Simulation practices are key for realizing the next-generation manufacturing enterprise. The Internet of Things for industries will influence design innovation, connectivity and mobility, and Big Data analytics so that successful companies will need to find new engineering processes and tools to support product change.

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The segment of discrete manufacturing is currently at a crossroads. With increasing globalization, there is a high degree of competition that is coupled with volatile consumer preferences and uncertain macro-economic scenarios. Furthermore, manufacturing is becoming the key focus point for all global economies. With manufacturing’s significant contribution to a country’s GDP and a rapidly expanding consumer market, policy makers around the globe realize that a strong manufacturing footprint has become a strategic necessity for growth. Because of a strong push from governments, the manufacturing industry is set to undergo a wave of transformation in the coming years, aided by the influx of commercial information and communication technologies. One of the key catalysts aiding this transformation is the Internet of Things (IoT), which is set to re-invent every entity in the manufacturing value chain.
The **manufacturing industry** is set to undergo a wave of **transformation** in the coming years.

The IoT for industries will empower new ways of ideation, engineering innovation, production execution and service excellence. Although the impact of the IoT is expected to pervade all elements of manufacturing, its effect in the initial phase of product conception is expected to be particularly significant. According to Frost & Sullivan (F&S) estimates, nearly 12 billion devices in the manufacturing world are anticipated to be connected via advanced machine-to-machine–based technology in 2020. This will be achieved by including embedded software (smart electronics) in all devices to promote mobility, connectivity and interoperability.

Manufacturers across the globe, who are currently grappling with macro-economic uncertainty, fluctuating commodity prices and intense competition, must understand this impact and alter their design processes for an efficient and effective transition into the next era of manufacturing. Increased connectivity at the plant is likely to be complemented by a need for advanced design and engineering capabilities, thereby catering to growing demands for innovation, efficiency and productivity.

The **IoT in Manufacturing**

The impact of the IoT in the manufacturing world will be twofold.

1. The IoT will generate new preferences and demands for products from the consumer world.
2. The IoT will influence the way manufacturers design, engineer, produce and service products.

The two trends are not mutually exclusive, and one trend actually leads to another.

According to F&S, there are three key areas of IoT influence:

1. **Product innovation**
2. **Connectivity and mobility**
3. **Big Data analytics**

**Product Innovation**

Innovation has become a linchpin for success across industries. A flat, globalized manufacturing world with equal access to technology, talent and market calls for a qualitative differentiation that can be achieved only via innovation. More important is that this innovation has to be a continuous process that does not merely end with a single product launch. Innovation cycles must be far more frequent and involve new ways and means to emerge with ideas and convert them into products. The advent of the IoT has made the quest for design innovation a lot more complex. The increased connectivity of products provides more visibility into how they are used by various market segments. This, in turn, puts more demand on design engineers to emerge with custom variants.

To meet customer needs and ensure profitability, engineers need to think outside the box, explore ideas, experiment with new ways of design, and still satisfy overall demands of time and money. Thus, the design quest for engineers in the years to come will encompass multiple elements, starting from material composition, power needs and manufacturing process needs, and ending with real-world operating conditions and consumer behavior.

The **Internet of Things** will influence product design and manufacturing in three ways: product innovation, connectivity and mobility, and Big Data analytics.
The IoT for industries will **empower new ways** of ideation, engineering innovation, production execution and **service excellence**.

Although there are multiple challenges that will impact engineers in the future, the chief challenge is analyzing and assessing the performance of a newly designed product. Product design involves a combination of strategies spread across electrical, mechanical, digital and embedded software disciplines. Since each of these disciplines operates individually, arriving at a consensus on final design metrics is a formidable task for design engineers. The Smart Manufacturing Industry 4.0 scenario incorporating smart electronics has heightened the degree of complexity.

Is there a way for engineers to manage this web of complexity in the future? Although there are many commercially available industrial software tools for product design, engineering and planning (authoring and analysis tools, collaborative product definitions management, etc.), a successful design strategy will be incomplete without a rigorous simulation framework. Simulation is a core technological component for meeting growing consumer demands for product functionality, customization, power, bandwidth and other product attributes. It will enable engineers to meet these needs within the stipulated time, budget and margin targets. Simulation is critical to enable engineering design to enter the age of Industry 4.0. It is, possibly, the most significant technology to effectively help improve products, fine-tune manufacturing processes, shorten lead times and optimize production costs.

### Connectivity and Mobility

Mobility and connectivity are the new normal. Most things produced will need to support mobility and offer connectivity, from airplanes to airbags; these two trends are increasingly making their presence felt across all industry verticals.

Connectivity and mobility in new products exert a significant impact on the nature of design, engineering and production. The surge in communication standards, from Wifi, Bluetooth® and ZigBee® to industrial standards such as WirelessHART®, ISA 100.11a, etc., has catalyzed radical transformations of device or product functionality at the design stage. Embedding mobility and connectivity in products is most critical at the design phase in which a number of critical design issues can be pre-empted and corrected before prototyping. In the design phase, engineers have to grapple with the idea of incorporating multiple standards, arrive at efficient power utility designs and ensure long-lasting performance. From F&S research, we infer that there will be a surge in adoption of software solutions/applications that will help manufacturing engineers to design and validate their connectivity and mobility features. Software solutions that aid in embedded software development, antenna performance testing, etc., are poised to be more fully adopted in the coming years. Whether these solutions can meet the needs of manufacturers in the small- and medium-end segments who face strict investment constraints remains to be seen. A viable usage-based business model from suppliers can be a suitable alternative to convince end-users of a low yet long-term investment strategy.

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*PLM includes authoring and analysis tools, simulation and analysis software,
Big Data Analytics

Big Data is a functional twin of connectivity. The surge in smart, connected devices is likely to result in vast amounts of data that can be assessed and effectively used for improving product functionality. A historical analysis of a product provides valuable insights into product failure, functional gaps and service needs, which can be of immense value to a manufacturer.

At F&S, we believe that, in the future, supplier to end-user relationships will be heavily determined by after-sales services. For instance, in our recent research on the industrial services market in Europe, we inferred that services were growing at nearly one-and-a-half-times the product sales across many key industrial product segments. We also see that the trend is quite consistent across many high-tech and electronics segments, where services have essentially become the platform for manufacturers to reach the consumer. In all these trends, we find that Big Data analytics play a central role in discerning product performance and consumer behavior. Some of the key product performance attributes include data for product failure, materials, service and warranty, core product design, etc. The insights gained from such an analysis directly helps companies to emerge with new service offerings that can improve product performance and also fill the gaps left at the design phase.

From an engineering standpoint, understanding and implementing Big Data will be beneficial to perfecting product design. Analytics provide the next logical step for design improvisation, as it enables understanding the true usage of a product from its deployment to its end of life. Conventional analytics, however, are restricted to making predictions surrounding a product’s service needs. Analytics will provide a way to resolve issues beforehand, but they cannot prescribe remedies to design concerns. Physics-based simulation provides the perfect backdrop to transform the predictive nature of analytics into a prescriptive format that can help design engineers to alter designs and verify product performance at a very early stage of product development.

The advent of the IoT and the move toward the next era of manufacturing will exert significant pressure and influence across the length and breadth of the value chain. This impact is likely to be extremely prominent in product design, engineering and development phases. The result will be growing demands for new industrial software solutions that help engineers to understand the feasibility, efficacy and longevity of their product design. Simulation-driven design, engineering and production are expected to become key norms in the future factory framework, and they are set to experience further acceptance and investment from the manufacturing community.