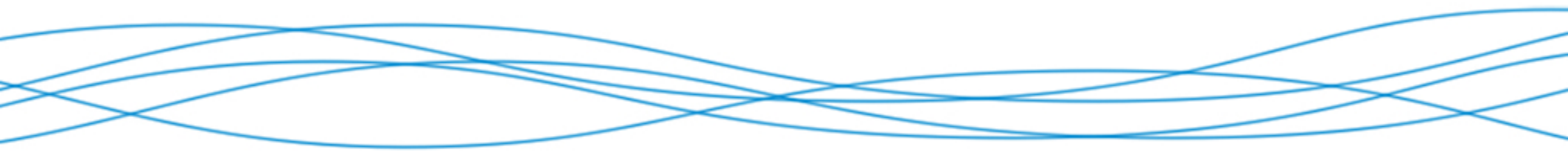
ENABLING THE DIGITAL THREAD

Unifying Design, Manufacturing and ERP in a Closed Loop Digital Thread



iBASEt

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Introduction

Manufacturing is in the midst of another revolution and it is again transforming the industry as we know it. Today the revolution is digital, and as with all revolutions, this one did not occur overnight. From the introduction of the PC to the factory floor in the 1970s to the development and maturation of computer-aided design, clear evolutionary steps resulted in productivity and efficiency gains in manufacturing.[1]

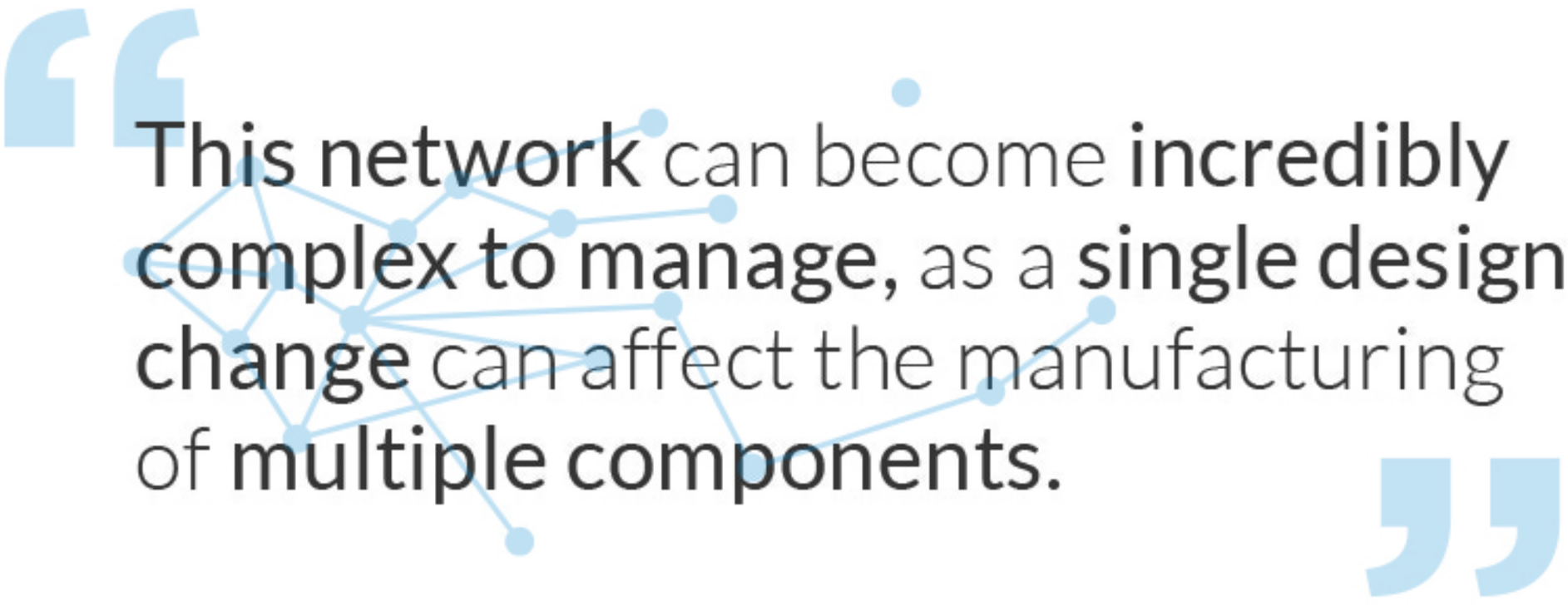
A critical and concurrent evolution was also occurring within design and engineering, where technical documentation evolved from blueprints to two-dimensional drawings to three-dimensional models. This had dramatic effects across design engineering functions and could have even more impact on the manufacturing enterprise. The Model-Based Definition (MBD) could facilitate design communication across the entire product lifecycle and across the organization from design to production and quality assurance.

The digital thread with the Model-Based Definition (MBD) can eliminate the problems of complexity consolidating the 3D CAD model, component list, revision levels, Geometric Dimension and Tolerance (GD&T) interpretation, product details and other production and inspection requisite information into a model information package that is shared beyond engineering functions.[2]

As the development of digital technologies continues to accelerate, manufacturers are continuing to rethink their enterprises in terms of how to best leverage those advances to remain competitive in a progressively nuanced, increasingly challenging global marketplace. It is within this marketplace that products and processes are changing rapidly to meet demand, and where innovation and quality are no longer the mark of an exceptional competitor, but rather a prerequisite to compete. Bringing us to where we are today, and revealing the need to enable the digital thread of manufacturing into a complete manufacturing Model-Based Enterprise (MBE).

Managing Complexity with the Digital Thread

Today's manufacturers, especially those in sectors such as aerospace, defense, medical devices, industrial equipment, and electronics, are faced with the challenge of managing a complex and often far-flung supply network. An end product may have hundreds of individual components or assemblies, some of which the manufacturer may produce and others sourced from a range of suppliers (or suppliers' suppliers). This network can become incredibly complex to manage, as a single design change can affect the manufacturing of multiple components.



For example, a company may have a requirement to produce a part with three measurements that are verified. If nothing changes (i.e., no engineering changes), the process is simple. But when a product has multiple layers that are changing (e.g., dimensions, characteristics, supplier), associativity needs to be maintained among engineering, manufacturing, inspection and maintenance—across the entire enterprise—so that the product is produced and verified to the correct engineering level. To facilitate this process and better manage complexity, an increasing number of manufacturers are looking to the model-based enterprise model.

The National Institute for Standards defines a Model-Based Enterprise this way:

> *A Model-Based Enterprise (MBE) is an organization that applies modeling and simulation technologies to integrate and manage its technical and business processes related to production and product lifecycle support. By using product and process models to define, execute, control, and manage all enterprise processes, and by applying science-based simulation and analysis tools to optimize processes at every step of the product life-cycle, it will be possible to substantially reduce the time and cost of product development and delivery.*[3]

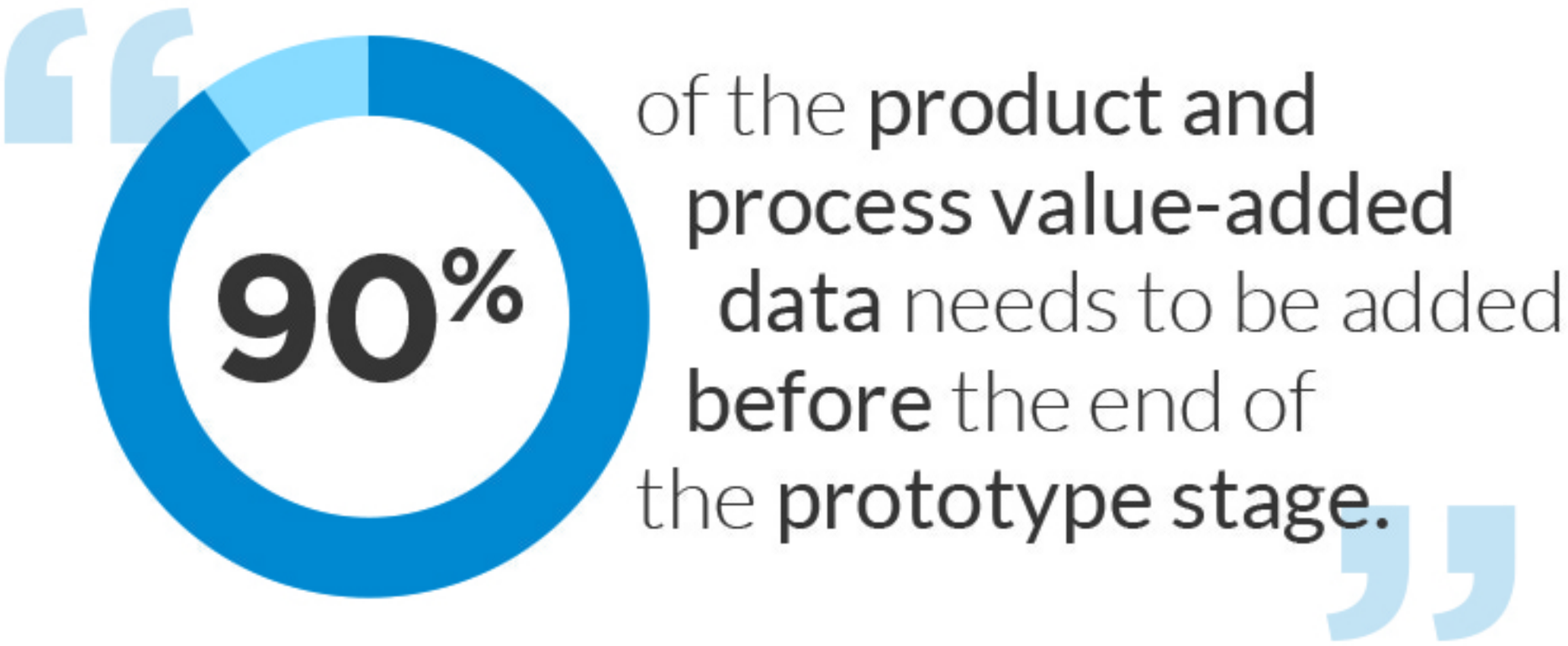
Model-based enterprises utilize model-based definition: the practice of using 3-D models (such as solid models, 3-D Product Manufacturing Information (PMI), and associated metadata) within 3-D CAD software to define (i.e., provide specifications for) individual components and product assemblies. The types of information included are GD&T, component level materials, assembly level Bills of Materials (BOM), engineering configurations, design intent, and so on. By contrast, other methodologies have historically required accompanying use of 2-D engineering drawings to provide such details.

The core tenet of a model-based enterprise is that data is created once and directly reused by all data consumers (i.e., all functional areas) in the manufacturing enterprise. This is the "single source of the truth," the digital thread.

Simply put, the digital thread represents the sum of all data (i.e., model data, product structure data, metadata, effectual data, and process definition data including supporting equipment and tools) digitally linked to form a single, contiguous definition of all value-added decisions made during the definition of a product, its configuration, manufacturing and repair processes, logistics, and operational support. For a complex manufacturer, it provides a single reference point for design, engineering, and manufacturing, ensuring they act in concert.[4]

The Three Opportunities

Throughout the product lifecycle, key value-added elements are defined and inserted into product and process definitions. Anywhere this data is defined too late creates a cost, risk, and quality impact. Anywhere this data is copied, transcribed, or reinterpreted increases the potential risk and quality impact. Consequently, ninety percent of the product and process value-added data needs to be added before the end of the prototype stage.



Realizing a digital thread affords manufacturers the opportunity to **ensure quality, control costs, and mitigate risk.**

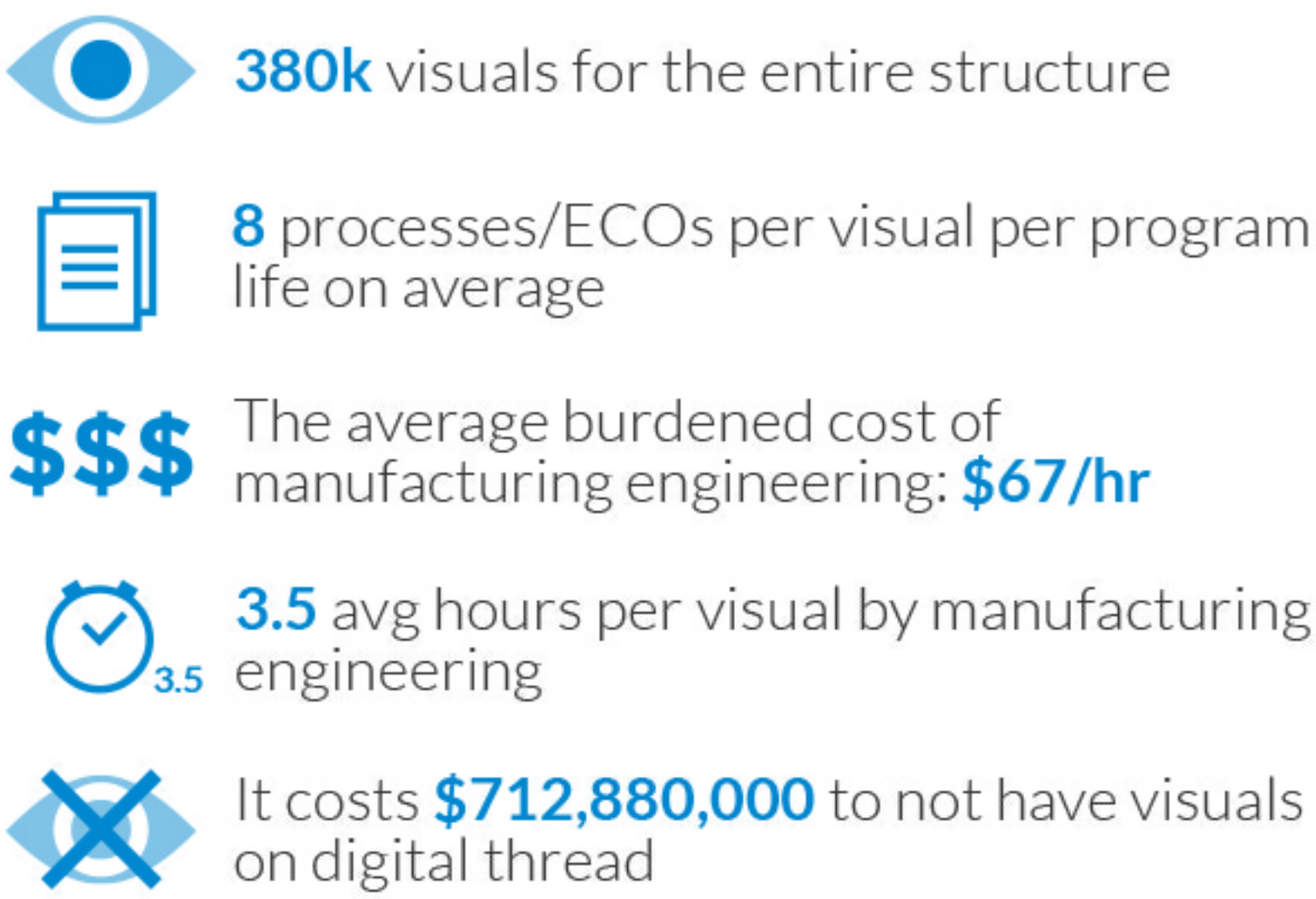
Quality

Each element of a manufacturer's value stream where data is reinvented, reinterpreted, or transcribed introduces an opportunity for product or process defects. If the defect is caught in house, it nonetheless costs time and money to address. If the defect enters the downstream supply chain, its escape compromises corporate credibility and diminishes the prospects for repeat or new sales. Having a digital thread in place reduces the likelihood of such events.

The Three Opportunities

Cost

The digital thread introduces a framework where value-added actions are efficient and sustained. Work gets done once. Quality variances are resolved once. Engineering changes are processed once. Consider the example of step-by-step visuals for a major defense program:



Risk

Even if cost and quality were not an issue, a program cannot afford any variation that will affect its ability to reach and maintain goals. Most programs now have penalty clauses that may be triggered by late deliveries, escape rates, and availability rates. As such, programs need stability and little or no process variability. By preserving and sustaining value-added content, the digital thread supports this stability.

Realizing the Thread with Product Lifecycle Execution (PLE)

Enterprise Resource Planning (ERP) and **Product Lifecycle Management (PLM)** have long been considered the fundamental enterprise systems in a model-based enterprise; but a genuine digital thread cannot exist without a **Product Lifecycle Execution (PLE) platform.**

To develop, describe, manage, and communicate information about their products from conception to end-of-life, manufacturers use PLM. PLM architecture is object-oriented and structured around products, product relationships, and configuration management functions.

To manage resources for production, manufacturers use ERP. ERP architecture is transaction-based and organized around production resources. While the ERP system utilizes product data and process plans contained in the PLM system, the architectures of ERP and PLM are fundamentally different. Both systems must control their own data and not duplicate or impede the functions of the other.

PLM provides **"the what"**: modeling, BOM management, process planning, process simulation, and engineering change management. ERP provides **"the when, where, and how much"**: scheduling, financials, and inventory. But to have a fully developed model-based enterprise—and a fully functioning digital thread—manufacturers also need **"the how."** That's what PLE provides through process execution, process control, quality assurance, traceability, and deviation handling.

Realizing the Thread with Product Lifecycle Execution (PLE)

By enabling a manufacturer to execute on the digital thread in real time, PLE provides or facilitates a host of benefits, including:

Historically, the biggest potential barrier to realizing the model-based enterprise and the full potential of the digital thread has been integration of the enterprise applications,[5] but this is something iBASEt has addressed with its Solumina G8 suite.

Closing the Loop with Solumina

Solumina easily integrates with all popular CAD, PLM, and ERP systems, in addition to third party and legacy systems manufacturers are using today. Every aspect of manufacturing—from automating and digitizing interactive work instructions using 2-D and 3-D CAD drawings and visualizations to providing real-time updates and data collection—is synchronized across manufacturing operations with Solumina.

Closing the Loop with Solumina

By connecting with PLM and ERP, Solumina closes the loop among the different functions within the manufacturing enterprise (i.e., design, engineering, production, quality and resource management), creating a seamless flow of data among systems heretofore isolated, realizing the potential inherent in manufacturing from the digital thread.

As data is collected in PLM (e.g., EBOM), it can flow into Solumina as an MBOM. Planning can either be done in the PLM or Solumina. Changes made are fed back to engineering; or, if resources are modified, consumed, or changed, they can be fed back into the ERP. The closed-loop environment encompasses the applications to complete and ensure the integrity of the digital thread.

Solumina is built specifically to handle the complex requirements in critical sectors such as aerospace and defense manufacturing. Managing product configurations and change management across the entire value chain and product lifecycle is where the solution delivers exceptional value to complex manufacturers. These capabilities allow companies to efficiently meet and exceed regulatory compliance, time-to-market, and quality requirements in today’s demanding global marketplace.

About iBASEt

Headquartered in Foothill Ranch, California, iBASEt makes discrete complex manufacturing simple. iBASEt solutions replace a myriad of disparate shop floor and supply chain solutions – such as manual paper and email processes – with one integrated suite of software systems that synchronize data and foster collaboration between internal and external teams.

From process and inspection, planning to the shop floor and supply chain execution, we provide proven, out-of-the-box solutions that deliver real-time information and process control that simplifies complex manufacturing.

iBASEt's Manufacturing Execution Systems (MES), Maintenance, Repair and Overhaul (MRO) and quality management software systems are giving our customers the power to monitor every aspect of production, quality and compliance efficiency. Throughout manufacturing, supply chain, and maintenance, repair and overhaul, the iBASEt Solumina suite of applications enable full shop floor to top floor manufacturing visibility, consistent practices, continuous product and process improvement, and effective compliance with process standards including ISO 9001, ISO 13485, AS9100, and FDA's 21 CFR Part 11 and Part 820.

The iBASEt Solumina software suite also enables enterprise-level product life cycle execution delivers lean efficiency, improved quality management and compliance processes. Many aerospace and defense (A&D) and medical device industry's largest manufacturers are using the iBASEt Solumina software suite to enable collaboration and quality assurance across diverse, global supplier networks. Streamlining and simplifying complex manufacturing strategies to enable fast time-to-market for new or improved product with high levels of quality and compliance are where iBASEt customers see the greatest results.

Developed specifically for the most challenging, complex, discrete manufacturing environments, we have a proven track record of delivering global implementations across multiple tiers of the supply chain.

Notes

1. Hartman, Brian; King, William; and Narayanan, Subu. “Digital Manufacturing: The Revolution Will Be Virtualized,” McKinsey & Company, August 2015.
2. “Model Based Definition Promises Big Dividends for Quality Assurance,” http://www.hexagonmetrology.us/applications/2011-09-16-14-41-07/310-model-based?tmpl=component&type=raw
3. Frechette, Simon P. “Model Based Enterprise for Manufacturing,” Manufacturing Systems Integration Division, Engineering Laboratory, National Institute of Standards and Technology, March 2010.
4. Packer, Michael. “How the Digital Thread Is Transforming Manufacturing,” http://www.aerodefevent.com/how-the-digital-thread-is-transforming-manufacturing/.
5. Ibid, Frechette.

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