Workstation-Based Digital Prototyping

Accelerating Better Design— Why Digital Prototyping Is So Important

Introduction

Thomas Edison said, "There has to be a better way – find it." With advancements in workstation technologies and the integration of CAD, Meshing, CAE, and CFD software – there has to a more efficient way to create, test, modify and visualize products.

Today's industry-leading manufacturers are using Digital Prototyping to drive innovation, improve quality, accelerate time-to-market, and cut costs. Made possible by major advances in the performance and capabilities of the latest Autodesk software for product development, as well as Intel® Xeon® processor-based workstation technology, Digital Prototyping allows manufacturers to simplify workflow from design to manufacture and even to marketing and selling of the final product. With Digital Prototyping, collaboration happens much more dynamically; information accuracy is maintained throughout; and customer engagement is made possible to a degree never before imaginable. In addition to allowing manufacturers to make more products faster and more cost-effectively, perhaps the greatest benefit from Digital Prototyping is that it allows them to make better products, and in many cases to design products that without the advances of workstation-based Digital Prototyping would not have been feasible. Using technology from Autodesk and Intel, companies can leverage the combined strengths of a leader in software for design innovation and a leader in workstation processor technology to drive unprecedented success in their product manufacturing.

The Need for Digital Prototyping

Manufacturing today is inherently complex and only getting more so. It's not unheard of for product assemblies to number thousands or even hundreds of thousands of parts. Take, for instance, Dynamic Structures of Vancouver, Canada, whose products include up to 300,000-part assemblies. The company is currently designing the structure for the Thirty-Meter Telescope on Mt. Mauna Kea in Hawaii, which will be the largest telescope in the world, and the parts for it easily number in the hundreds of thousands. The amount of information involved in bringing such a product to market is immense, and keeping track of it can be extremely difficult. It would be hard enough if this information were static, and of course it is anything but. Multiple designs are usually considered before a product is even approved; revisions are made extensively; materials, processes and suppliers can all change; and customer requirements never stand still.

In the past, product development systems have often struggled under the weight of massive information and complexity. However, the advent of 64-bit enables software, memory and processor technology advances that now make it feasible to create a complete digital model of a complex product. As an example, engineers can now digitally produce a 3D prototype to more accurately simulate its behavior in near realistic circumstances fast enough to impact product design. A complex detailed digital model that previously was too large to work with older software and workstations can now be opened, acted on and tested. Engineer's can now design, visualize and simulate large models in real-time. Complex analyses that might have had to be batch scheduled on expensive mainframes, and that required an extensive lag time between when an engineer submitted them and when the results were returned, can now be completed in less time than ever before.

Managing all the information associated with complex products can indeed be daunting. In many cases, information might be in several incompatible systems, resulting in the need for labor-intensive and time-consuming manual processes in order for the information to be shared throughout an organization, let alone with suppliers and/or customers. Errors invariably creep into any system involving manual processes. It is nearly impossible to avoid data errors when information is transferred manually from one system to another. Such errors can drive up costs and slow down product delivery – or worse, result in significant problems that aren't discovered until the product fails after delivery to a customer. With its definition of a complete product model, Digital Prototyping greatly simplifies managing all product information, eliminates redundant data entry (and associated mistakes), and makes many of the problems associated with this complexity go away.

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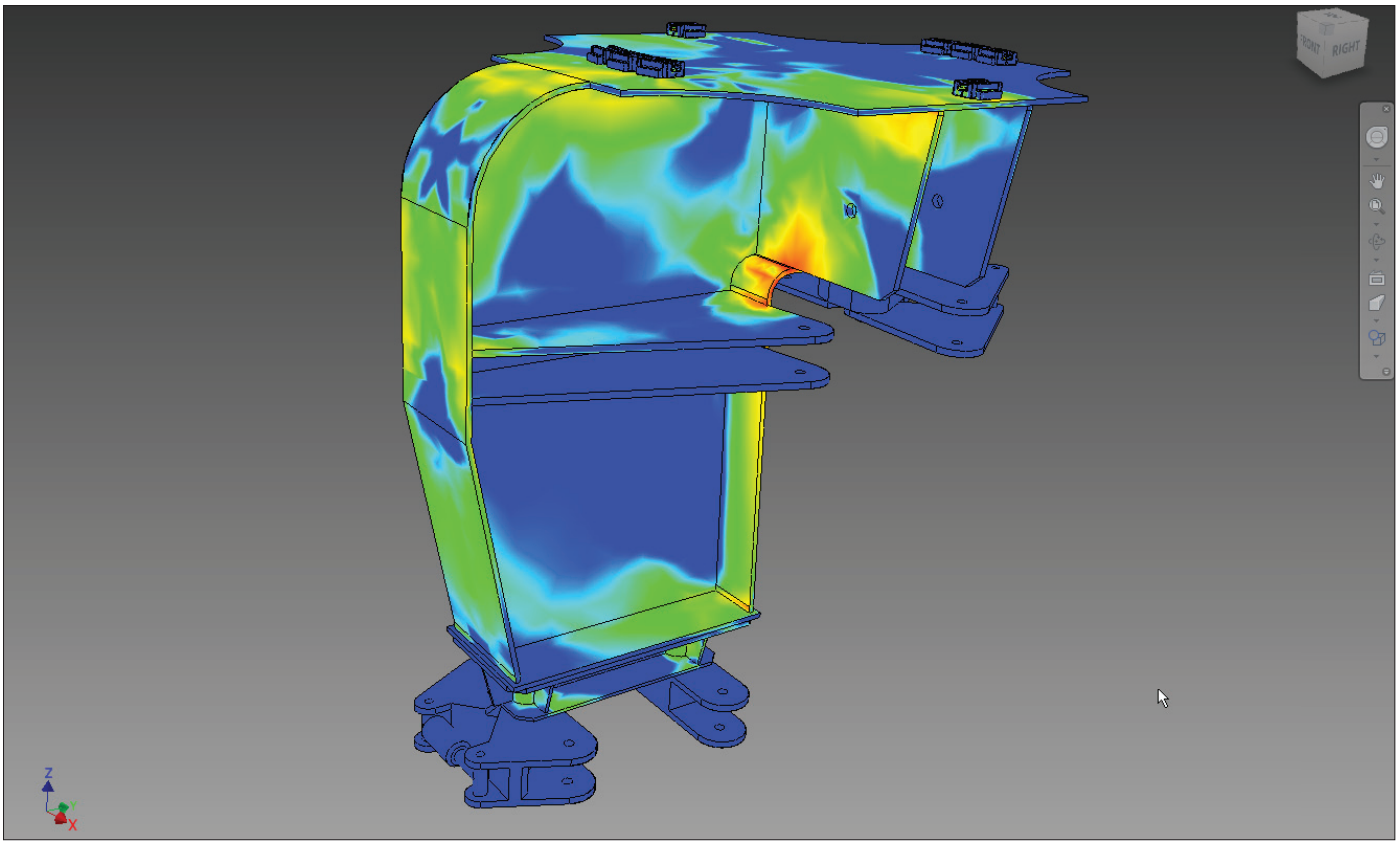

Figure 1. Image courtesy of Dynamic Structures of Vancouver, Canada. Simulation using Autodesk® Inventor® software.

Prototypes: Can't Live With Them – Can't Live Without Them

Prototypes serve an invaluable role in manufacturing. They help designers, engineers, factory managers, and everyone involved in the manufacturing process to visualize what is being built, simulate the product in action, analyze its performance, help ensure that it can perform as intended, determine how to more accurately assemble it, and faithfully describe its characteristics and capabilities to customers. However, the time and capital investment needed to create physical prototypes is daunting. Furthermore, prototypes are often on the critical path as new products head to market. You can limit their number, but in doing so you probably compromise original product definitions – ending up with a suboptimal product that may be more expensive to manufacture, maintain or support. All negatively impact product profitability.

Clearly a more iterative approach to designing products is needed. Unfortunately, the nature of physical prototypes makes it cost-prohibitive to produce and test many iterations – the shop floor is an inefficient place for innovation to happen. Innovation inevitably suffers when the number of design options being simulated and tested is limited, making this a severe drawback to relying on physical prototypes.

Digital Prototyping: A Way To Accelerate Innovation And Control Cost

Digital Prototyping is a revolutionary approach to product development that helps designers and engineers design, visualize and simulate new products rapidly and cost effectively. It helps companies analyze and test product performance in advance of manufacturing, and it allows industrial design, engineering and manufacturing teams to collaborate using a *single digital model*.

With Digital Prototyping, it's possible to replace the typical but inefficient *design > build > test > fix* manufacturing cycle with a more streamlined and cost-efficient *design > analyze > optimize > build* workflow. Digital Prototyping can dramatically reduce the number of – and in some cases even eliminate the need for – physical prototypes. It allows manufacturers to bring higher quality and more innovative products to market faster and at less cost.

Digital Prototypes built with Autodesk® Inventor® software on Intel Xeon processor-based workstations represent a breakthrough improvement in product development. They allow products to be viewed from any angle and at any level of detail in ways that convey meaning and understanding to non-engineers far beyond what has been possible with 2D representations and written specifications. This greater comprehension becomes increasingly more important the further away from

the product designer one gets. For example, assemblers can be trained faster to make fewer errors and sales people can help the customer better comprehend the product's characteristics.

Digital Prototyping is far more than just a 3D representation of a product, however. Because it is a true virtual representation of the product, it includes everything necessary to simulate the product's performance – even going so far as mold simulation and tooling design to help ensure your product design is manufacturable and sustainable. This comprehensiveness means that analyses can be more complete and more accurate, limiting the need for physical prototypes and minimizing delays by helping ensure a design can be manufactured. And because the performance of workstation-based Digital Prototyping has improved so dramatically in recent years, it is now feasible to have a genuinely dynamic, iterative process that can allow designers and engineers the flexibility to test many options before the product goes to manufacturing.

Family-owned farm equipment manufacturer Unverferth of Kalida, OH, uses Digital Prototyping to reduce errors and speed time-to-market. With Autodesk Inventor software and Intel-based workstations, they have been able to increase collaboration, Unverferth plans to expand the use of their system beyond modeling, simulation and stress analysis to also start using the Digital Prototypes in advertising and sales as well. Most importantly, the flexibility of Digital Prototyping allows them to consider more design options and still reduce product development time by 50 percent. They have also decreased the number of physical prototypes they need to build by 75 percent. The company sees these as key factors in their continued ability to do well against their competition.

Digital Prototyping makes digital workflows a reality. Because it relies on a single digital model, everyone involved in the manufacturing process can work off the same information. The digital model becomes the "single source of truth" about the product, improving the speed and accuracy of communication with all stakeholders. Using 3D digital models for factory planning, for example, can help factory designers determine the optimal location and layout for everything from cooling equipment and overhead conveyors to tubing and piping to shipping and receiving. It can even help them avoid building too little capacity or overbuilding too much capacity. This alone can result in substantial savings for large manufacturers, both in real estate and energy costs. Intel Corporation itself uses Intel Xeon processor-based workstations and Autodesk Factory design solutions to plan, develop, and build complex, multi-billion-dollar semiconductor "fabs." Intel encourages its suppliers to create Digital Prototypes of machines and equipment to be used at the fabs, so they can easily export a BIM-ready model for Intel to plug into its overall digital factory planning system. In a very real way, Digital Prototyping helps manufacturers maxmize their digital assets for shareholder return.

Prerequisites for Getting the Most from Digital Prototyping

Success with Digital Prototyping is dependent on having the right systems, both hardware and software, that can make the virtues of Digital Prototyping a reality.

Reliability, stability, and *performance* are essential prerequisites for workstations performing the key tasks of Digital Prototyping. While critically important, it's not enough for workstations to be fast. The work of designers and engineers creating products is absolutely mission-critical. The workstations they use must therefore have reliability and dependability characteristics previously only demanded of server computers. The market competitiveness and reputation of a manufacturer demand no less. One would be no more likely to find an unreliable or unstable workstation used by a leading manufacturer than one would be to find a dull blade in use by a top surgeon.

HTC Sweden, a global leader in innovative floor polishing equipment, runs Autodesk® Inventor, Autodesk® Alias,® AutoCAD,® Autodesk® Vault, and AutoCAD® Electrical software on Intel Xeon processor-based workstations. Karl Thysell, head of product development at HTC Sweden, finds the reliability of the workstations to be absolutely critical: "The dual Intel Xeon processor workstations give us dream levels of power, letting us do virtually anything we can imagine. Another major benefit is that we don't have to bother about hardware issues anymore. When programs aren't working, many manufacturers blame the hardware. Maybe this can be true, but with Intel Xeon processors, we never have those problems."

The high performance of the latest workstation technology is what makes Digital Prototyping more attainable. Today, leading manufacturers are rendering animations of complex products in a few hours on workstations that computers with non-workstation-class processors would take more than a week to render, if they are capable of doing so at all. What's more, workstations today are able to handle several tasks in the background while still providing a dynamic, interactive experience for the foreground task. This allows designers and engineers to stay productive instead of having to wait around for their computers to be freed up. The extra productivity gained by a high-value employee like an engineer, could in one day easily pay for the cost differential of buying a workstation-class computer.

Unverferth creates their Digital Prototypes in Autodesk Inventor and runs their simulations in Autodesk® Algor® on workstations using the Intel Xeon processor. According to Dave Smith, director of engineering at Unverferth, the company is now able to handle much larger models with many more parts: "It would be close to impossible to run our simulations without these high-end workstations. And because of their multithreading, we can continue to work on other tasks while the simulations are underway."

Figure 3. Image courtesy of HTC Sweden AB. Render created with Autodesk® Inventor®.

Figure 4. Image courtesy of Unverferth Farm Equipment of Kalida, Ohio. Render created with Autodesk® Inventor®.

The software systems that are prerequisite for Digital Prototyping must be *scalable, attainable* and *cost-effective.*

Few systems test a computer's ability to scale as much as Digital Prototyping. Software producing great 3D images won't cut it if it can't handle a model with many thousands of parts, if it slows to a crawl when running complex analyses in the background, or if it handles your business today but has no headroom for growth when your new product line comes out and your business takes off.

Furthermore, Digital Prototyping by its nature needs to co-exist easily with other systems. Implementations don't need to be company wide; it can often make sense to begin with one key software product and then expand adoption at a pace suited to the unique needs of the organization. This approach makes adoption much easier – but it is only feasible if the software can be implemented without the kind of organizational disruption that's often been associated with implementing organization-wide software systems. In other words, the goal of implementing Digital Prototyping has to be readily attainable by organizations of all size. Manufacturing complex products isn't made any easier by extremely complex implementations.

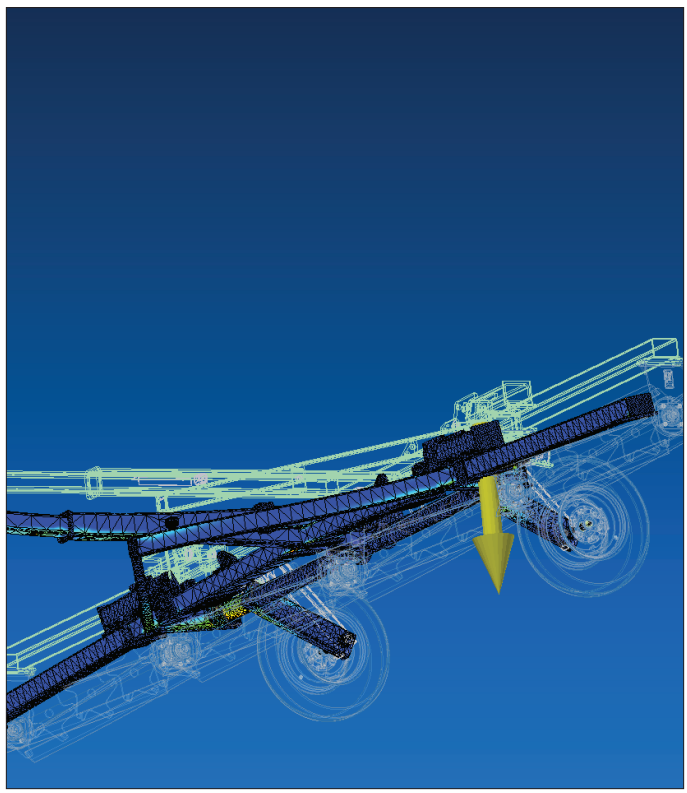

Figure 5. Image courtesy of Unverferth Farm Equipment of Kalida, Ohio. Technical documentation shown in Autodesk® Inventor®.

Figure 6. Image courtesy of Pi Mobility of Sausalito, California.

Finally, Digital Prototyping software has to be cost-effective. The cost barrier to entry needs to be low, and the ROI needs to be genuine both in terms of time to market and hard dollar savings. And just because the cost of entry is low, it shouldn't mean that you have to sacrifice anything in terms of power, ease-of-use or productivity. Innovative bike manufacturer Pi Mobility of Sausalito, CA, saw nearly instant returns from their adoption of Digital Prototyping. After just the third week, they were able to reduce the diameter of their tube by half an inch, resulting in savings of more than $300,000. The company estimates that the rate at which they are saving money due to Digital Prototyping will allow them to achieve profitability fully one year ahead of schedule.

Intel and Autodesk Offerings for Digital Prototyping

What Dynamic Structures, Unverferth, Pi Mobility and many other leading manufacturers all have in common is that they conduct Digital Prototyping on Intel Xeon processor-based workstations running the Autodesk solution for Digital Prototyping, including Inventor software. Both companies' products help enable users to design, visualize and simulate their ideas almost as fast as they think about them. Together Autodesk and Intel technologies are helping accelerate the innovation cycles of their customers. They provide the power for Digital Prototyping efforts at leading manufacturers worldwide.

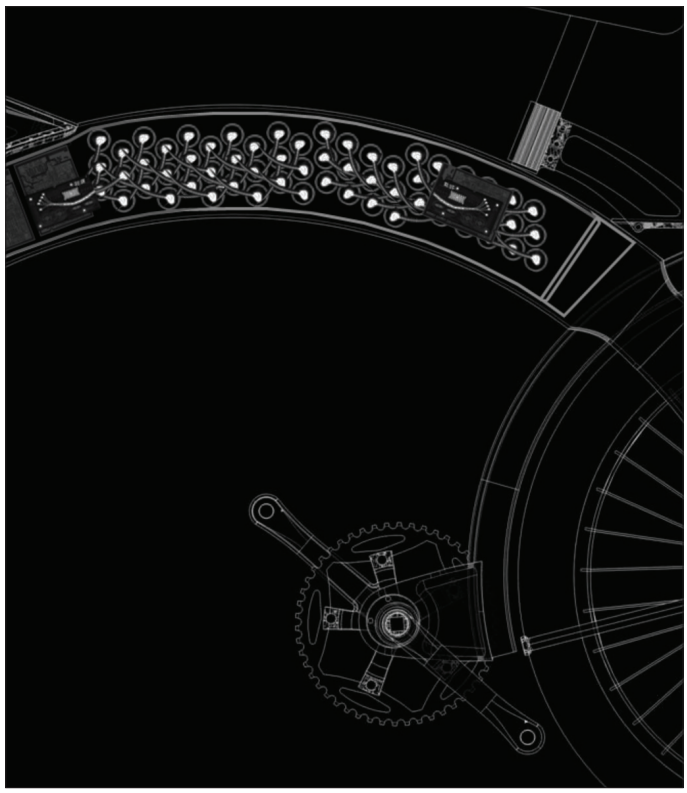

Figure 7. Image courtesy of Pi Mobility of Sausalito, California. Wireframe view created with Autodesk® Inventor®.

The Intel Workstation Portfolio

Intel's workstation lineup offers enhanced reliability, stability and performance for the engineers, designers, artists, financial analysts, scientists and digital media creators who create the digital assets of an organization. Based on Intel Xeon processors, the portfolio for Digital Prototyping has four important family members:

The Expert Workbench is powered by two Intel® Xeon® processors 5600 series, and is the ideal setup for analysis-driven design, simulation, 3D rendering, large model generation, and all of the most demanding tasks of Digital Prototyping. An expert workbench allows your designers and engineers to be their most creative, analytical and productive, giving them the kind of dynamic capabilities necessary to bring their most powerful work to life.

The Essential Workstation is optimized for the power user, providing more capacity, performance and reliability than an entry workstation. Based on the Intel® Xeon® processor 3600 series, this setup easily handles 2D and 3D model generation and basic CAD.

The Mobile Workstation is the essential tool for engineers and designers who need to go onsite for close collaboration with customers, suppliers and others. Based on the Intel® Core™ i7 vPro™ processors, they offer nearly the performance of the entry workstation and allow you to design not just for your customers, but side-by-side with them.

The Entry Workstation is based on the Intel® Xeon® processor 3400 series with the Intel® 3450 chipset. It delivers stability, reliability and performance surpassing that of a PC, and makes an excellent platform for basic design work.

The Autodesk Solution for Digital Prototyping

Autodesk has a successful track record of helping manufacturers go beyond 3D design with an industry-leading software portfolio for Digital Prototyping. The Autodesk solution for Digital Prototyping brings together design data from all phases of the development process into a single digital model created in Inventor. Developing a complete and accurate Digital Prototype gives manufacturers the ability to:

- **Design, visualize, and simulate products digitally** before they are built. All design data is integrated into a single digital model, simplifying the product development process and increasing communication. Powerful visualization capabilities allow manufacturers to create a virtual representation of the final product to review design intent, secure early customer validation, and market products before they're built. Furthermore, the software can allow designers and engineers to digitally simulate the real-world performance of products, saving the time and money required to build multiple physical prototypes.
- **Effectively communicate and collaborate** both inside and outside the organization with architects, engineers, designers, marketing and sales people, builders, supply chain partners, and customers.
- **Win more customers** and project bids.
- **Enable design decisions to be made earlier** in the design process, resulting in potential cost savings.

The Autodesk solution for Digital Prototyping delivers an integrated workflow that can enable better productivity, predictability, and control throughout the product development process. This simplified workflow is changing the way manufacturing companies think about their design practices and is helping them build better products faster, with greater confidence and fewer costs. Autodesk offers these capabilities in a way that is truly scalable, attainable, and cost effective for manufacturers. From conceptual design to engineering, manufacturing and the end-customer, Autodesk provides the compatible tools for Digital Prototyping that allow manufacturing, automotive and transportation companies to connect their entire product development process through a single digital model, enabling them to compete and win.

Autodesk Inventor software is compatible with Autodesk's extensive Digital Prototyping software portfolio, including Autodesk Vault, Autodesk Algor, Autodesk® Moldflow®, Autodesk Alias, Autodesk® 3ds Max®, Autodesk® Showcase®, Autodesk® Inventor® Publisher, Autodesk® Inventor® Factory, Autodesk® Revit® family of products, AutoCAD, AutoCAD® Electrical, AutoCAD® Mechanical, and Autodesk Streamline®.

Conclusion

Digital Prototyping is a reality today, already well in use by leading manufacturers around the world. It helps them realize tangible, substantial time-to-market and cost-savings benefits; more importantly, it helps them build better products with higher quality. Digital Prototyping isn't just for large companies – indeed, many smaller manufacturers use it to maintain the flexibility and competitive edge they need to keep up with and often surpass larger competitors.

What makes Digital Prototyping more attainable now is the availability of powerful technology from Intel and Autodesk that brings high performance computing to the workstation and puts powerful and comprehensive design, visualization, simulation and collaboration capabilities in the hands of engineers and designers of companies of all sizes.

Powerful processor technology from Intel effectively turns workstations into workstation supercomputers. The Intel Xeon processor 5600 series provides designers and engineers with the reliability, stability and performance they need to produce truly innovative work faster and with higher quality than ever before.

Autodesk provides a rich and cost-effective software portfolio for Digital Prototyping. The Autodesk approach is unique in that it is scalable and attainable, allowing a broader group of manufacturers to realize the benefits of Digital Prototyping with minimal disruption to existing workflows, providing a straightforward path to creating and maintaining a single digital model in a multidisciplinary engineering environment.

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