital infrastructure concepts primarily focus on hardware and data centers. However, since we interface with hardware via software, it stands to reason that we should leverage the potential of software to enhance sustainability too. Despite only being an emerging concept, green coding has the potential to serve as a powerful catalyst for the development of greener digital infrastructures.

Three key aspects influence energy consumption in software – the implementation of the operating system, the runtime environment, and the software product itself. All software affects power consumption regardless of where it fits in the stack. For example, previous operating system versions would typically drain more power than recent versions. Greener operating systems are designed to accommodate idle time by automatically switching the device into a low-power mode. Application-level software may reduce energy consumption by limiting API calls to external resources.

Optimized code reduces the processing power needed, improving performance while reducing energy consumption. Green software, especially at the operating system or infrastructure level, might also include built-in analytics for measuring efficiency. The list goes on.

Read more about the role of digital infrastructures in sustainable production in the latest report by the ICNAP at: ***http://www.icnap.de/en*** ■

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