PREDIX

Digital Twin Runtime Starter Kit

A Digital Twin is a collection of formulas, algorithms, data, and advanced analytics that compute present and future states of specific physical assets. At the core of any twin are the elements referred to as “models” that calculate and simulate the behaviors of a specific physical asset or larger system of assets. For example, these models can describe thermal, mechanical, electrical, chemical, fluid dynamics, material, economic, statistical and many other characteristics. These models can also represent the influence of many operational and economic factors including fuel mix, quality, temperature, humidity, load, stress, weather, market demand, and supplier pricing.

The Starter Kit on Github.com

The starter kit tutorial is intended to be used by software engineers. It will guide you through an example Digital Twin use-case scenario. It explains each of the 5 steps and describes how to build a Digital Twin application. The kit provides examples of data sources, a model, orchestration services, and a sample application. The kit also contains definitions and criteria of a Digital Twin. Simply bring your model and data to get started!

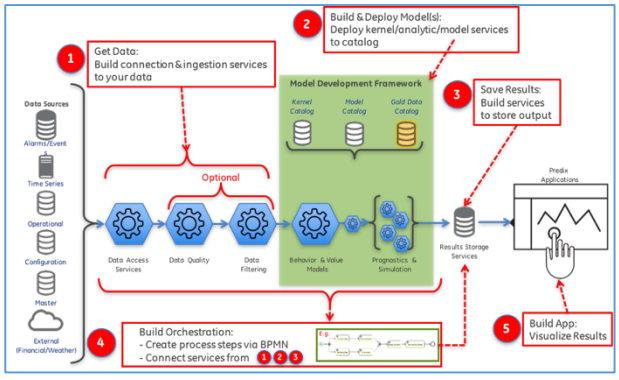
Scan the code or use the URL to go directly to the Kit on Github.
`https://github.com/DigitalTwin/steam-turbine-tutorial/blob/master/README.md`

The Runtime Starter Kit 5 Steps

Digital Twin and Predix Runtime Framework are the foundation on which the core elements of the Digital Twin are built. These Digital Twin elements are represented by the 5 Steps of the Digital Twin Runtime.

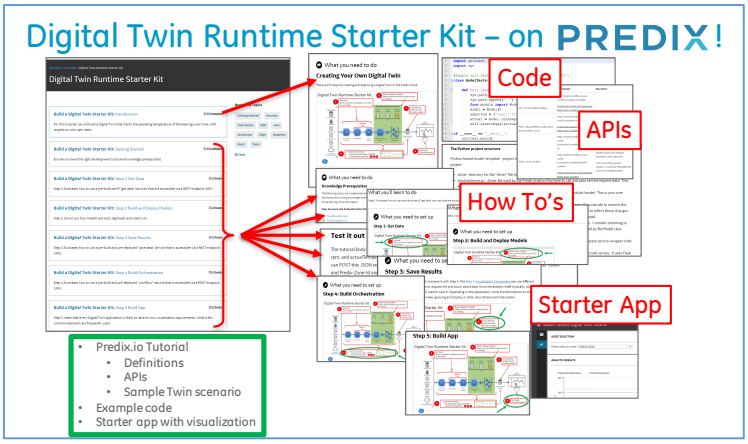
This 5 Step process relies on:

1. The Predix infrastructure that contains the tools needed to support constructing and hosting Digital Twins.
2. The 5 Steps to define the major components needed for constructing a Digital Twin.
3. Your model and data to complete your Digital Twin.



The Digital Twin Runtime Framework

The Digital Twin Runtime Framework supports the 5 step process and provides the needed enterprise architecture to enable:



- Stability at Scale
- Auditing & Governance
- Security
- Complex multi-model orchestration

Digital Twins are by definition processes that run automatically, as scheduled, or in response to an event or trigger. To support continuous and semi-continuous runs, the 5 steps define several key points to which Digital Twins need to conform.

The Digital Twin Runtime in combination with the Predix platform provides the needed infrastructure to create, host, and maintain Digital Twins for all your assets. The following example illustrates the need for building a Digital Twin to better understand the operation of the asset, reduce costs, and improve efficiency.

Tutorial Scenario: A Steam Turbine Rotating Shaft

The Digital Twin Starter kit uses the steam turbine rotating shaft damage model as the sample Digital Twin application. Steam turbines have a rotating shaft component called a rotor which spins at different rates of speed, depending on operating conditions. The rotor sits on a set of bearings that

enable the rotor to spin in place with minimal friction, thereby assisting in the overall efficiency of the turbine. Over time the weight of the rotor pressing on the bearings, plus the friction of the rotor spinning against the bearings, causes the bearings to heat up, wear, and degrade to the point where they fail causing damage to the rotor. As bearings degrade, friction increases, causing the operating temperature of the bearings to increase leading to additional wear. Faster rotor spin rates on degrading bearings can contribute to significant temperature increases and damage. Replacing a damaged rotor in a turbine is extremely costly; thus the ability of the Digital Twin to predict asset failures reduces unplanned downtime, can extend the life of the asset, and improves operational efficiency.