RESEARCH REPORT

Industry 4.0 Success Requires PLM Platform Support for the Business of Engineering

By John Tenore

Introduction

Today, many leading product manufacturers around the world are striving to prepare for, or implement, Industry 4.0, alternatively known as The Industrial Internet or The Industrial Internet of Things (IIoT). Success with Industry 4.0 will depend heavily on the C-suite's ability to grasp the key concepts and recognize how to apply them within their enterprise and extended supply chain.

The main enabler of Industry 4.0 is what manufacturing industry experts refer to as the digital thread. It is the connected digital information that describes a product, from its initial conception and design, through to its manufacture and in-field maintenance. What makes the digital thread so powerful and transformational for manufacturers is the wealth of data it contains – data which they can harness to gain substantial operational efficiencies in manufacturing, respond faster to product defects and increase competitive agility.

Yet, acting upon the massive amount of data that surrounds a product proves elusive for the majority of product manufacturers today. Findings from an LNS Research survey of 400 manufacturing executives reveals that over 80 percent of companies have not yet approved any budget for IIoT.[1] This corroborates findings from the Digital Manufacturing and Design Innovation Institute (DMDII). DMDII states that 81% of U.S. manufacturers acknowledged that digital manufacturing is a key element in their future competitiveness, but only 14% said they were adequately equipped today with digital technologies and related expertise.[2]

For those manufacturers eager to take advantage of Industry 4.0, the opportunity is massive to both improve operational efficiencies and separate themselves from competitors. According to Tom Enders, CEO of the Airbus Group "The opportunities of the digital revolution need to be utilized. This includes that the design, development, engineering and manufacturing of our products become much more efficient and faster…"[3]

Commenting on the LNS Research survey, Kapil Venkatachalam of Technology Crossover Ventures characterizes the opportunity this way: "Manufacturers that start by exploring and adopting a platform approach based on new, easy-to-use and flexible software for their core manufacturing software foundation will lead the way forward; those that don't will be left behind."[4] The results of a recent Product Lifecycle Management (PLM) study conducted by Gatepoint Research echoed the need for a platform approach. Among manufacturing IT executives, the most common problem plaguing cited by 56% was "Different systems are used in different parts of the company."[5]

This market analysis report provides VP- and C-level executives at product manufacturing companies with insights into how they can prepare their organizations for Industry 4.0. It discusses how they must be prepared to lead a digital transformation of their product-related processes. Specifically, the analysis demonstrates how a platform approach to PLM can connect the digital thread across the extended enterprise, and add context to it, so that every person and 'smart' machine knows what to do to achieve optimal product success.

Industry 4.0 Cannot Happen without Context

At the heart of Industry 4.0 is the interconnectedness between the data that comes from product design and the industrial machinery on the factory floor that produces the actual products. Where currently the digital thread connects product design through to product release and stops there, it must extend through to manufacturing and the in-service product.

But a word of warning: there is a lot of hype around connecting product design to the factory floor and the use of such new technologies as data analytics, machine-based sensing and advanced robotics. While pundits are painting the future of incredibly 'smart' factories (a present reality for those few visionary manufacturers), there's a reason why the majority of manufacturers are not yet making Industry 4.0 real within their companies. Their data resides in unconnected silos that lack context.

It is true that manufacturers have adopted many of the rights tools and are gathering much of the necessary data to take the next step toward to the Industrial Internet. Nevertheless, they are failing to provide context around their data. As a result, appropriate processes cannot be put in place to ensure that manufacturing systems know how to adjust for change, respond quickly to defects, communicate the meaning of defects back to product design and optimize the factory floor.

Following is an example of the need for context which specifically applies to the data analytics aspect of Industry 4.0:

We are all familiar with the sensors that are placed within products that constitute the Internet of Things. Industry 4.0 involves putting those sensors into manufacturing systems on the factory floor. For instance, when a sensor on a machine sends a signal indicating its current operating temperature, people and manufacturing systems need to understand the purpose of the machine, what it is attempting to do at the moment of sending the signal, what temperature is acceptable and not acceptable and the appropriate response.

Accenture: Digital Industry 4.0/ Industrial Internet of Things

Connected, intelligent products that communicate with users, new digital business models that harness collected data to offer additional services and as-a-service products, products on the assembly line that tell shop floor machinery how they are to be processed. The core of Digital Industry 4.0 is highly intelligent connected systems that create a fully digital value chain, the 4th industrial revolution enabled by the Industrial Internet of Things.
(sourced online March 30, 2016 at: http://prd.accenture.com/microsites/digital-industry/digital.html)

In these ways, manufacturing and product design can work together to optimize one another. Such collaboration is only possible via a product information platform that connects product design data, manufacturing data, warranty data and associated information. Only then can an organization interpret factory sensor data in context, allowing it to adjust its designs and processes to raise factory machine uptime, lower product failure rates and optimize product designs to reduce the cost of after-market support.

> "Just like innovation, design and manufacturing need to be closely intertwined to learn from each other and adapt to each other, so digital technologies and industrial manufacturing need to be melded to learn from each other and spur each other to reach higher levels of performance." (GE. "Why Interconnectedness Matters for Industrial Companies," Harvard Business Review, June 22, 2015)

Manufacturing Engineering Holds the Key

Manufacturing engineering is the critical lynch pin between product design and the factory floor. Manufacturing engineering translates the product design data to the physical world of the factory floor through a series of process steps that include the following:

- Manufacturing process planning
- Manufacturing bill of materials (MBOM) creation/maintenance
- Work instructions
- Quality planning (including PFMEA)
- Quality systems (including CAPA)

Today, the reality on the ground is that most product design data is not integrated well into manufacturing engineering. Moreover, the different elements within manufacturing engineering are themselves disconnected from one another and from the factory floor. Thus, the three domains of design, manufacturing engineering and the factory floor are all disconnected, both internally and externally.

These disconnects within and between domains represent a major inhibitor to Industry 4.0 becoming a reality. Yet, with statistics such as 86% of US manufacturers lacking the digital know-how to make such connections, manufacturers must seek technology platforms and IT partners that make it possible for them to do so.[6]

The Platform Should Be PLM

To date, many manufacturers have looked to their Product Lifecycle Management (PLM) system to connect the digital thread between design and manufacturing. However, legacy PLM systems, despite their hype, have failed to make the process and information connections necessary to accommodate the various and fast-changing needs of product design, manufacturing engineering, the factory floor and the supply chain. Their failure is reflected in the results of a recent study from Gatepoint Research:

- 64% of companies attempted to implement their PLM system for over 2 years with limited cross-functional results
- 76% of enterprises responded that they can't easily modify their existing PLM system to handle changing business requirements
- Only 31% of global manufacturers surveyed are supporting more than 1,000 users with their PLM systems[7]

The results of Gatepoint's study underscore the need to recognize the difference between future PLM platforms and the legacy systems in use today.

Current PLM systems typically consist of a collection of independent systems from different vendors. While each may perform a specific task well, overall, they impede the flow of information and provide inadequate support for cross-functional processes.

The platform and Industrial Internet solutions

Platforms are essential to enable and monetize the value of interconnectedness. Interconnectedness is all about communication, collaboration and compatibility, including for big industrial equipment, and it all starts with platforms. The power of platforms has been abundantly demonstrated in the digital world; just think of the burgeoning range of increasingly powerful apps on our smartphones. (GE. "Why Interconnectedness Matters for Industrial Companies," Harvard Business Review, June 22, 2015)

Key to the architecture of the future PLM backbone is that it be built on a single platform that spans the enterprise. Thus, when a new product design emerges, manufacturing engineering can be automatically included in process flows to prepare everything required to actually manufacture the associated product. Critical elements of a PLM platform are:

- Integration with legacy design authoring environments, such as MCAD, ECAD, software and analysis tools — either directly or indirectly by overlaying existing Product Data Management (PDM) and Application Lifecycle Management (ALM) environments
- Integration with enterprise systems, such as ERP (for procurement) and MES (for factory scheduling)
- Native applications supporting critical processes, such as cross-discipline design collaboration, configuration management, engineering change and manufacturing engineering processes
- Support for cross-functional business processes

With everything either built on or connected to a single platform, information flows easily, and cross-functional processes become properly supported – benefits that today's system silos cannot provide. For example, a manufacturing BOM can be generated from a process flow that connects it with the engineering BOM. At the same time, other process flows are taking place. Manufacturing engineers working in quality control can have their quality management system automatically reference the manufacturing process plans and work instructions to ensure product quality is robust.

Really, any process flow can be modeled in a future PLM platform. Referring back to the earlier example regarding the machine that sends signals indicating its current temperature, a PLM platform makes retrieving that data in context very simple. This is a major leap forward to enable Industry 4.0, as querying the massive amounts of data in context provides actionable intelligence. Here's how it works:

If a product was seen to be failing in one of the ways that was anticipated based on its manufacturing process (as captured in the PFMEA), the engineer could request an analysis correlating failing products to the time they were machined and the machine's temperature at that time. If statistically significant results were found, corrective action could be taken. A second process would then be initiated in which the manufacturing process is updated while simultaneously informing design engineering of the issue.

PLM Platform is Key to Industry 4.0 Success

Now consider that a global manufacturer may be running 5,000 machines, each equipped with 12 sensors that beep out a signal every 10 seconds. That's 360,000 data points per minute coming from the factory floor that the manufacturer can mine to find useful data points. But what's the aim? Improvement via corrective actions? Evaluating different suppliers? Tracking product lot performance by geography, date or time spent in transit? The point is that the possibilities for tapping data analytics to improve manufacturing are limitless. More importantly, not even deeply experienced teams can anticipate where and how they must gain context across the product lifecycle, particularly with complex 'smart' products that involve an array of suppliers and a combination of hardware, software and electronics.

As I noted in my recent research report, IoT's Impact on the Business of Engineering[8], CIMdata states that PLM requires a platform approach and that newer, more modern technologies are capable of filling in data and process gaps left by legacy PLM systems.

Conclusion

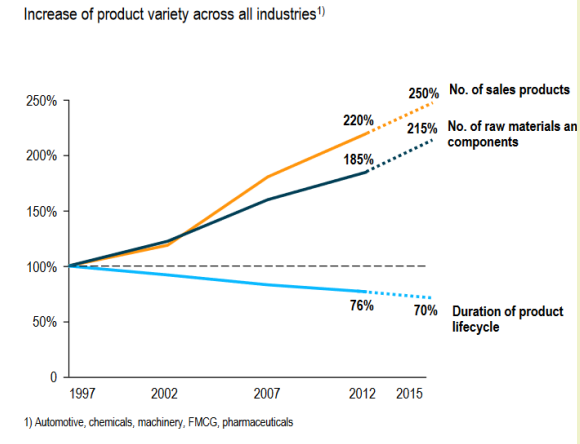
Industry 4.0 is undoubtedly the way forward for manufacturers to radically improve their manufacturing processes and products to gain significant, sustainable and long-term competitive advantage. Yet, taking advantage of IIoT will not just happen organically. Manufacturers must plan carefully to establish the necessary conditions to make it happen.

I contend that the most critical pre-condition for Industry 4.0 success is to develop an integrated approach to sharing information across product design/development, manufacturing engineering and the factory floor.

Relying on disconnected enterprise systems and legacy PLM simply will not progress manufacturers to where they must go with Industry 4.0. As such, it is imperative that they take a new platform approach to capture the data they need and to put that data into context. Only then can they reap the rewards of higher efficiencies, product success rates and profitable growth in a world of increasingly complex and competitive products.

Product Complexity Skyrockets

According to Roland Berger's report Mastering Product Complexity, the complexity of products more than doubled during the 15 years ending in 2012 and continues to accelerate. Complexity, Roland Berger said, "manifests itself in the demand for a wider variety of specialized products across multiple manufacturing industries."



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