Digital Twin for CPSS

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Introduction

- It is a digital representation of a physical object, person, or process, contextualized in a digital version of its environment.

- It helps an organization to simulate the real situations and their outcomes for better decision making.

Use

- Optimization
- Identify Flaws
- Improve Quality
- Real-time Adjustment
- Testing and Training Platforms

Stages of Building

- *Create a blueprint*.
- *Build the base digital twin*.
- *Boost capabilities*.

The concept of digital twins was first put forward by David Gelernter's 1991 book 'Mirror Worlds,' with Michael Grieves of the Florida Institute of Technology going on to apply the concept to manufacturing.

By 2002, Grieves had moved to the University of Michigan when he formally introduced the digital twin concept at a Society of Manufacturing Engineers conference in Troy, Michigan.

Design Digital Twin

- Data
- Model
- Linking

Security Considerations

- Intrusion Detections
- Allow security analysts to identify unused network services by first recording the network traffic while simulating plant operation and then mapping the captured traffic flows to the specified services.
- Attack Response Mechanisms
  - Proactive
  - Reactive
- Hardware and Software Misconfiguration

Life Cycle

- 30 or More years for Industrial Control System.
- Secure Decommissioning [including the digital twins].
- Security and Legal Compliance

Digital Twin Vs Simulation

	Digital Twin	Simulation
Purpose and Scope	In-depth, includes real-time feedback and realistic physics	General term, often lacks depth and complexity
Data Integration	Instantaneous, real-time data from physical counterparts	Varies, not always real-time
Real-Time Updates	Constantly updated in real-time	Can be static, not necessarily real-time
Realistic Physics	Uses realistic physics	May or may not use realistic physics
1-1 Representation	Direct digital replica of a physical entity	Not always a direct replica
Implementation	Complex, requires high-quality data and precise structure	Generally simpler, varies widely
Static vs. Dynamic	Dynamic, constantly learning and updating	Often static, doesn't use time as a factor
Applications	Many applications across various industries	Can take many forms, including gaming and training
Complexity	High complexity	Generally less complex
Decision-Making	Effective for real-time stakeholder decisions	Predicts potential outcomes, less effective for real-time decisions

https://digitaltwininsider.com/2024/06/05/digital-twin-vs-simulation-understand-the-key-differences/