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Unlocking Manufacturing Efficiency: The Power of Design Engineering, High-Performance Computing and Digital Twins

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In the competitive manufacturing industry, staying ahead means embracing digital transformation. Technologies like digital twins, simulations and AI offer substantial benefits, including enhanced efficiency, reduced costs and improved sustainability.

In a recent Dell Technologies-sponsored Manufacturing Dive webinar, "**Unlocking Manufacturing Efficiency: The Power of Design Engineering, High-Performance Computing and Digital Twins**," Todd Edmunds, Manufacturing and Digital Twins CTO for Dell Technologies Global Industries, hosted a discussion with Dell's Ken Flannigan and Sunita Shenoy from Intel Corporation on how manufacturers can utilize modern workstations equipped with high-performance computing (HPC) to transform processes — from boosting design engineering productivity to ensuring seamless collaboration between the office and factory floor.

Bringing Smart Factory Innovation Into Design Engineering Processes

Edmunds, Flannigan and Shenoy explored an evolving landscape for manufacturers, where there is a growing expectation to incorporate AI and vast data sets into modeling, analysis and simulation. Key trends include:

- **Greater access to innovation:** Flannigan noted that tasks once requiring an outside specialist can now often be integrated into core processes with simple, one-click solutions. Independent Software Vendors (ISVs) add tremendous value if you have the computing power to support these features.
- **Heat impacts performance:** Workstations supporting high-performance tasks generate significant heat. Without proper thermal management, workstations can throttle performance, causing productivity delays.
- **AI raises the stakes:** Shenoy highlighted AI's potential to transform operations, from quality assurance and defect detection to enhancing product yield and optimizing processes. Future-proofing systems enables phased adoption of modern AI-based applications.

Manufacturers benefit from modern workstations engineered to adapt to the ever-evolving requirements of the latest use cases, workloads and technologies.

Equipping an Ecosystem of Doers, Specialists and Collaborators

The era of siloed roles is over. Manufacturers must support collaboration across the entire value chain. Flannigan emphasized the importance of the right workstations for maintaining productivity across various classes of users:

1. The "Doers"

Design engineers are the essential creators and users of data that must be shared and collaborated on. Prioritizing their workstation and CPU needs is crucial. These users often face frustration with slow performance on mundane tasks like opening and exporting large files. Flannigan described this issue as "click, pause" — which occurs when data sets are so large that the database is queried with every selection. Workstations that support generational leaps in CPUs can alleviate this issue, providing the necessary computing power.

2. The Specialists

Roles like simulation and reality capture specialists are increasingly integral to engineering. They require systems capable of handling demanding workloads. Shifting heavy computation tasks from CPU to GPU when appropriate can significantly impact performance. Understanding these users' specific needs helps in selecting suitable systems.

3. Collaborators

Ensuring project managers and collaborators can interact with design data is crucial. Though not daily users, they need systems to access information and work efficiently. Often customer or stakeholder-facing, they require a fast and reliable experience. Thin, light (yet powerful) workstations allow them to interact with design applications efficiently, even on the go.

Navigating CPU, GPU and NPU Requirements

A common concern in manufacturing today relates to workload demands. However, Shenoy noted that one size does not fit all. Manufacturers should evaluate user requirements before choosing hardware architecture.

Consider that:

- CPUs are ideal for fast single-threaded performance and low-latency tasks that are essential to industrial applications.
- GPUs handle parallel processing of thousands of threads simultaneously, crucial for AI and machine learning.
- NPUs are purpose-built to accelerate neural network inference and training, ideal for low power, low latency, real-time and edge applications.

Collaborating From the Back Office to the Plant Floor

Collaboration extends beyond the back office. Design engineers need to collaborate with plant engineers and managers on the factory floor, leveraging real-time feedback loops to drive productivity. As Todd Edmunds aptly puts it, "The integration of IT and OT is crucial in manufacturing. It's about breaking down silos to enable seamless collaboration that enhances operational efficiency and innovation." This collaboration between IT and OT is especially important when equipping users with high-performance computing in rugged environments as it will help overcome challenges, including:

- **Digitization of operational environments:** Connecting devices to the internet and deploying new applications in manufacturing plants creates IT challenges, with cybersecurity being crucial down to protecting devices at the edge.
- **Zero trust and cybersecurity requirements:** Everyone in the value chain must adhere to zero-trust policies, which means not trusting any workload on devices or infrastructure without authentication to prevent malicious software or bad actors from compromising the system.
- **Need for rugged devices:** Just as entering a factory requires PPE to protect the body, workstations on the plant floor must withstand the rigors of manufacturing environments. Dell's rugged portfolio, for example, includes glove-ready touchscreens that enable seamless navigation of PDFs or 3D models, allowing for safe digital collaboration on the factory floor.

Using Digital Twins for Real-World Simulation

Traditional engineering design simulations use synthetic data, but digital twins integrate real-time data. Flannigan noted that this technology allows you to model actual operational processes and collaborate with managers on the plant floor before deploying the processes locally.

Shenoy described how AI, combined with digital twin technology, can shorten product design, improve efficiency, and reduce manufacturing costs, creating closed-loop control systems based on actual data. The challenge lies in handling these large data sets efficiently, making them manageable and actionable from anywhere in the world.

To support optimal results, consider:

- Intel's high-performance computing platforms, such as Intel Core or Intel Xeon, with multiple cores, hyper-threading parallelism and AI Accelerators that are either integrated or discrete.
- Intel Xeon with built-in AI accelerators such as AVX2, AVX-512 and TMUL.

Conclusion

To drive smart factory innovation, it's essential for all collaborators — from design engineers to specialists and managers — to have the right high-performance tools. Applications like design simulation and digital twins are moving from the back office to become essential on the factory floor, making workstations with high-performance CPUs critical. This shift not only enhances efficiency but also drives transformation across the entire manufacturing ecosystem. Moreover, AI is rapidly evolving from a luxury to a necessity. With competitiveness on the rise, the time to act is now. By ensuring your team has the necessary tools and technologies, you can stay competitive in this rapidly changing landscape.

To learn more about Dell design and engineering solutions that use NVIDIA technology, check out AI for Design and Engineering Workflows and visit Dell AI Technologies.

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