

DIGITAL TWIN – TECHNOLOGY THAT IS CHANGING INDUSTRY

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DIGITAL TWIN

A revolution in industry

DIGITAL TWIN - NASA

"The goal is to fabricate, test and produce products in an entirely virtual space. Before we actually produce the product, it has to meet our requirements completely."

John Vickers, National Center for Advanced Manufacturing within NASA

We then want that physical build to tie back to its digital twin through sensors so that the digital twin contains all the information that we could have by inspecting the physical build

NASA research

- In the early days of space exploration. NASA grappled with the challenge of designing things that travel so far away, beyond the ability to immediately see, monitor or modify.
- NASA's innovation was a Digital Twin of the physical system, a complete digital model that can be used to operate, simulate and analyze an underlying system governed by physics.



Digital Twin

Identical digital/virtual copy of the real machine, part or product



A digital twin



Is born with the product idea



Serves as virtual template during assembly



Growth continues in product development process



Remains connected for the entire life cycle



Prevents errors in production

With help from the digital twin:



Protects reputation & prevents financial loss

It is a product that improves itself

Digital Twin At Work

- *Digital twin eliminates guesswork from determining the best course of action to service critical physical assets, from engines to power turbines. Moving forward, easy access to this unique combination of deep knowledge and intelligence about your assets paves the road to optimization and business transformation.*

DEVICE SHADOW



‘Digital twins’ could make decisions for us within 5 years

- WITHIN five years we could have a “digital twin” capable of making decisions for you and even interacting with loved ones after we die
- We’re already off to a good start with software like Apple’s Siri, Microsoft’s Cortana and “Eugene Goostman”

DIGITAL TRANSFORMATION

- The way to track data or transactions, the way we collaborate and communicate, have all been changed and advanced through digital technology.
- Profound changes in our societies

IoT space

- The idea of a Digital Twin is now being developed in the IoT space, and it is rapidly becoming the technology of choice for digitalizing the physical world.
- It is the bridge between the physical and the digital world.
- A technology that is dynamic, learning and also interactive.

What are Digital Twins exactly?

- Fundamentally, it is the combination of data and intelligence that represent the structure, context and behavior of a physical system of any type, offering an interface that allows one to understand past and present operation, and make predictions about the future.
- These are very powerful digital objects that can be used to optimize the physical world, significantly improving operational performance and business processes.

The Digital Twin

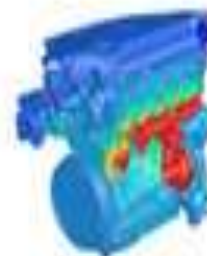
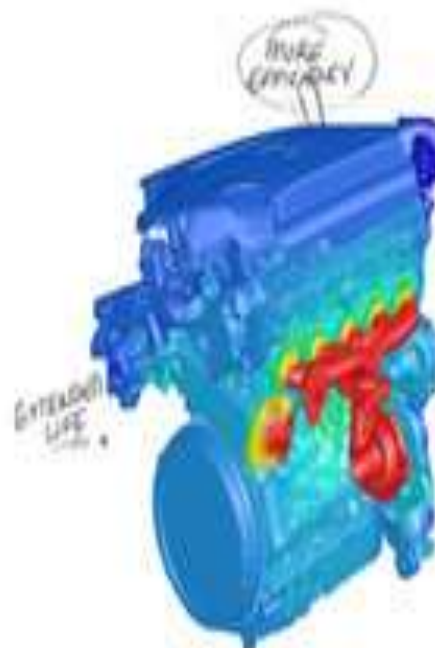
- A complex system produces massive amounts of data. Connect a group of systems together through the internet, and the data increases exponentially. All of the data coming off of these devices is descriptive. That is, the data tells you what happened and when it happened. Data analytics extends the data to be predictive and tell you when something will happen — a failure, for instance. But data analytics doesn't tell you how to improve the product to avoid the failure. However, a digital twin — a 3-D digital model of a physical system — can do this!

Digital Twin -- From Design to Operation

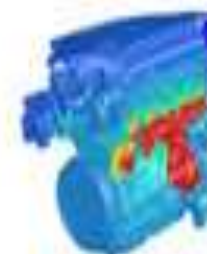
Physical Asset



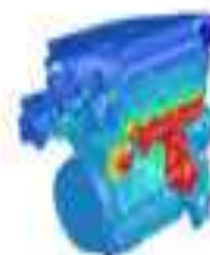
Virtual Prototype



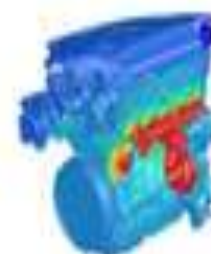
Digital Twin



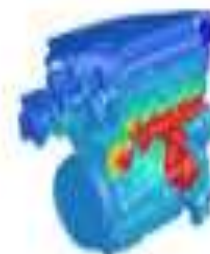
Digital Twin



Digital Twin



Digital Twin



Digital Twin

Physics-based analytics to model the present state of every asset

Airframe Digital Twin

- The Digital Twin— a concept which combines **as-built** vehicle components, **as-experienced** loads and environments, and other **vehicle-specific characteristics** to enable ultrahigh fidelity modeling of aircraft and spacecraft or their components throughout their service lives.

Digital twin is a dynamic software model of a thing or system that relies on sensor and/or other data to understand its state, respond to changes, improve operations and add value.

It includes a combination of ...

metadata

condition or state

event data

analytics

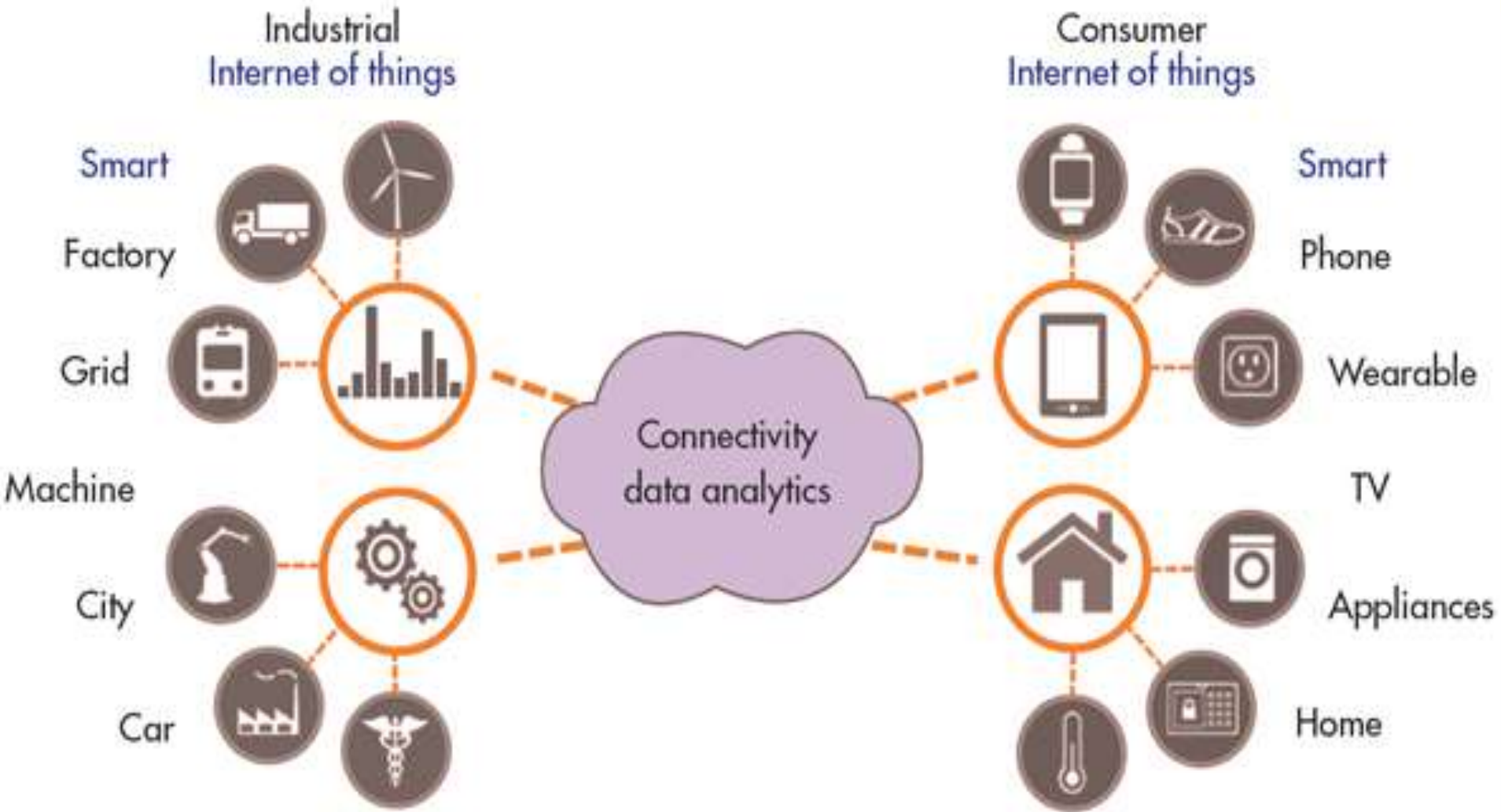


Can be used for Training

- A Digital Twin is a working model, of the products and processes being developed. Using a combination of simulation, cloud computing, animation and other technologies, product engineers and research and development (R&D) scientists can now visualize exactly how their new products would come to life without resorting to clay models, prototypes and the like.
- Also, the same platform can then be leveraged to mitigate the evergreen challenge of sales training, after-sales support and technician training once the products are in the market.

- Digital Twins can potentially slice away as much as 50% of product development time and costs. Salesforce and channel partner productivity can be dramatically increased, by as much as 25-33%, through the effective deployment of the platform for training and support purposes.

Industrial Internet of Things



EMERGENCE OF THE DATA ECONOMY

- A vast array of industrial machines — jet engines, power generators, pipelines, locomotives — increasingly are becoming connected through the Internet.
- With the amount of data generated by machine sensors rising exponentially, coupled with ever-more powerful Big Data analytics, the Industrial Internet has reached a critical tipping point. It requires industrial companies to adopt a digital mindset that embraces what the Industrial Internet can offer in new growth opportunities.

Digital Twin for MRO operations

- Technicians and operators can be presented with detailed MRO procedure steps, track time needed to complete the procedure, resolve service tickets with feedback from their side and also submit problems and remarks found during the device inspection.

USED FOR MONITORING, DIAGNOSTICS AND PROGNOSTICS

- Sensory data is sufficient for building digital twins
- These models help to improve the outcome of prognostics by using and archiving historical information of physical assets and perform comparison between fleet of geographically distributed machines
- Finding the root cause of issues and improve productivity.
- Its ability to deliver early warnings, predictions, and optimization is fairly universal.

Digital Twin At Work

- The need to service jet engines can be determined in advance, and furthermore helps plan ways to extend the use of the asset. After a plane spends much of its operational life in the dry, sandy air of the Middle East, this technology could suggest redeploying the plane in a different climate such as the Pacific Northwest, offering cooler, moist air to reduce risk of engine failure. Another option might be to reroute the plane closer to maintenance facilities that can regularly provide service.

LIFE CYCLE COSTING

- The idea behind the digital twin is to go further than working with models; the costs of maintenance versus replacing an entire asset are also considered.
- If a company orders jet engines, the revenue projections become part of the digital twin, along with the designs for the engines, specific materials used in construction, and information on the factory where they were built. When the engine starts up, and when it is serviced, sensors feed that data into the twin.

THE FUTURE OF DIGITAL TWIN

- What the digital twin produces, when bundling data with intelligence, is a view of the each asset's history and its potential future performance. This continuum of information leads to early warnings, predictions, ideas for optimization, and most importantly a plan of action to keep assets in service longer.
- It will be about sending commands to machines in response to those forecasts.

MEASURABLE BUSINESS OUTCOMES

- Reduced asset downtime and maintenance costs,
- Improved plant and factory efficiency,
- Reduced cycle times, and increased market agility

HUMAN

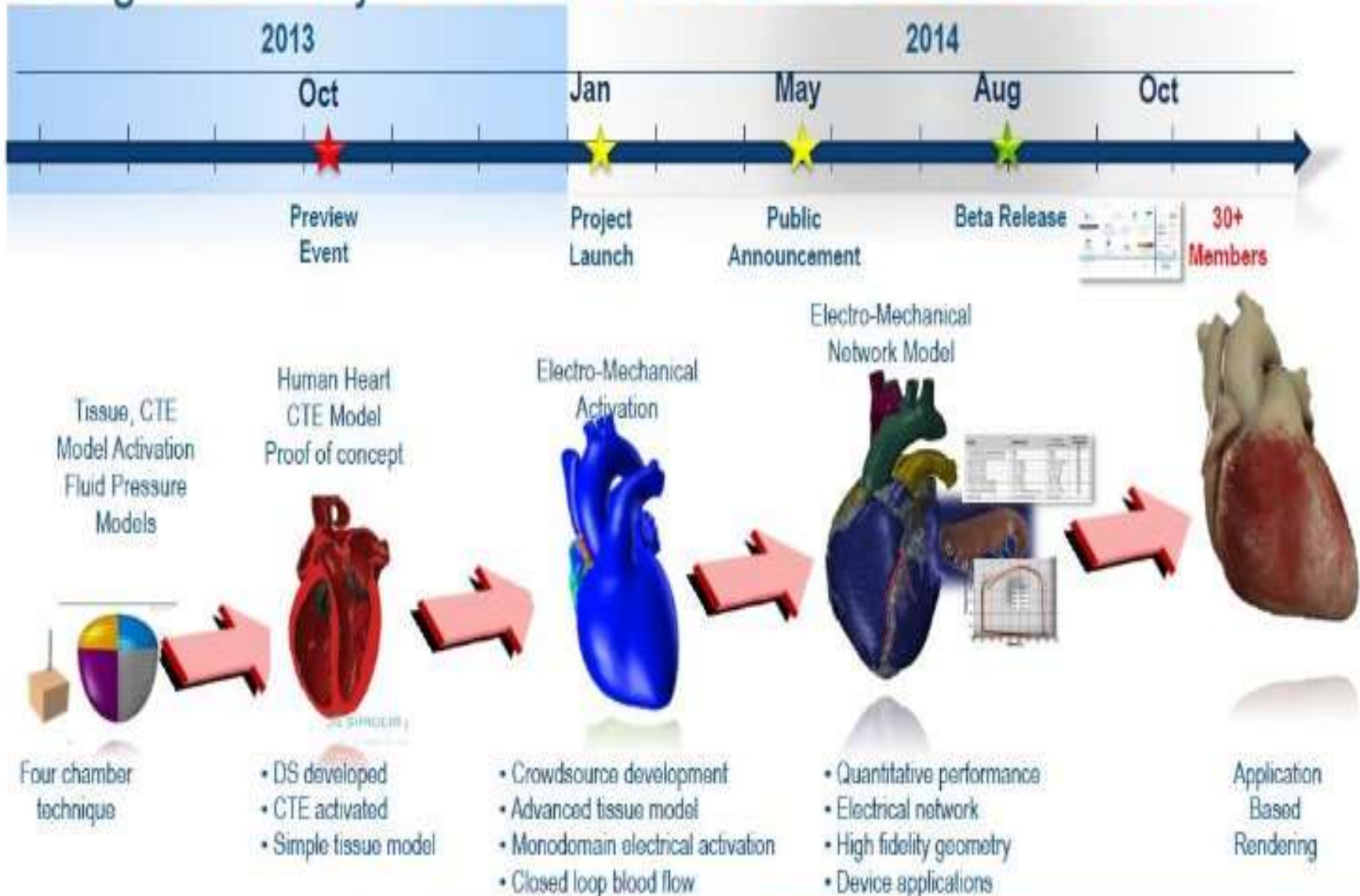
HUMAN DIGITAL TWIN



Digital Twins Revolutionize Strategic Planning in Healthcare

- By enabling massively-collaborative, data-driven and scenario-based decision making.
- Without a digital twin, leaders rely on tribal knowledge and basic analysis to plan new facilities and next year's budget for existing facilities. This is normal but it leaves much to be desired. With a digital twin, leaders virtually test changes to bed mix, bed algorithm, task assignment, floorplan, equipment, ALOS, model of care, staffing etc.

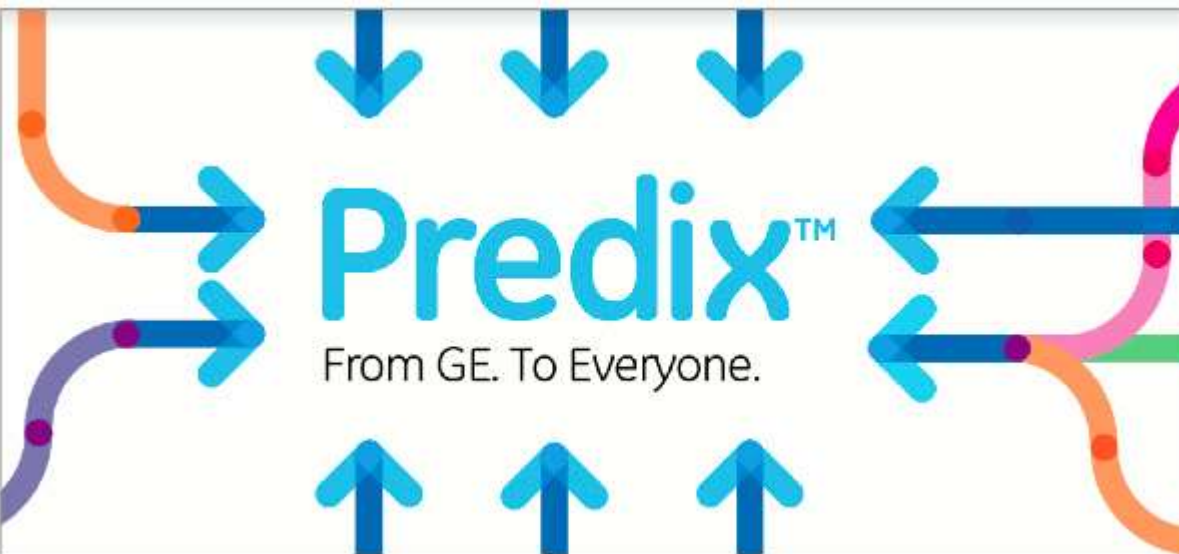
Living Heart Project 1st Year: Power of 3DEXPERIENCE



DIGITAL TWIN OF THE HUMAN

- Can be built organ by organ.
- If successful, it can enable comprehensive digital twin tracking of an individual from birth to death. This will pave the way for a highly personalized diagnostics model capable of predicting upcoming illnesses, recommending life style or dietary changes, and even calculating the age of death. This, in turn, can help find solutions to extend life through a healthier lifestyle or early intervention treatments.

Tools



SIEMENS



DASSAULT SYSTEMES
The 3DEXPERIENCE® Company

3D Design
V3

3D DMU Digital Mock-up
V4

3D PLM Product Lifecycle Management
V5

3DEXPERIENCE
V5

The block contains four distinct visual elements: a small 3D model of a mechanical part (V3), a green 3D model of an airplane (V4), a silver 3D model of a sports car (V5), and a circular logo with a play button and the text "3D V+R 3DEXPERIENCE" (V5).

PTC
Creo
ThingWorx

The block shows a man riding a bicycle on a stationary bike. In the background, there are two computer monitors. The top monitor displays the PTC Creo interface with a 3D model of a bicycle. The bottom monitor displays the ThingWorx interface with a 3D model of a bicycle. Below the monitors, there is a diagram showing the integration of various PTC products: ThingWorx, Internet of Things, Axeda, vuforia, and COLLABORATE.

Digital Manufacturing and Design Innovation Institute (DMDII)

- US federally-funded research and development organization
- Project call to demonstrate technologies that can provide real-time, dynamic visibility (or digital twins) from all supply-chain participants



DMDII

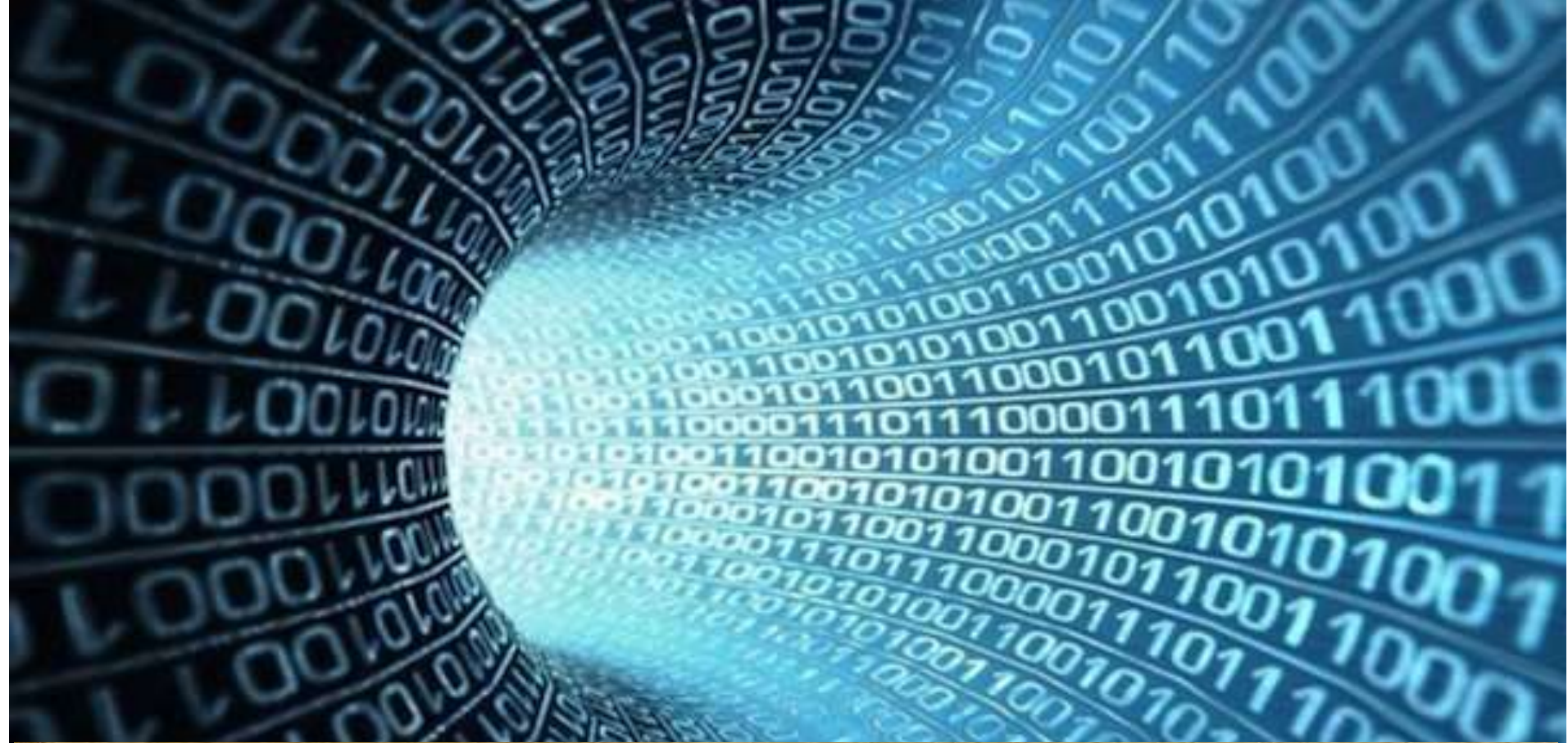


ManufacturingUSA™

Digital Wind Farm

- THE NEXT EVOLUTION OF WIND ENERGY

- Optimizes turbine performance and equipment life through the use of Predix*, a predictive analytics software platform.
- Predix provides a digital infrastructure for the wind farm, enabling us to collect, visualize and analyze unit & site level data. Through the constant collection of real time data—weather, component messages, service reports, performance of similar models in GE's fleets—a predictive model is built and the data collected is turned into actionable insights. This model can perform advanced planning, such as forecasting a 'plan of the day' for turbine operation, determining a highly efficient strategy to execute planned maintenance activities, and providing warnings about upcoming unplanned maintenance events, all of which ultimately generates more output and revenue for the customer.



Do you have any
questions? Thank you
for your attention