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Digital Twin and Industry 4.0 in support of Heliostat Technology Advancement

Tietronix Software

HelioCon Project

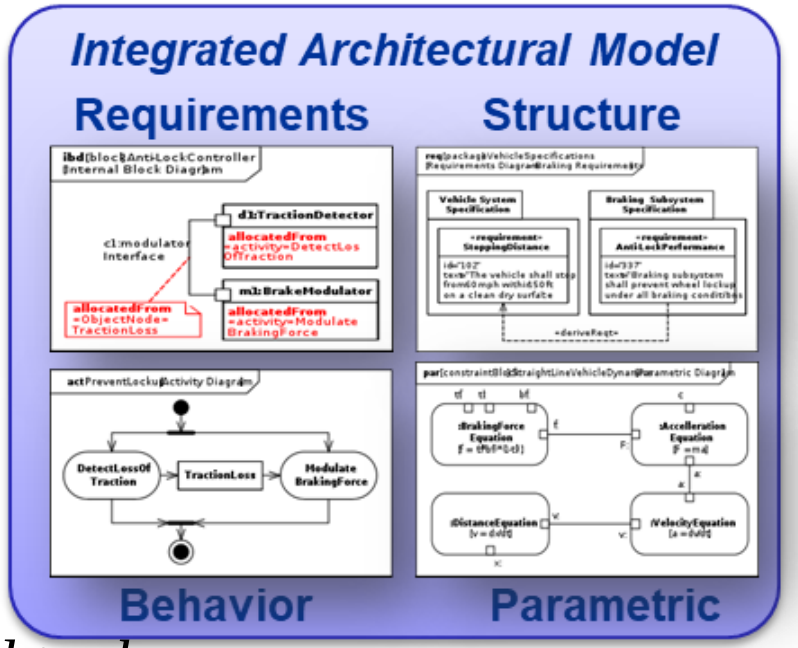
July 12th, 2023

Objective

- Project aims to apply multiple technologies from the Industry 4.0 to the heliostat design, manufacturing, deployment and operations in order to realize the cost reduction seen by other industries which have adopted these technologies.
- Industry 4.0 technologies:
  - *Model Based System Engineering (MBSE)*
  - *Digital Twins*
  - *Machine Learning*
  - *Industrial Internet of Things (IIoT)*
  - *Virtual and Augmented Reality*

MBSE

- Models use common data sets
  - *Provides a consistent view of the architecture*
  - *Can lead directly to system specifications & test plans*
  - *Reduces systems integration and testing risks*
  - *Promotes traceability*
  - *Makes it possible to identify gaps and overlaps*
  - *Facilitates model reuse and integration*
- Uses a standards-based modeling language
  - *Defines architectures that can be simulated with standard tools*
  - *Models can be used with many standards compliant automation tools*
- Automation tools are used to generate artifacts
  - *Less labor intensive to generate & update*



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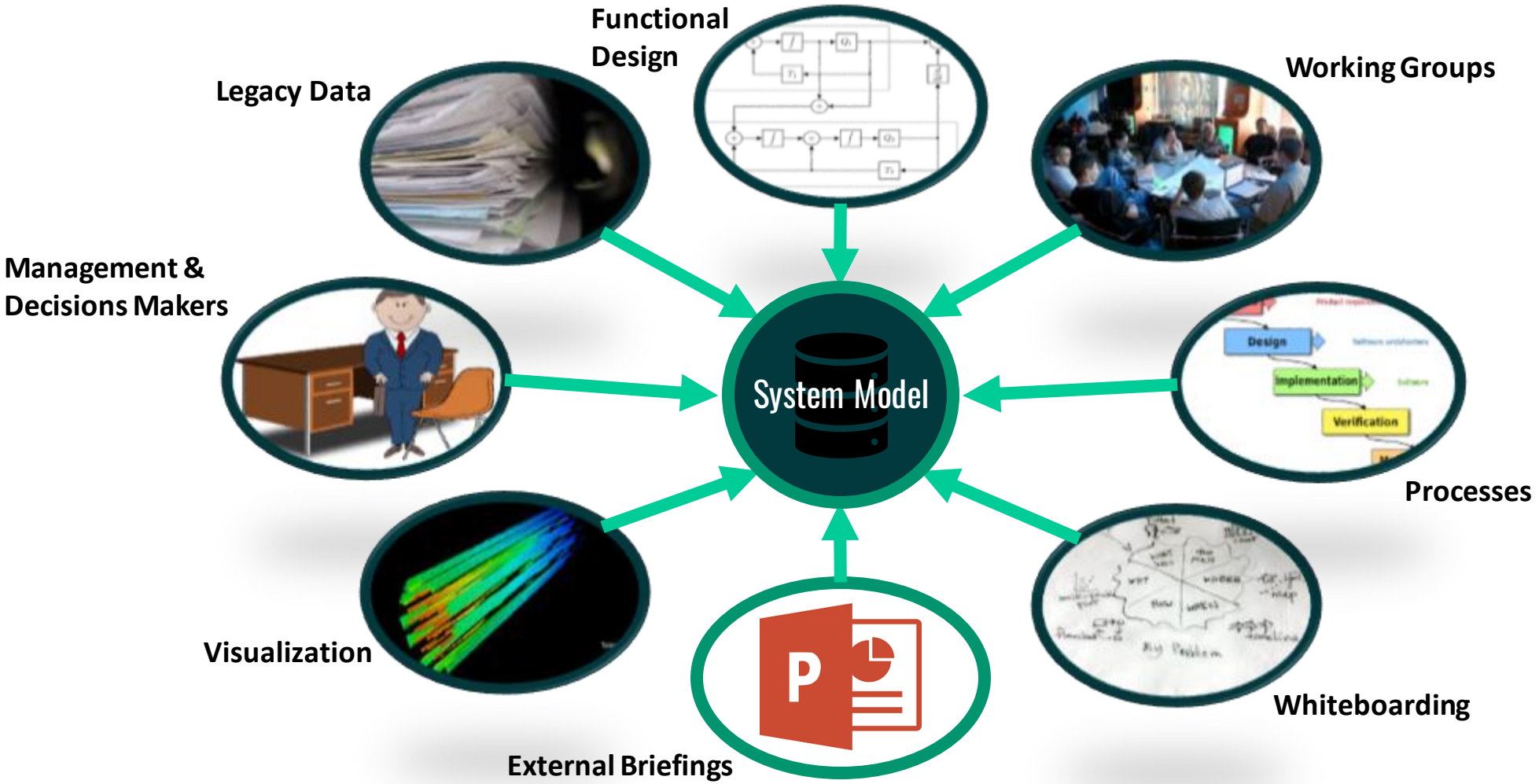
Data as a single source of truth

Inputs from multiple streams



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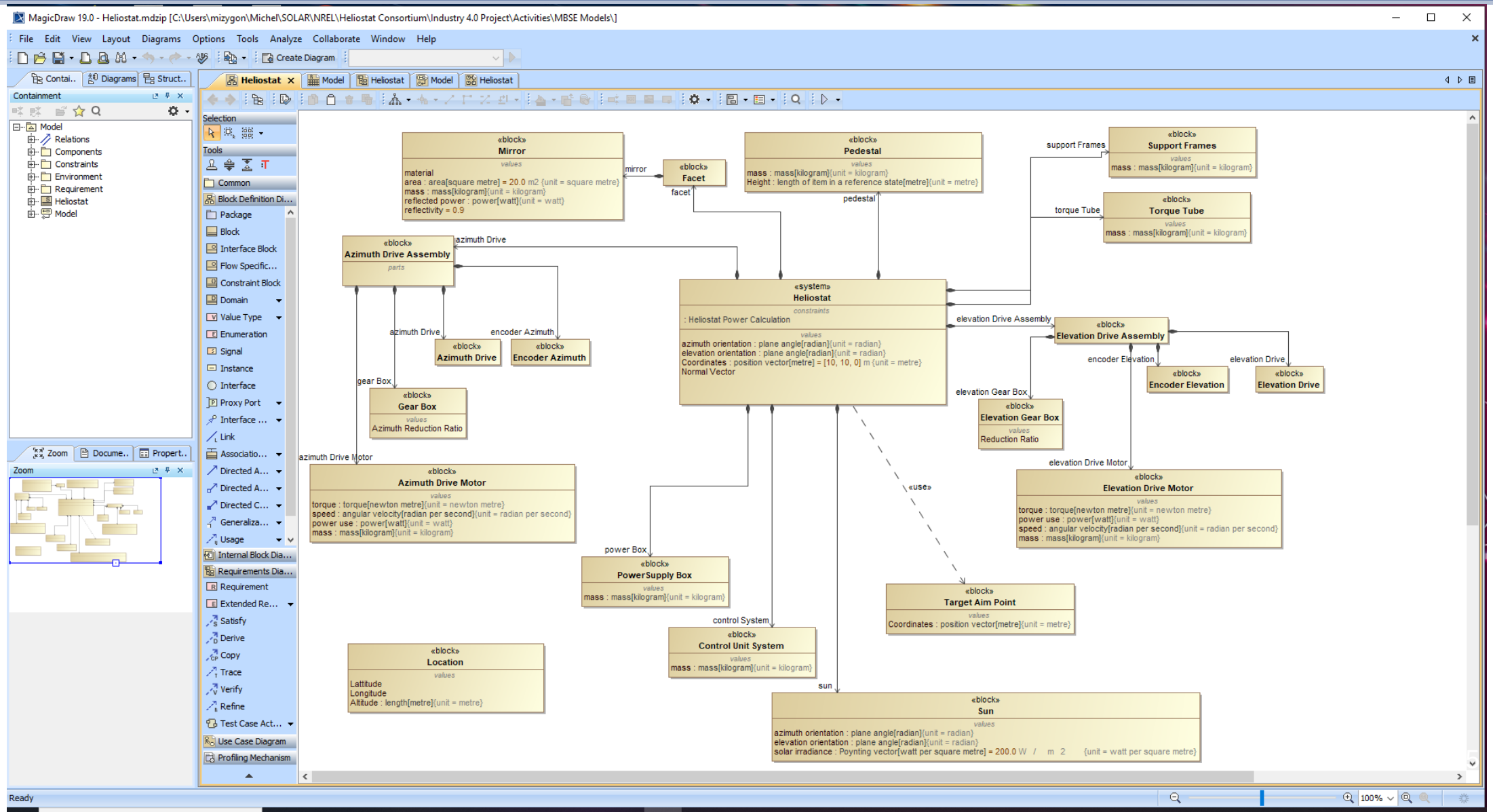
Modeling Heliostat



Digital Twin

DT is a virtual model, designed to accurately reflect a physical system that enables better understanding, prediction and collaboration of the physical system throughout all phases of the lifecycle

- Tenets of a DT:
  - *An immersive environment that allows stakeholders to collaborate through a common visualization and interaction platform throughout the system lifecycle*
  - *Connect IoT sensory data to the virtual model to gain insights, to generate possible improvement in the design and to apply back to the actual system during design*
  - *Connect systems telemetry and commands to the virtual simulation model to perform "what-if" scenarios and design trade studies to assess margins, impacts during operations*
  - *Access system data (schematics, 3D CAD, simulations, procedures, FMECA, fault trees, Anomaly Reports, IFI history) to support design trade studies, analysis and predict anomalies and real-time decision making.*
  - *Collect and ingest operational archive data to update/train the virtual model with data mining and machine learning technologies.*
  - *DT is used for VR/AR Training and AR for operational procedures development verification*

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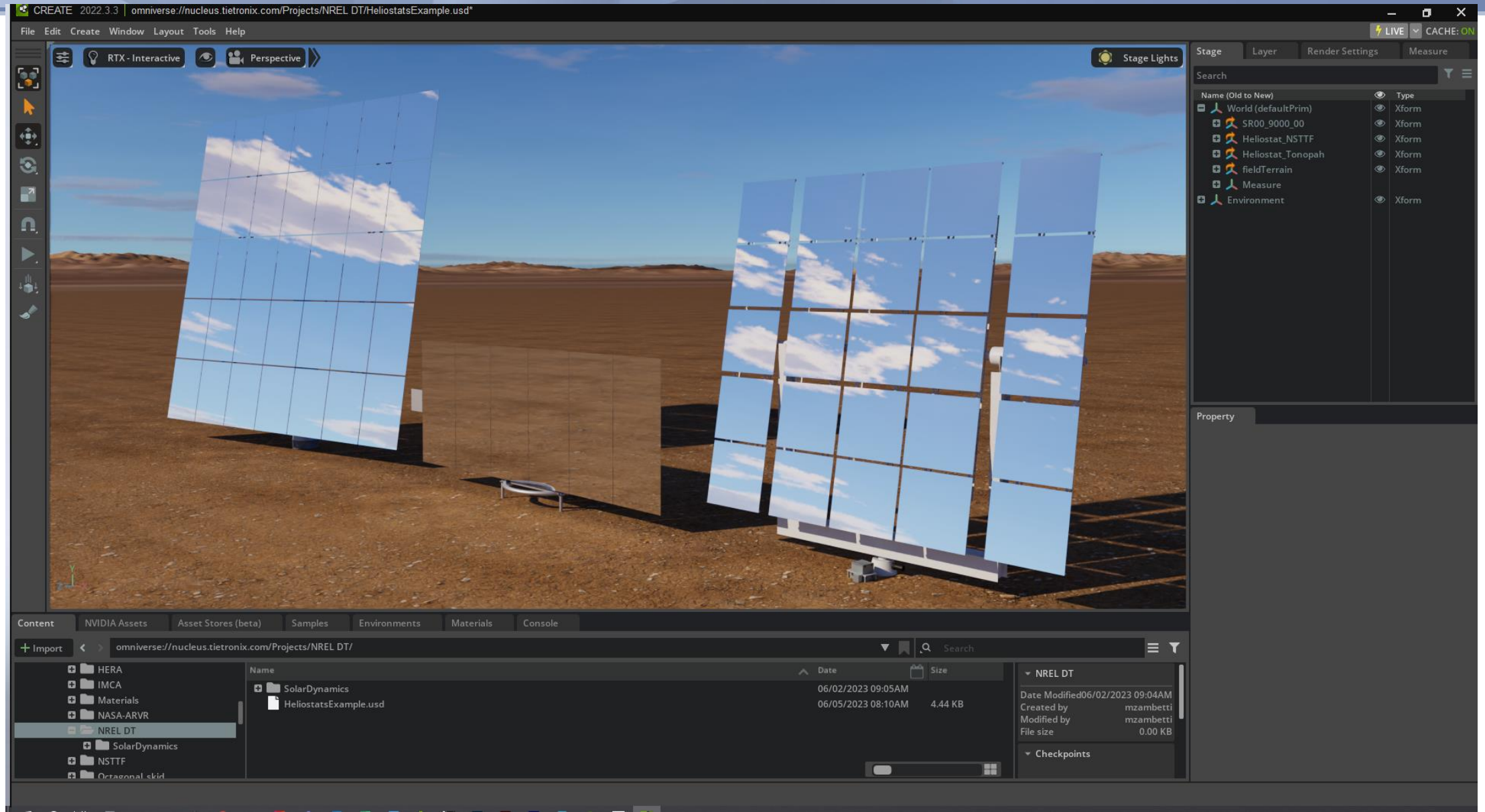
Initial Digital Twin prototype



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Initial Digital Twin prototype