



# Unwrapping Inspection's Digital Thread

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# The Challenge

How can we get the most out of existing assets?

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- Manufacturing improvements, new materials, new revolutionary designs all contribute to the growth and improvement of the Aviation industry
- But are there other methods, too? Has all of the improvement been “unlocked” in current designs and materials? Processes and people?
- No, which is why the **Digital Thread** can be used to make leaps in improvement and profitability without necessarily investing in new technologies



# What is the Digital Thread?

Buzzword, or Disruptive Technology?

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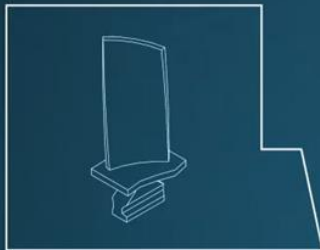
- **Digital Thread** *seamlessly integrates information through the value chain – from initial capability planning and analysis, through design, manufacturing, testing, and on to final sustainment and disposal phases – meaning that specialists throughout the process can work on the item simultaneously to inform decisions through the life of a system or product*

**Data gathered throughout the application life can be analyzed to improve design, manufacturing and operations processes – in near real-time**

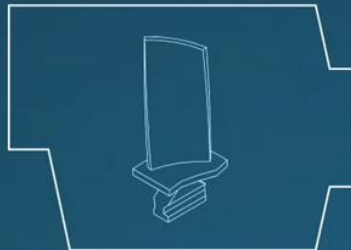


# What is the Digital Thread?

## Planning



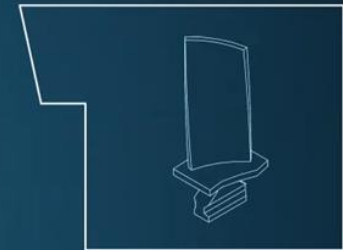
## Design



## Production



## Services



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# Digital Thread Use Case

## Where can I apply Digital Thread?

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- A routine inspection of an engine reveals an anomaly on a single airfoil
- This feedback is uploaded to a central location where it is noted that there are two other similar occurrences on the same engine type
- Data from the three engines and aircraft is correlated for similarities in parts origin, maintenance records, operations, environment, etc.
- Is there a way to find a common cause? How quickly can it be remedied? Can this be used to **prevent** other occurrences?



# Consumer vs. Industrial Internet

## Consumer

- Ford pickup
- Double-cab
- Manual Transmission
- Blue
- Within 100 miles of my current zip code

**(30) results in 5 minutes**

## Industrial

- Jet engine powerplant
- Single-aisle variant
- Stage 1 HPT blade replacement in last year
- Greater than 5,000 hours
- Inspection thread

**Today: Manual process**





# Digital Thread Relies on DATA...

...and doing something with it

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1. Gather/Save the Data
2. Structure Data
3. Aggregate Data – Cloud, Data Lake
4. Search, Analyze, Compare Data
5. Make predictive and reactive adjustments

**“Get connected, Get insights, Get optimized”**

**Cloud solutions**





# What is Predix anyway?

As iOS is to phones/tablets, Predix is to the Industrial Internet...

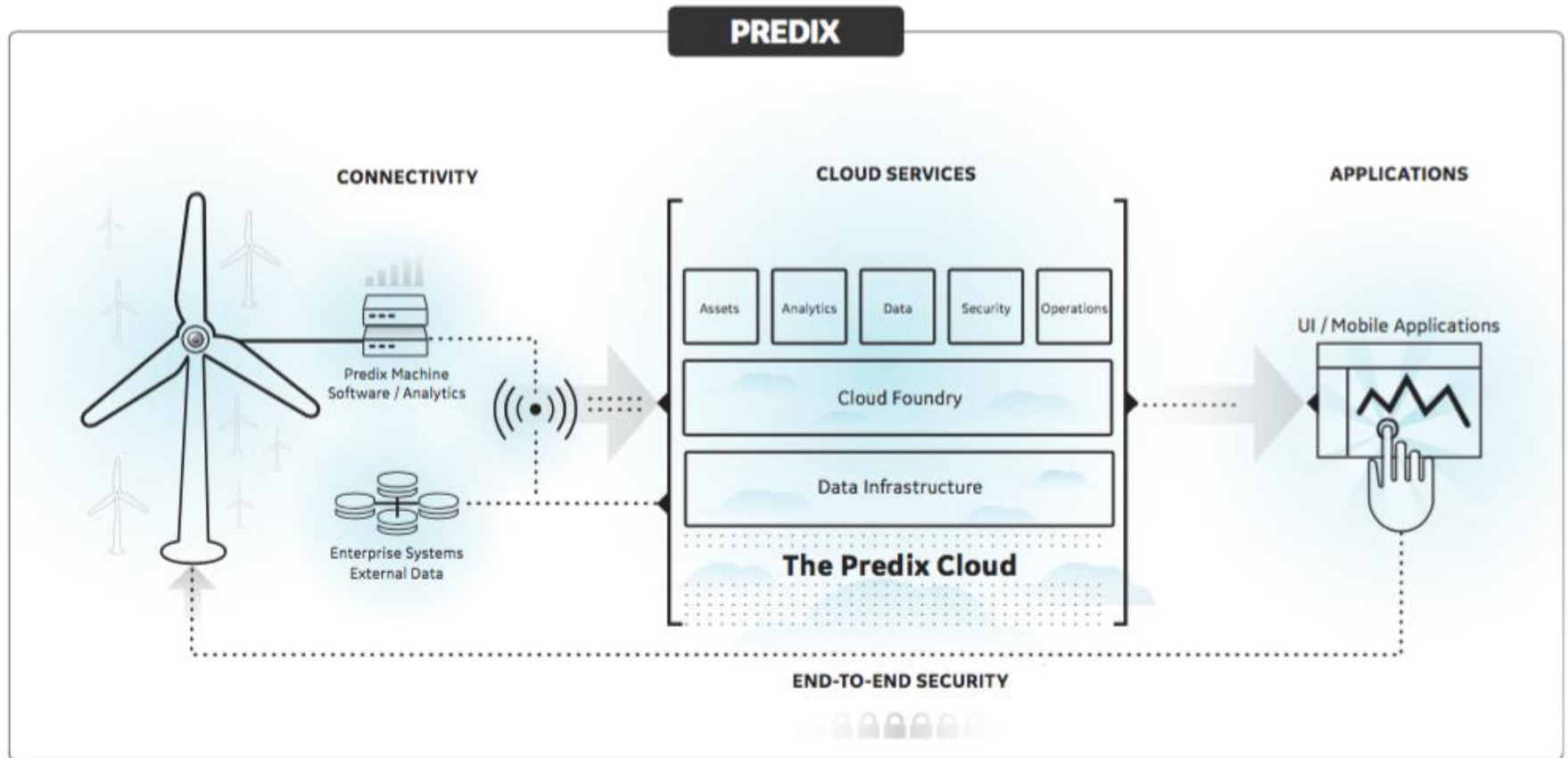


Predix



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# Predix Architecture



## Connect machines

Collect key industrial data from your machines and stream it to the Predix cloud.

## Implement services

Leverage services and development tools, so you can focus on solving problems for customers.

## Deliver and scale apps

Use the Predix cloud to deploy scalable services and end-to-end apps in secure environments.





How Can I Get  
Started With BSI?

# InspectionWorks Insight - Organize

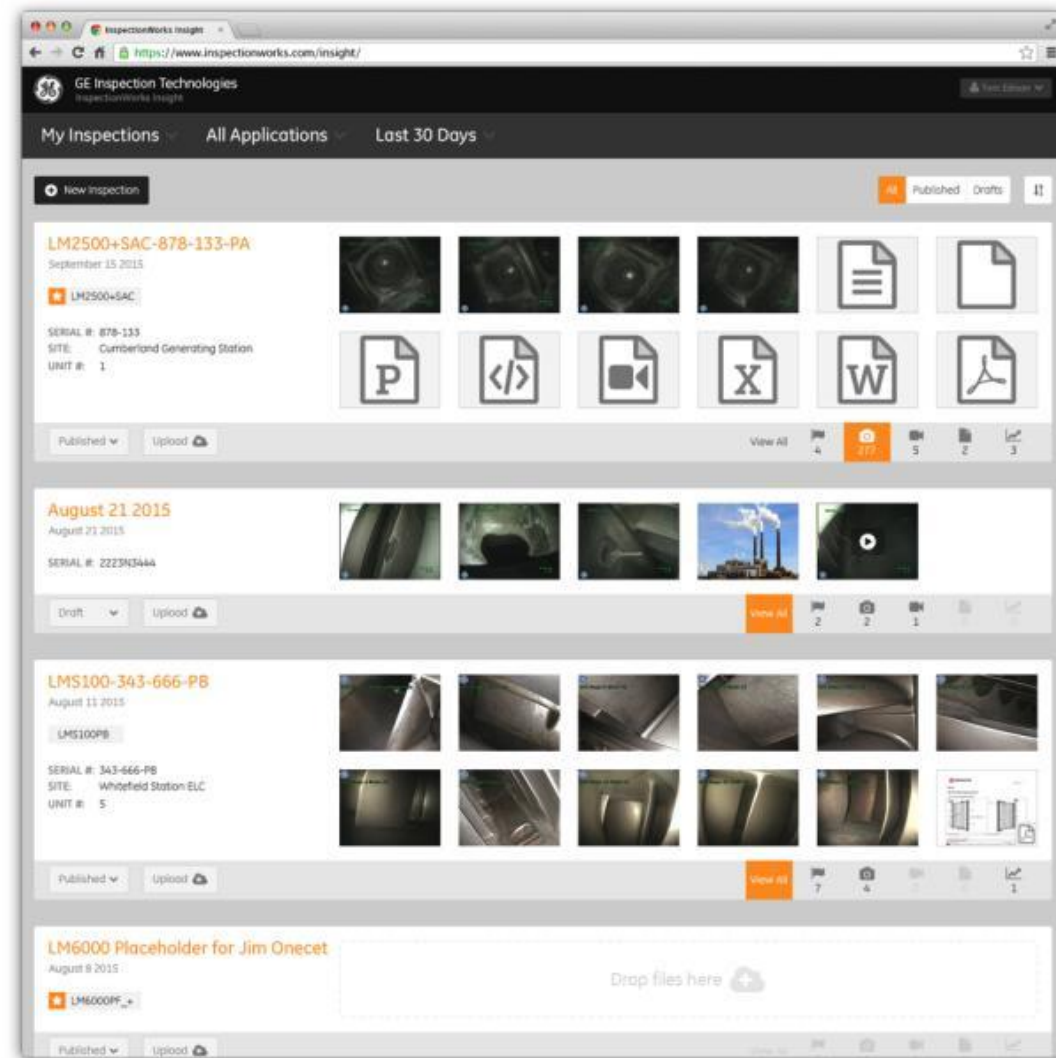
*Insight provides tools to quickly organize your inspection data, no matter the source.*

*Inspection applications built in, allowing you to apply structure (metadata) to raw content*

*Organize by date by default when there is no additional metadata*

*Menu Directed Inspection support to interpret MDI based datasets*

*Supporting data as part of the application allowing you to add conclusions, findings and*





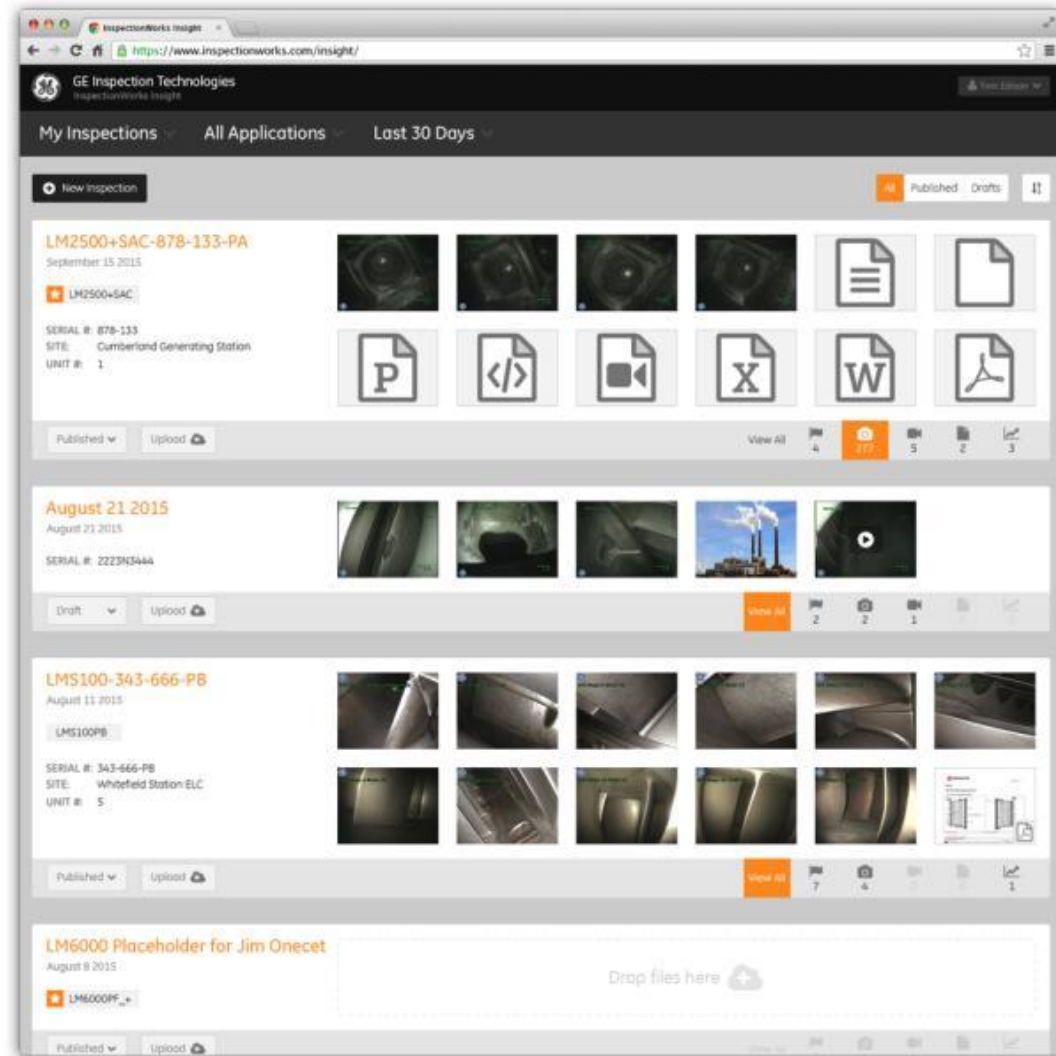
# InspectionWorks Insight – Filter/Find

*Insight provides tools to quickly filter and find the data your looking for through our web application.*

***Filter** inspection data by “My Inspections/All Inspection,” by Application (LEAP) or by Date*

***Filter by object type** such as flagged images, reports, images, videos*

***Find & Search** using the metadata you’ve applied, use text based search to quickly find what you’re looking for (ESN, Technician Name, etc.)*



# InspectionWorks Insight – Report/Share

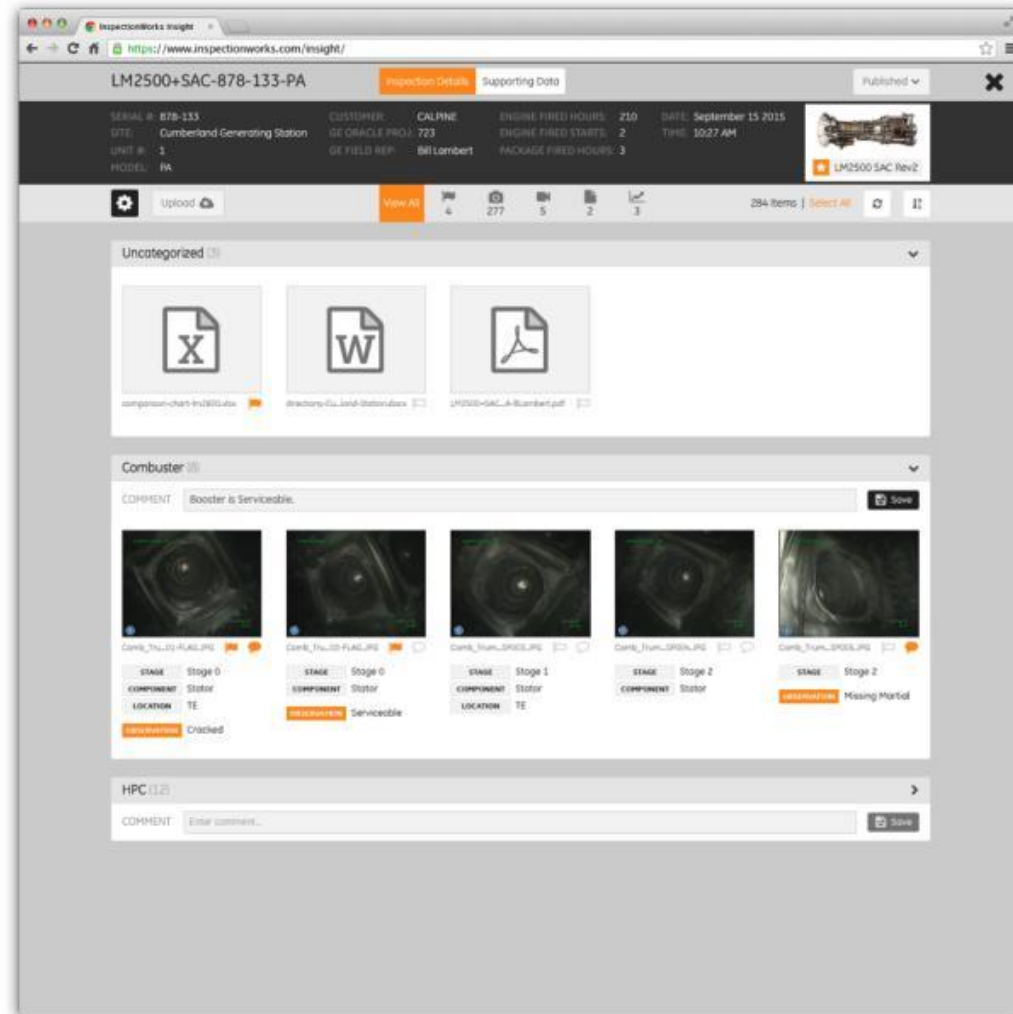
*Quickly generate custom reports and share your completed inspections with others.*

**Custom reporting** engine allowing you to generate reports based on application type or other attributes. Supports MS Word and Adobe pdf

**Managed report templates** within the environment, meaning we'll handle versioning and maintenance for you. Update once, everyone gets the latest version

**Publish** data to share with others in your organization

**Send email notifications** directly from the Insight environment



# Digital Thread Use Case - Conclusions

Compare the digital threads to find commonalities

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- Possible conclusions:
  - **DESIGN** - All three engines airfoil sets were of a new design, which allowed for overdrilling detection to be masked by current detection methods
  - **PRODUCTION** – Airfoils were manufactured on second shift, where an optional shift-change calibration procedure was being overlooked
  - **POINT OF USE** – Pilot variation
  - **OTHER** – FOD from a sand storm in Dubai two weeks earlier





# The Digital Thread Process

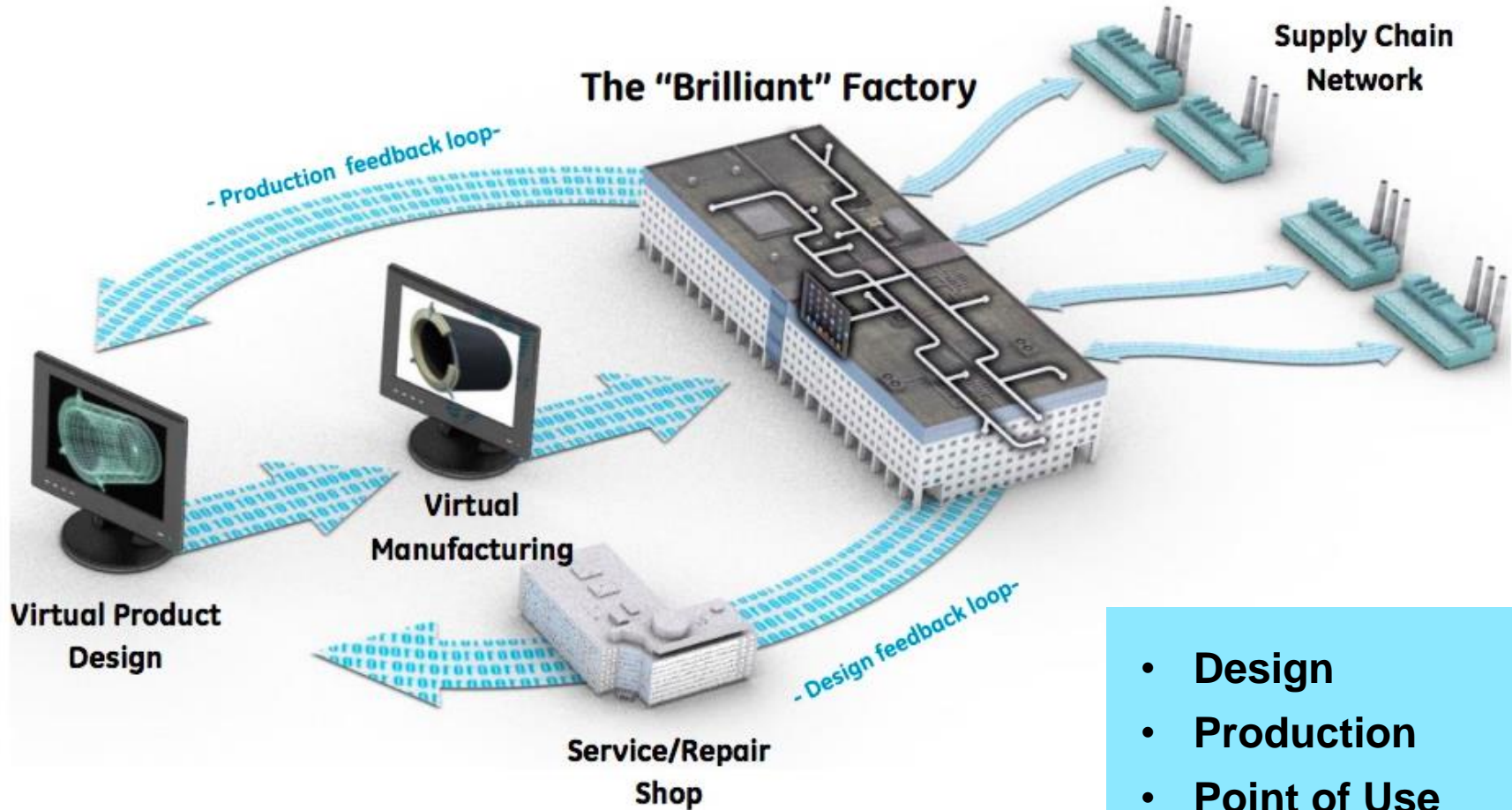
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- Save your inspection data!
- Standardize data-gathering processes
- Tag and index the data in a common format
- Aggregate the data in the cloud
- Build apps
- Improve
- Repeat





# Digital Thread Feedback Loops



- Design
- Production
- Point of Use



# Predix Solutions

Where is Predix used?

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- **Monitoring of industrial equipment** for availability and secured operations
- **Predictive analysis** to prevent unplanned downtime or equipment failures
- **Economic optimization** by efficiently operating industrial assets and fleets
- **Intelligent process automation**, such as in manufacturing or transportation
- **Sustainability solutions** for reducing environmental impact of operations



# Predix Catalog

Services

Analytics

Filter Categories

## Services and Software

Use these key industrial services to build, test, and run your innovative Industrial Internet applications.

### EDGE SOFTWARE AND SERVICES

#### Connectivity

Easily apply this plug-and-play, secure, and reliable connectivity service.

PREDIX

#### EdgeManager

Use the EdgeManager as a single point of entry for deploying and monitoring devices remotely.

PREDIX

#### Machine

Create solutions that enable machine-to-cloud, machine-to-machine, and machine-to-human connectivity.

PREDIX

### DATA MANAGEMENT

#### Asset Data

Create and store machine asset models and instances.

PREDIX

#### Event Hub

This industrial-grade messaging system (in beta) handles high-velocity event data, workload data, or other streaming data.

PREDIX

#### Time Series

Quickly and efficiently manage, ingest, store, and analyze data.

PREDIX

#### SQL Database

Store data securely, support best practices, and facilitate retrieval at the request of other software apps.

PostgreSQL

#### Blobstore

Use this binary large object storage (BLOB) to securely store large byte arrays and retrieve

#### Message Queue (AMQP)

Use this scalable, high-performance, multi-protocol tool to message between apps

#### Key-Value Store

Use this open-source key-value cache and store that can contain strings, hashes, lists

# Predix Catalog

Services

Analytics

Filter Categories

## Analytics

Predix provides analytics services as a framework for developing and embedding advanced analyses in business operations. This means you can better manage the execution of analytics through configuration, abstraction, and extensible modules.

### ANOMALY DETECTION

#### Trend Anomaly Detection

Manage critical time series trend detection.

PREDIX

#### High-Dimension Anomaly Detection

Check multiple sensors for key time series anomaly detection.

PREDIX

#### Low-Dimension Anomaly Detection

Maintain machine health with this critical time series anomaly detection.

PREDIX

#### Shift Anomaly Detection

Enable key time series shift detection.

PREDIX

#### Univariate Anomaly Detection

Improve time series rates-of-change anomaly detection.

PREDIX

#### Temporal Anomaly Detection

Assure accurate and highly detailed time series anomaly detection.

PREDIX

#### Kalman Anomaly Detection

This service identifies statistical anomalies in noisy data.

PREDIX

### RELIABILITY ENGINEERING

#### Machine Survival Analyzer

Find reliability or survival probability at a given time or length of time.

# Analytics-Past, Present and Future

Why pursue a Predix data-driven model?

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- **Descriptive analytics**-describe what's happening
- **Prescriptive analytics**-what happened and how to remediate it
- **Predictive analytics**-use data to foresee what will happen and to act in advance to optimize outcomes even further

**Data analysis unlocks additional performance  
hiding in existing assets**

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**[predix.io/resources](https://predix.io/resources)**

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