


The Process of Smart Manufacturing

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A satellite view of the Earth at night, showing the illuminated continents of North and South America. The lights from cities and towns are visible across the landmasses, creating a glowing pattern against the dark background of the planet and space.

Accelerating
Your Smart Manufacturing Transformation

Overview

- What is Smart Manufacturing?
- What is the actual process to “DO” Smart Manufacturing?
- The “Nuts and Bolts” of the SM Process and the SM Platform™



What is Smart Manufacturing?



Monetization of Manufacturing Data: Creation of the “Connected Enterprise”

By

- Leveraging connectivity – IIOT enabled systems
- Moving away from “Run-to-Failure” to “Predictive, Reliability-Centered” operations
- Performing Business/Financial/Energy Optimization at all levels of the enterprise value-chain
- Taking advantage of existing/legacy investment

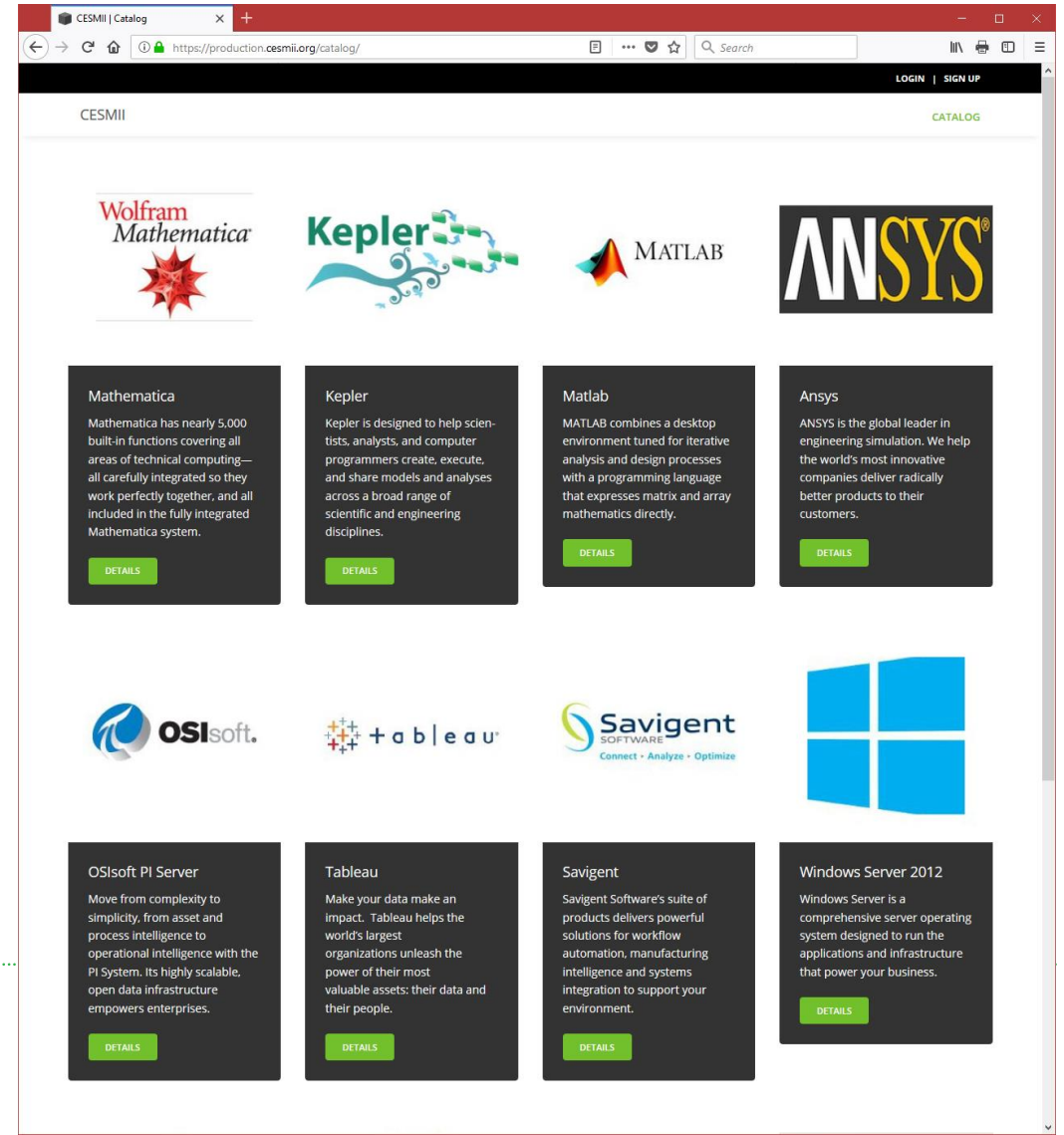
SM enables the **right information** and **right technology** to be available at the **right time** and in the **right form** to the **right people**

The Smart Manufacturing Process

What is Smart Manufacturing?

- The right data at the right place at the right time to make the right decision

- Data Acquisition
- Data Contextualization
- Data Aggregation
- Data Analytics and Models
- Data Presentation





Smart Manufacturing Process Explained



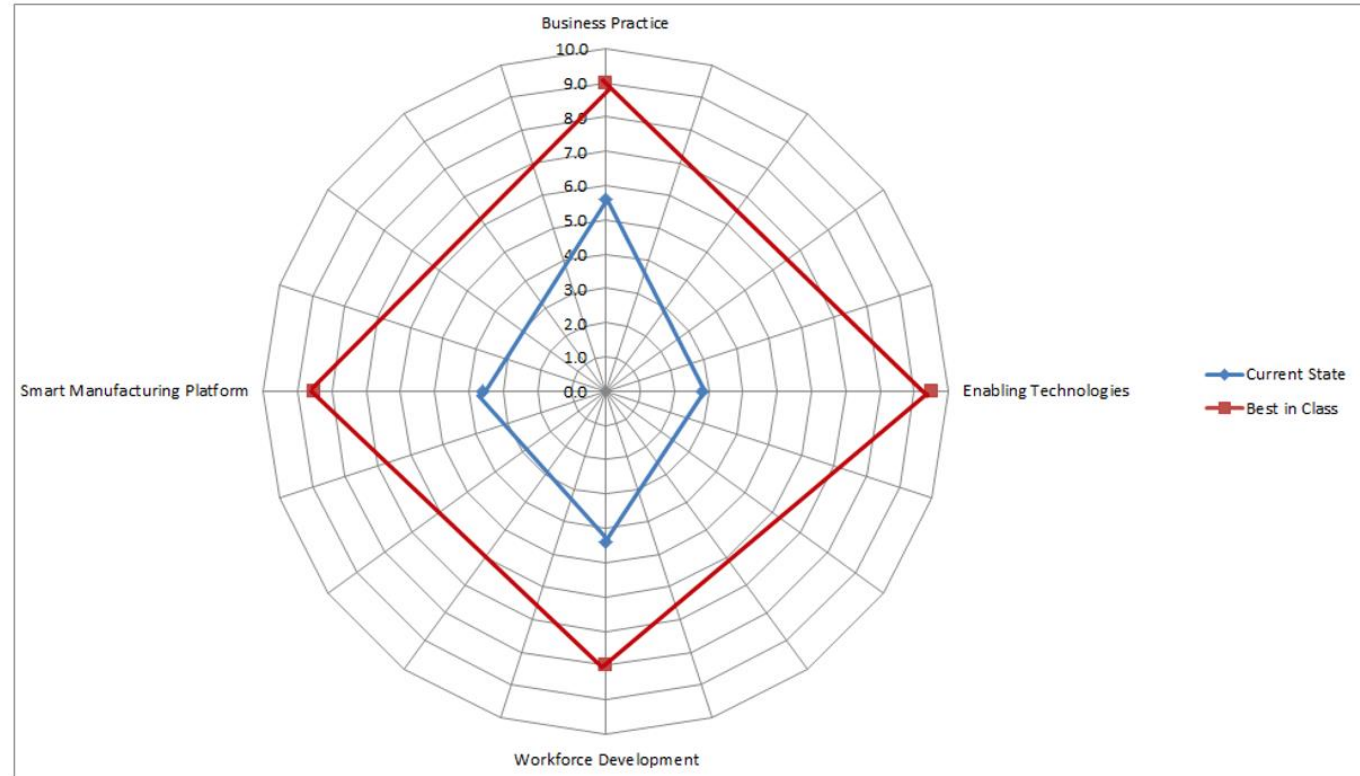
Getting Started with Smart Manufacturing

- Smart Manufacturing starts with a problem
 - Economics: How can we do things better to get increased value?
 - Management: How can we better manage our supply chain?
 - Quality: Can we maintain quality while reducing costs?
 - Energy: Can we reduce our energy costs/footprint without reducing production?
- Process
 - Determine readiness of enterprise to adopt SM
 - Identify stakeholders and how they are affected
 - Identify issues with current solutions (if they exist)
 - Determine how the use of data can enable solutions
 - Identify measurable goals/outcomes desired

Assessing Enterprise Readiness for SM

Assess Enterprise along CESMII technology roadmap factors:

- Business Practices
- SM Platform Readiness
- Enabling Technologies
- Workforce Development



A Discrete Manufacturing Use Case



Rob is in engineering operations at a medium sized manufacturer responsible for product quality and energy use of the manufacturing process.



Rob needs to shorten the time needed to achieve and verify workpiece batch quality in their manufacturing processes and to optimize energy used during the processes.

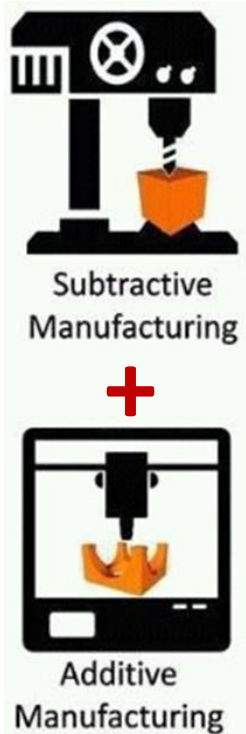
Defining the SM Requirements

- A SM Project has to be defined within the context of the problem you are trying to solve:
- Physical resources
 - Is problem centered at one location or multiple?
 - Are links currently available between resources/locations?
- Data
 - What data is currently available?
 - What data is required but not currently available?
 - How will data be used/presented?

Defining the SM Requirements (Continued)

- A SM Project has to be defined within the context of the problem you are trying to solve:
- Tools
 - What SM tools are desired and how will they be used?
 - How will marketplace tools be implemented?
- Results
 - What outcomes are desired/required for success?
 - How will results be communicated to stakeholders?

Discrete Manufacturing Requirements



Hybrid AM System



OT

- Instrumentation
- Real-Time Analytics
- Performance Tools
 - Monitoring
 - Optimization
 - Control
 - Maintenance
 - Scheduling
 - Planning



IT

- Computing Hardware
- Communication Protocol
- Interoperable Middleware
- Variety of Software

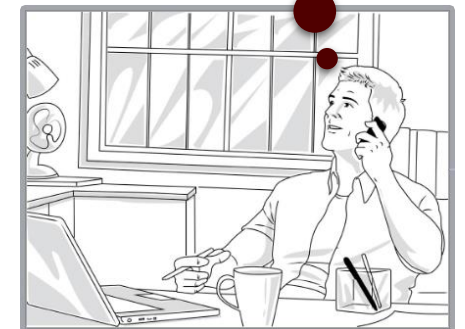


OT+IT

- Advanced Soft Sensors
- Real/Right-Time Analytics
- SM Platform
 - Seamless Integration
 - Ease of Commissioning
 - Performance Guarantees
 - Energy Efficiency
 - Safety and Reliability
 - Speedy ROI

Seamless Integration of Legacy Investment

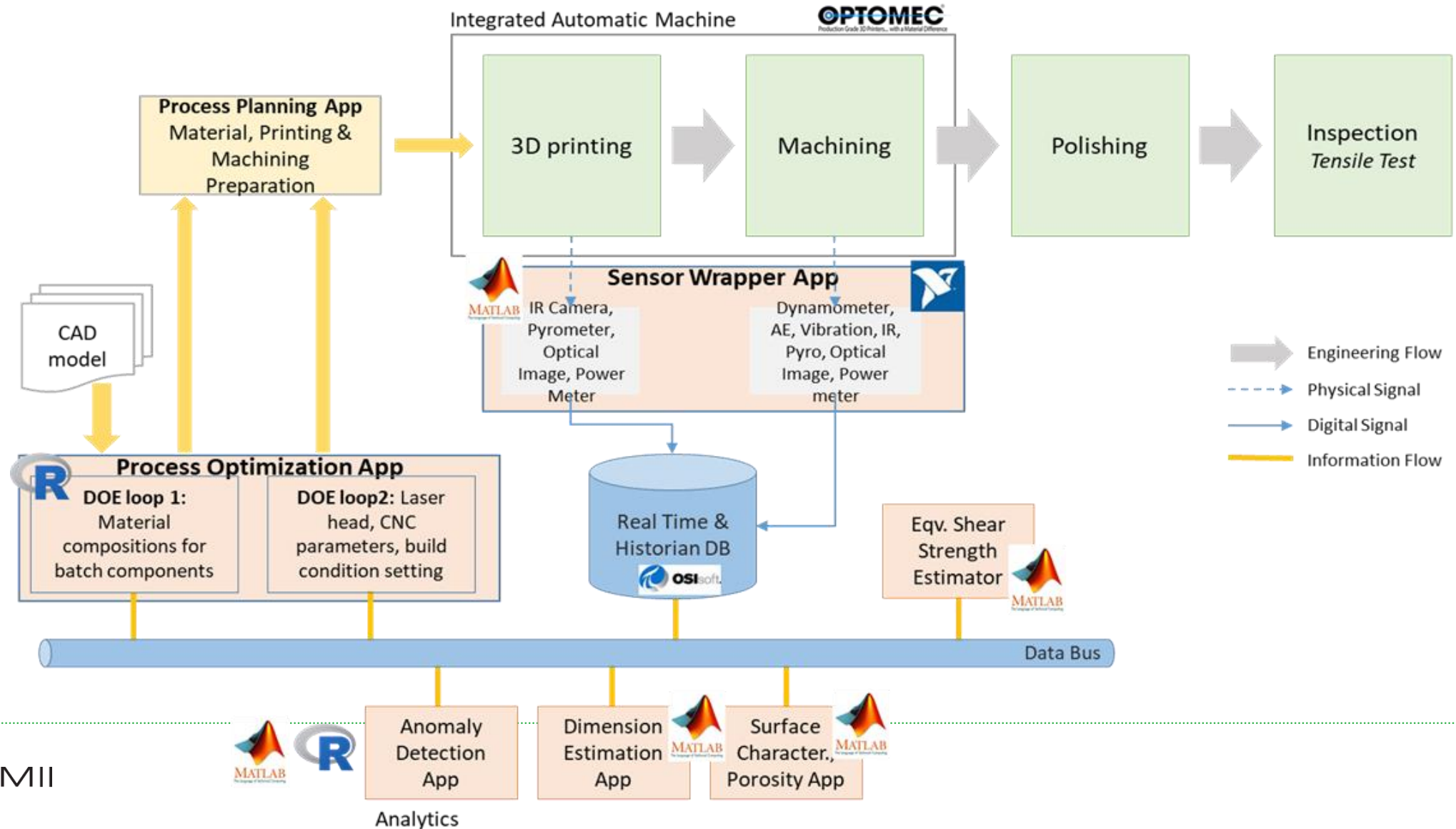
CESMII Team,
Can you please
help?



Determine the OT Framework and Data Structure

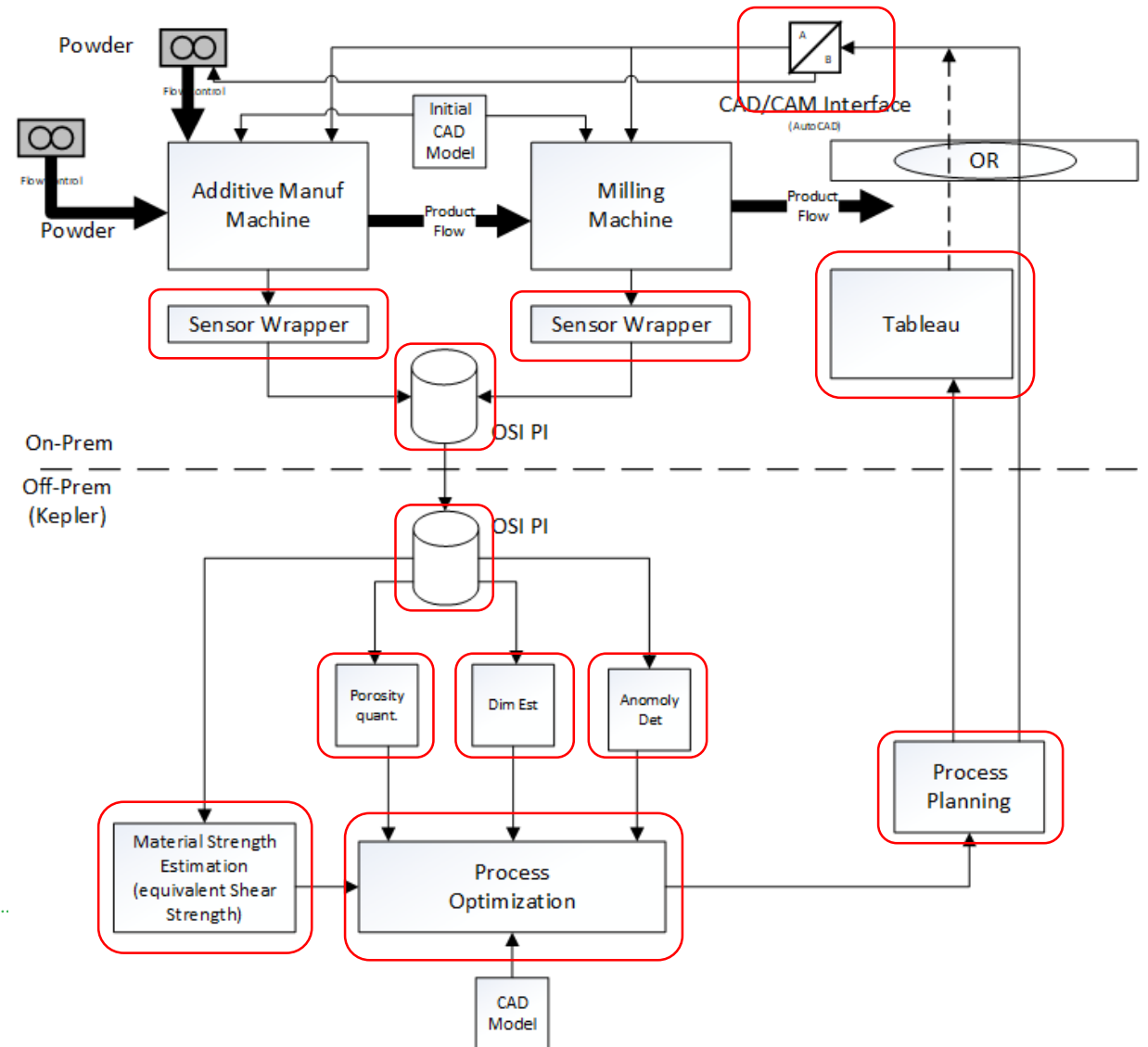
- Develop OT Framework
 - Processes and personnel
 - Machines and sensors
 - Physical connections
- Determine data structure (workflow)
 - Identify on-premises data workflow
 - Define cloud data workflow
 - Identify Smart Manufacturing products (on-premises and cloud)

Additive Manufacturing SM Application Framework

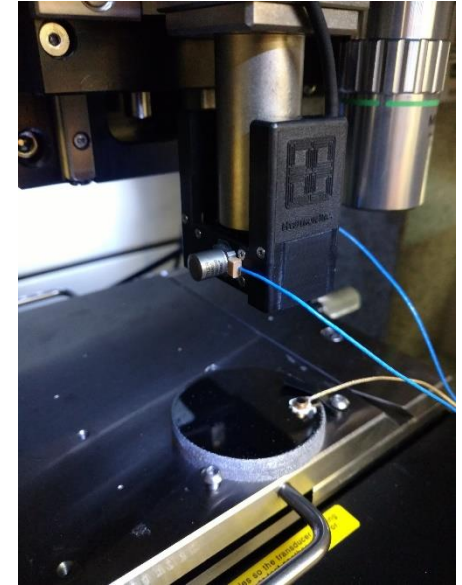


Additive Manufacturing Data Structure

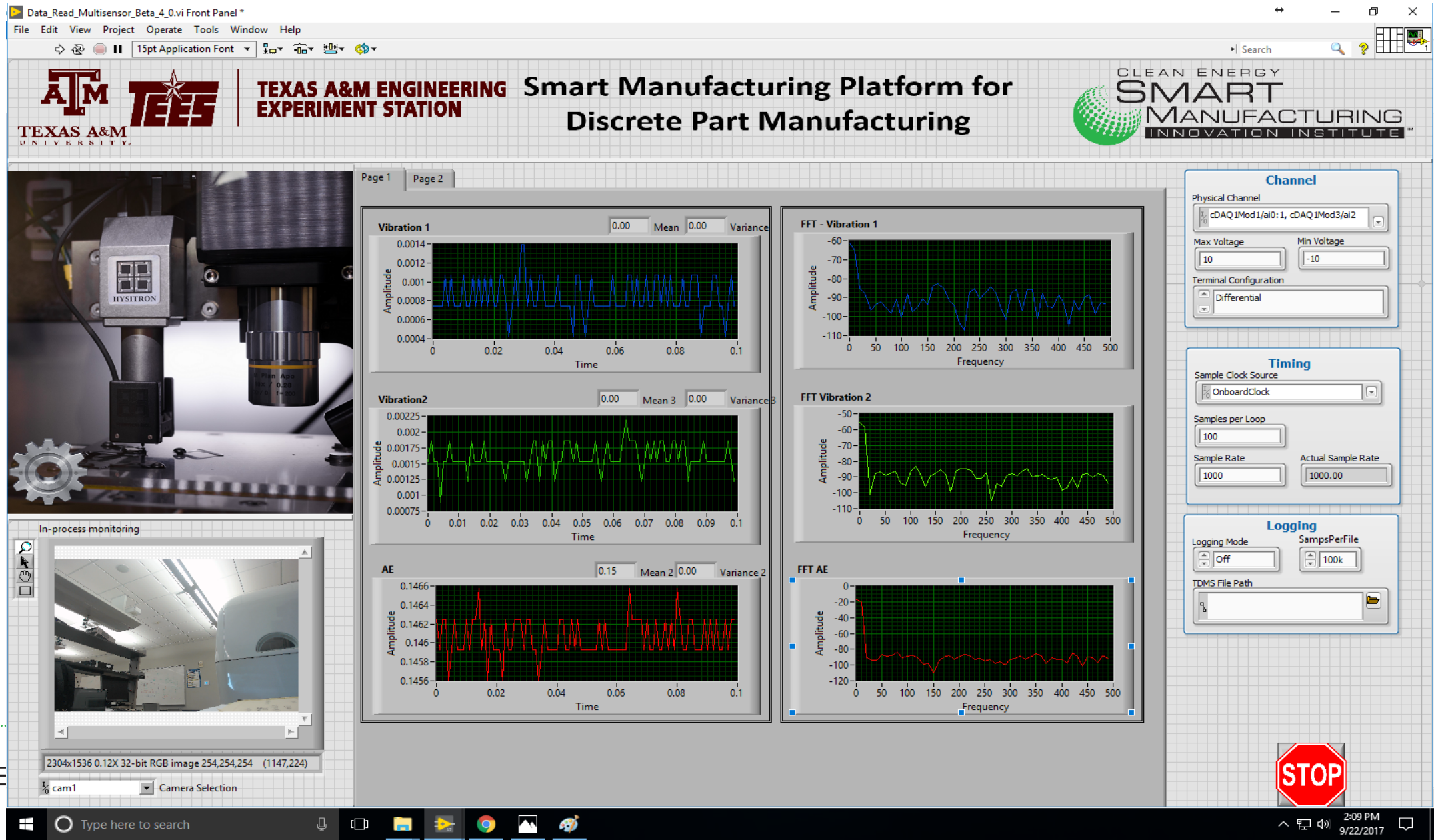
Phase 1 Workflow



- AM System Data Generation and Sensorization
- LabVIEW Data Acquisition
- Local OSI PI server
 - VM hosted in TAMU cloud



LabVIEW Local Display



Build the IT Infrastructure to support Workflow

- Local analytics
- Local data storage
- Cloud connection (authentication and security)
- Cloud data storage
- Cloud analytics
- People

Smart Manufacturing Configuration

Infrastructure

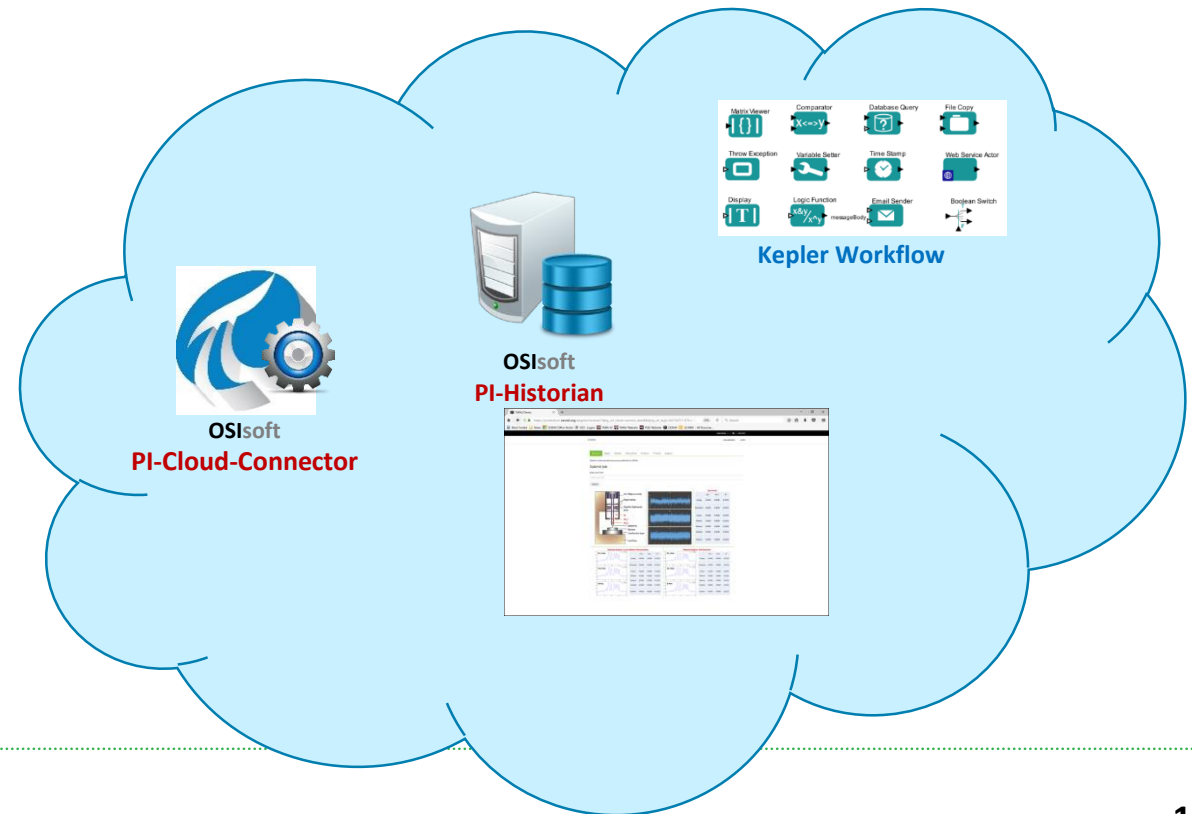
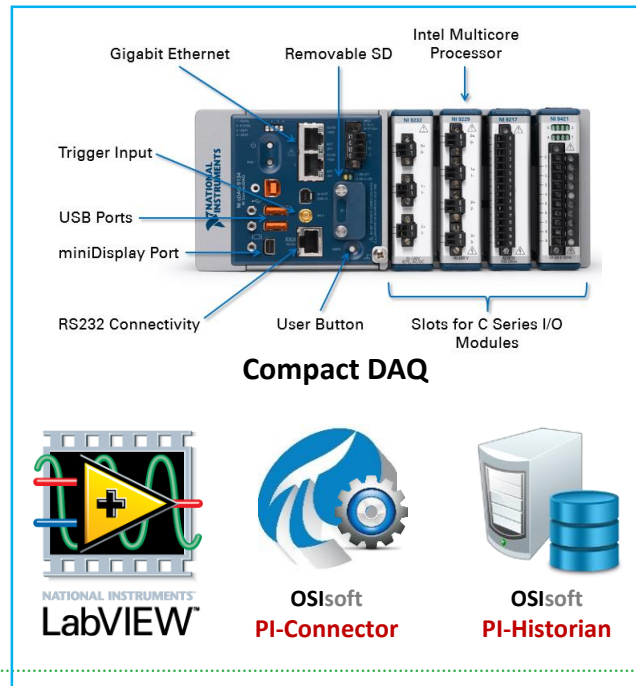
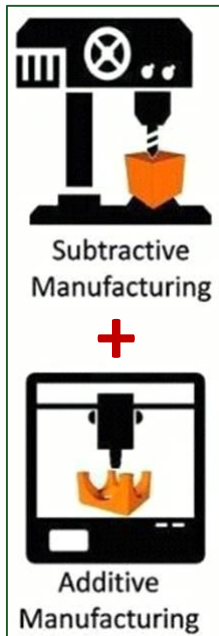
OT/IT Assets, Integration

Orchestration

Workflow, Composability

Deployment

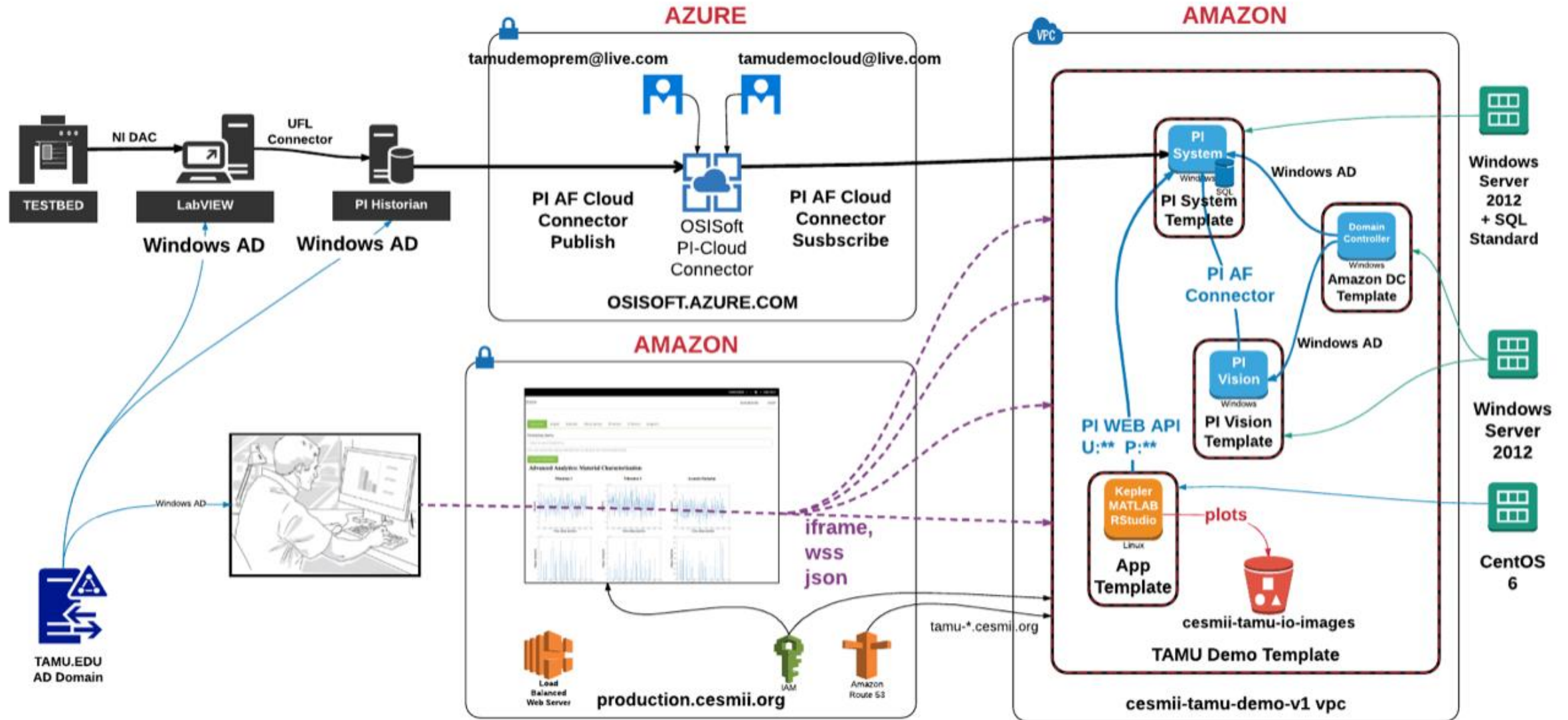
Marketplace, Tools



Platform OT/IT Infrastructure

Infrastructure

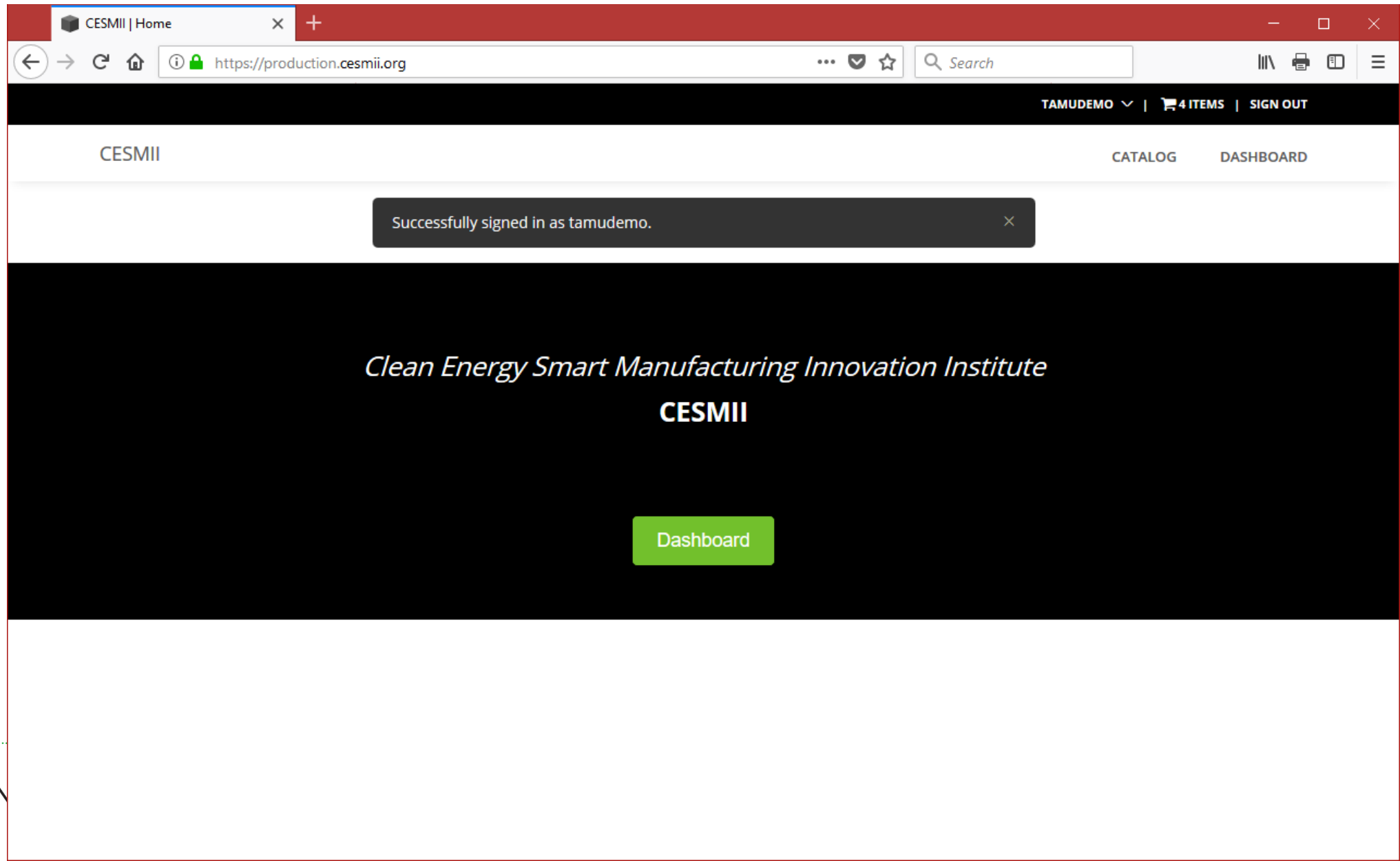
OT/IT Assets, Integration



Composing the Workflow

- Marketplace tools and applications
- Process/display outcomes

CESMII Production System



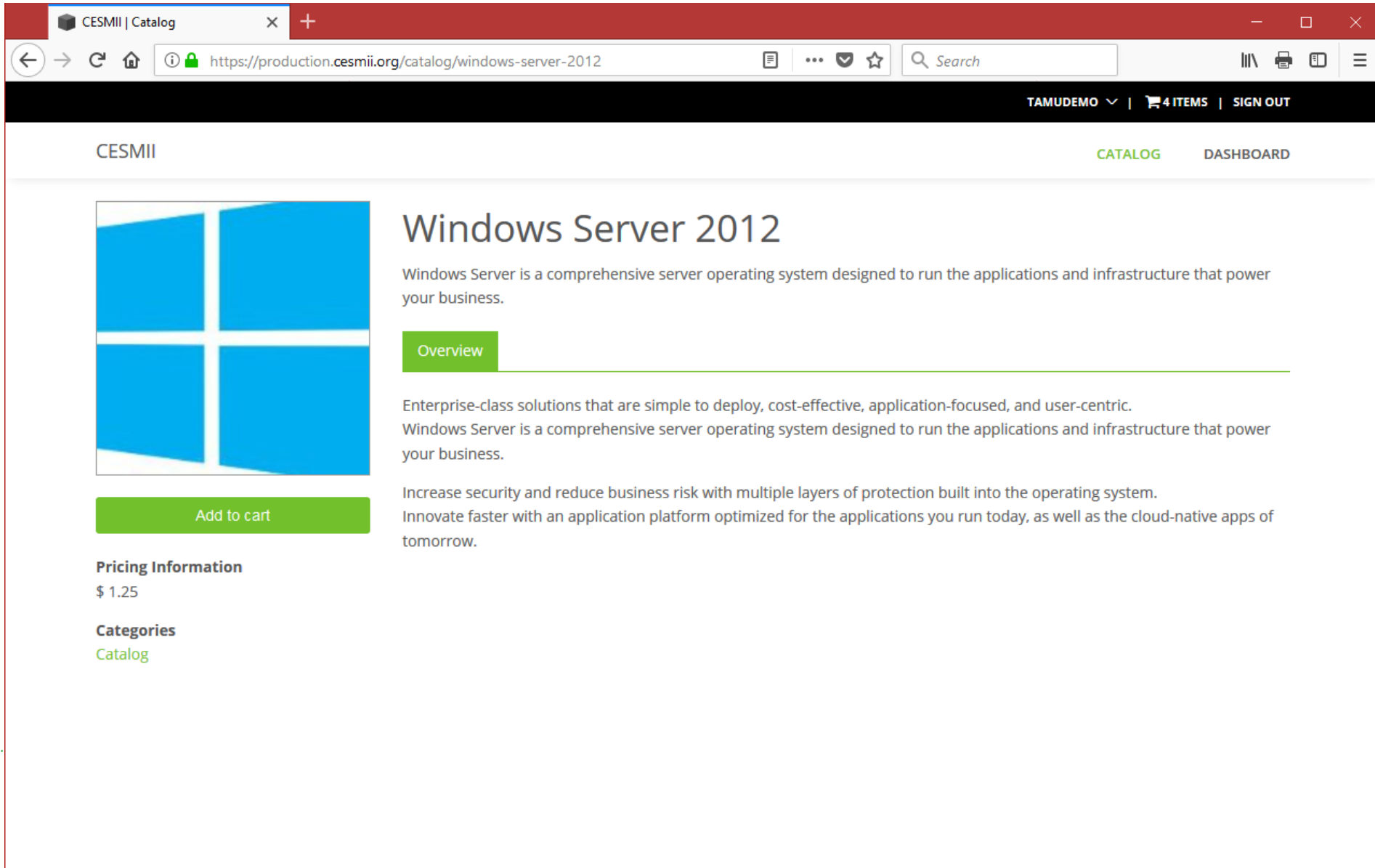
CESMII Marketplace Catalog

The screenshot shows a web browser window with the URL <https://production.cesmii.org/catalog/>. The page header includes "CESMII | Catalog", a search bar, and navigation links for "TAMUDEM0", "4 ITEMS", and "SIGN OUT". Below the header, the "CESMII" logo is on the left, and "CATALOG" and "DASHBOARD" links are on the right. The main content area displays four software products in a grid:

- Wolfram Mathematica**: A red star logo. Description: "Mathematica has nearly 5,000 built-in functions covering all areas of technical computing—all carefully integrated so they work perfectly together, and all included in the fully integrated Mathematica system." A green "DETAILS" button is at the bottom.
- Kepler**: A blue logo with a stylized 'K' and a green arrow. Description: "Kepler is designed to help scientists, analysts, and computer programmers create, execute, and share models and analyses across a broad range of scientific and engineering disciplines." A green "DETAILS" button is at the bottom.
- MATLAB**: The MATLAB logo. Description: "MATLAB combines a desktop environment tuned for iterative analysis and design processes with a programming language that expresses matrix and array mathematics directly." A green "DETAILS" button is at the bottom.
- ANSYS**: The ANSYS logo. Description: "ANSYS is the global leader in engineering simulation. We help the world's most innovative companies deliver radically better products to their customers." A green "DETAILS" button is at the bottom.

At the bottom of the page, there are logos for CESMII, OSIsoft, Tableau, Savigent Software, and a blue square logo.

Getting a Product from the Marketplace



The screenshot shows a web browser window with the address bar displaying `https://production.cesmii.org/catalog/windows-server-2012`. The browser's address bar includes navigation icons (back, forward, refresh, home), a search bar, and a menu icon. The website's header is black with white text for **TAMUDEM0**, **4 ITEMS**, and **SIGN OUT**. Below the header, the page has a white background with a green **CESMII** logo on the left and navigation links for **CATALOG** and **DASHBOARD** on the right. The main content area features a large blue Windows logo on the left. To its right, the product title **Windows Server 2012** is displayed in a large, dark font. Below the title, a paragraph describes the product: "Windows Server is a comprehensive server operating system designed to run the applications and infrastructure that power your business." A green button labeled **Overview** is positioned below this paragraph. Further down, another paragraph states: "Enterprise-class solutions that are simple to deploy, cost-effective, application-focused, and user-centric. Windows Server is a comprehensive server operating system designed to run the applications and infrastructure that power your business." Below this, a third paragraph reads: "Increase security and reduce business risk with multiple layers of protection built into the operating system. Innovate faster with an application platform optimized for the applications you run today, as well as the cloud-native apps of tomorrow." A green button labeled **Add to cart** is located below the text. On the left side of the page, under the **CESMII** logo, there is a section for **Pricing Information** showing **\$ 1.25**, and a **Categories** section with a link to **Catalog**.

CESMII | Catalog

https://production.cesmii.org/catalog/windows-server-2012

TAMUDEM0 | 4 ITEMS | SIGN OUT

CESMII

CATALOG DASHBOARD

Windows Server 2012

Windows Server is a comprehensive server operating system designed to run the applications and infrastructure that power your business.

Overview

Enterprise-class solutions that are simple to deploy, cost-effective, application-focused, and user-centric. Windows Server is a comprehensive server operating system designed to run the applications and infrastructure that power your business.

Increase security and reduce business risk with multiple layers of protection built into the operating system. Innovate faster with an application platform optimized for the applications you run today, as well as the cloud-native apps of tomorrow.

Add to cart

Pricing Information
\$ 1.25

Categories
Catalog

CESMII

Getting a Product from the Marketplace

CESMII | Cart



https://production.cesmii.org/cart/

Search

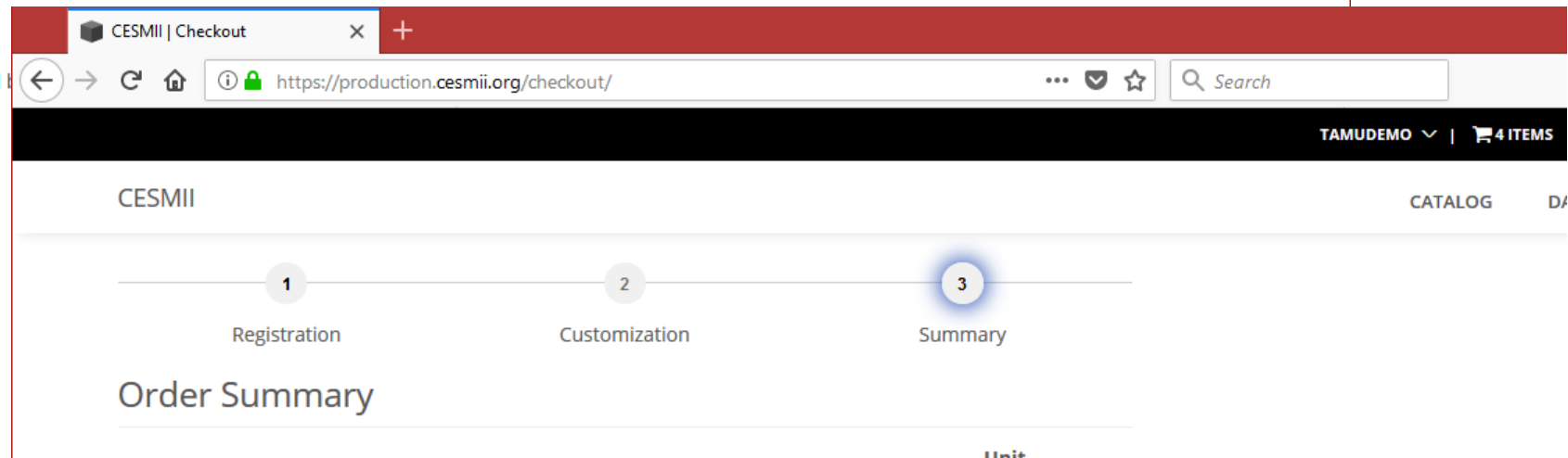
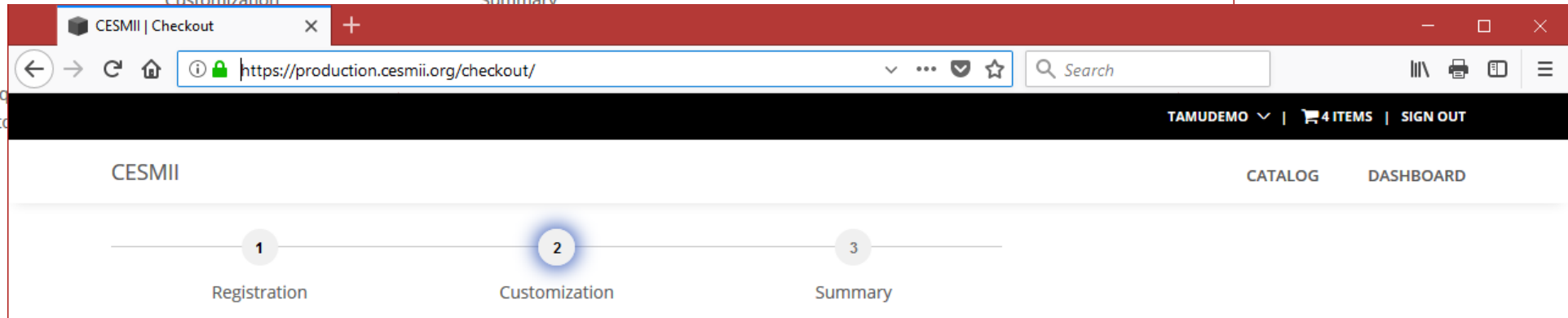
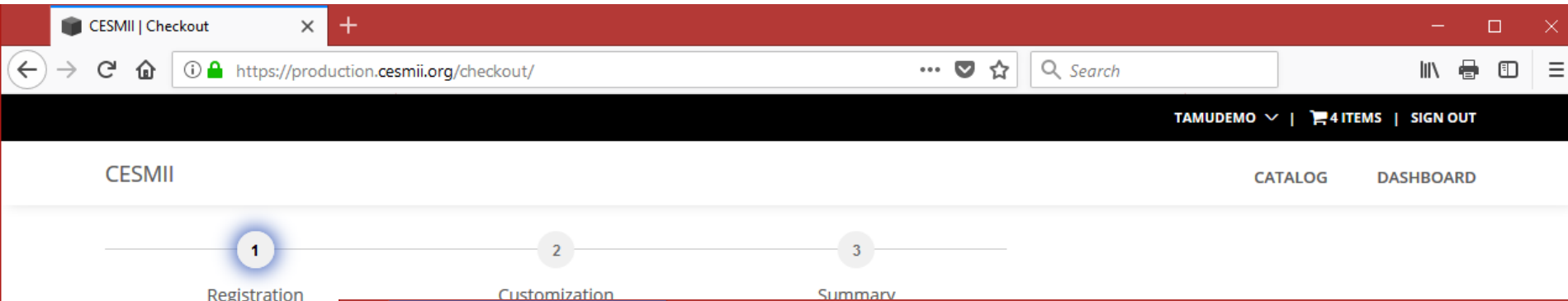
TAMUDEMOM4 ITEMS | SIGN OUT

CESMII

Your Shopping Cart

Product	Unit Price
<div> Matlab</div> <div><h3>Millions of Engineers and Scientists Trust MATLAB</h3><p>MATLAB combines a desktop environment tuned for iterative analysis and design processes with a programming language that expresses matrix and array mathematics directly.</p><h4>Professionally Built</h4><p>MATLAB toolboxes are professionally developed, rigorously tested, and fully documented.</p><h4>With Interactive Apps</h4><p>MATLAB apps let you see ...</p></div>	\$ 1.25 Remove
<div> Kepler</div> <div><p>The Kepler Project is dedicated to furthering and supporting the capabilities, use, and awareness of the free and open source, scientific workflow application, Kepler. Kepler is designed to help scientists, analysts, and computer programmers create, execute, and share models and analyses across a broad range of scientific and engineering ...</p></div>	\$ 1.99 Remove

Getting a Product from the Marketplace



The User Dashboard

CESMII | Dashboard

https://production.cesmii.org/dashboard/

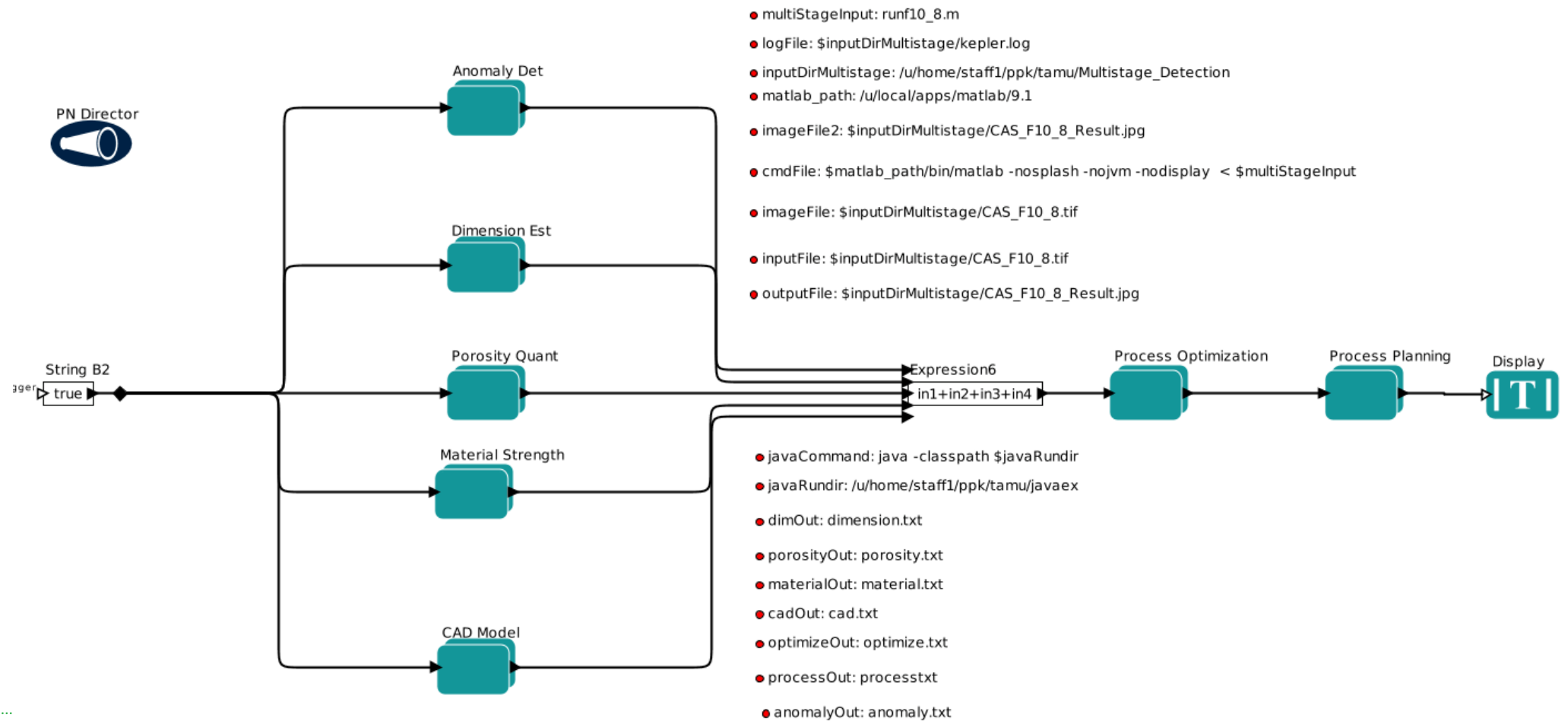
TAMU DEMO | SIGN OUT

CESMII

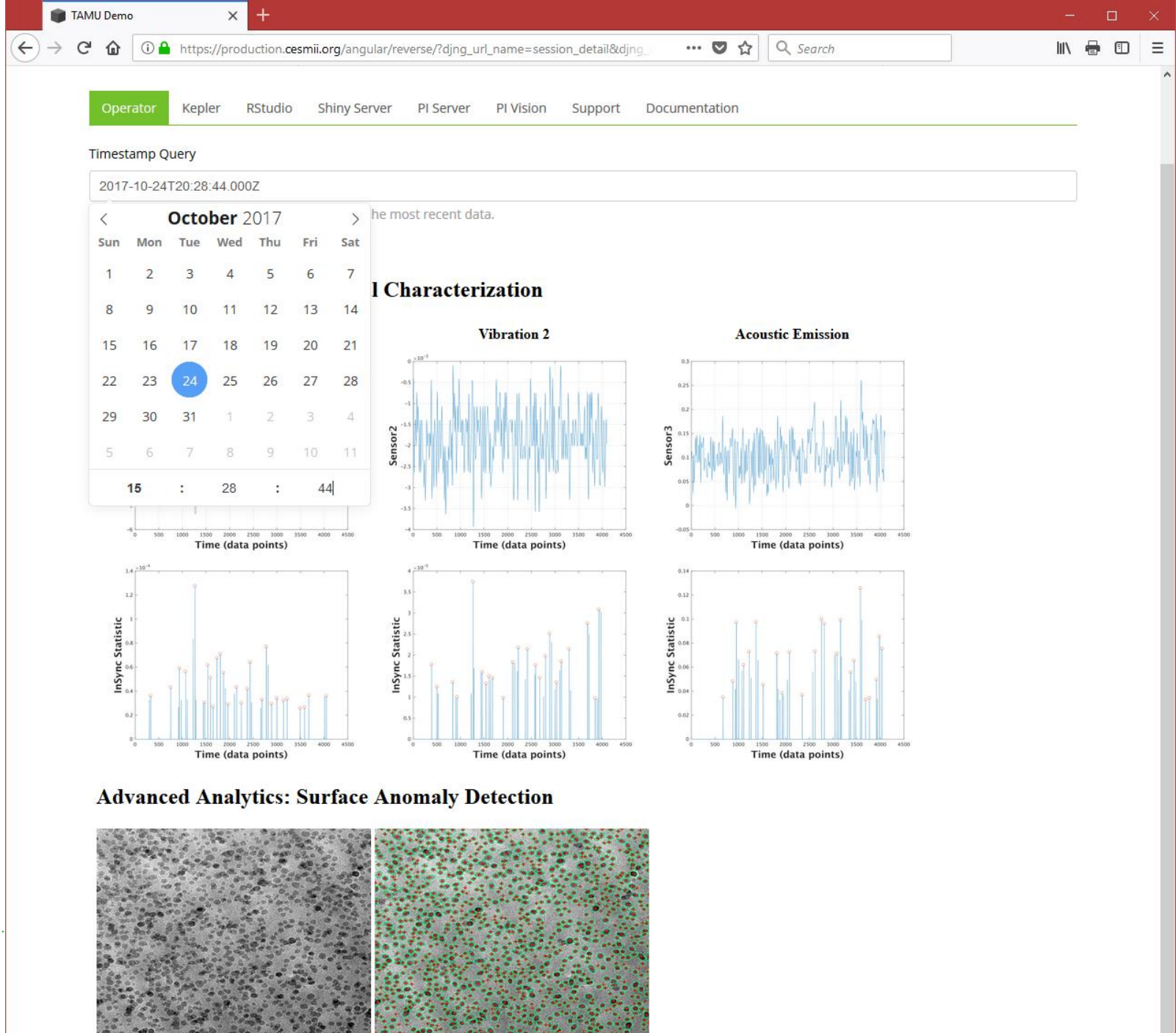
CATALOGDASHBOARD

Name	Short UUID	State	Latest Log Message	Actions
TAMU Demo	b0d3a52c	Running		Terminate
Matlab	bc36f768	New		Start
Kepler	61315eb7	New		Start
OSIsoft PI Server	598a0f1a	New		Start
Windows Server 2012	f8421a29	New		Start

Orchestration: Composing the Computational Workflow



Back to the User Dashboard



Launch the Workflow

TAMU Demo

https://production.cesmii.org/angular/reverse/?djng_url_name=session_detail&djng...

Operator Kepler RStudio Shiny Server PI Server PI Vision Support Documentation

Timestamp Query

2017-10-24T20:28:44.000Z

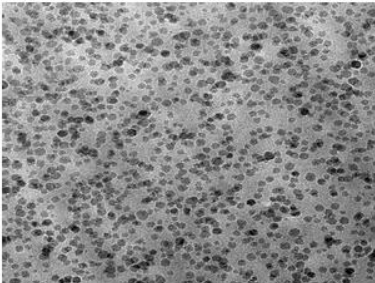
You can leave the above field blank to retrieve the most recent data.

Launch Workflow You must wait 232 seconds before launching the workflow again.

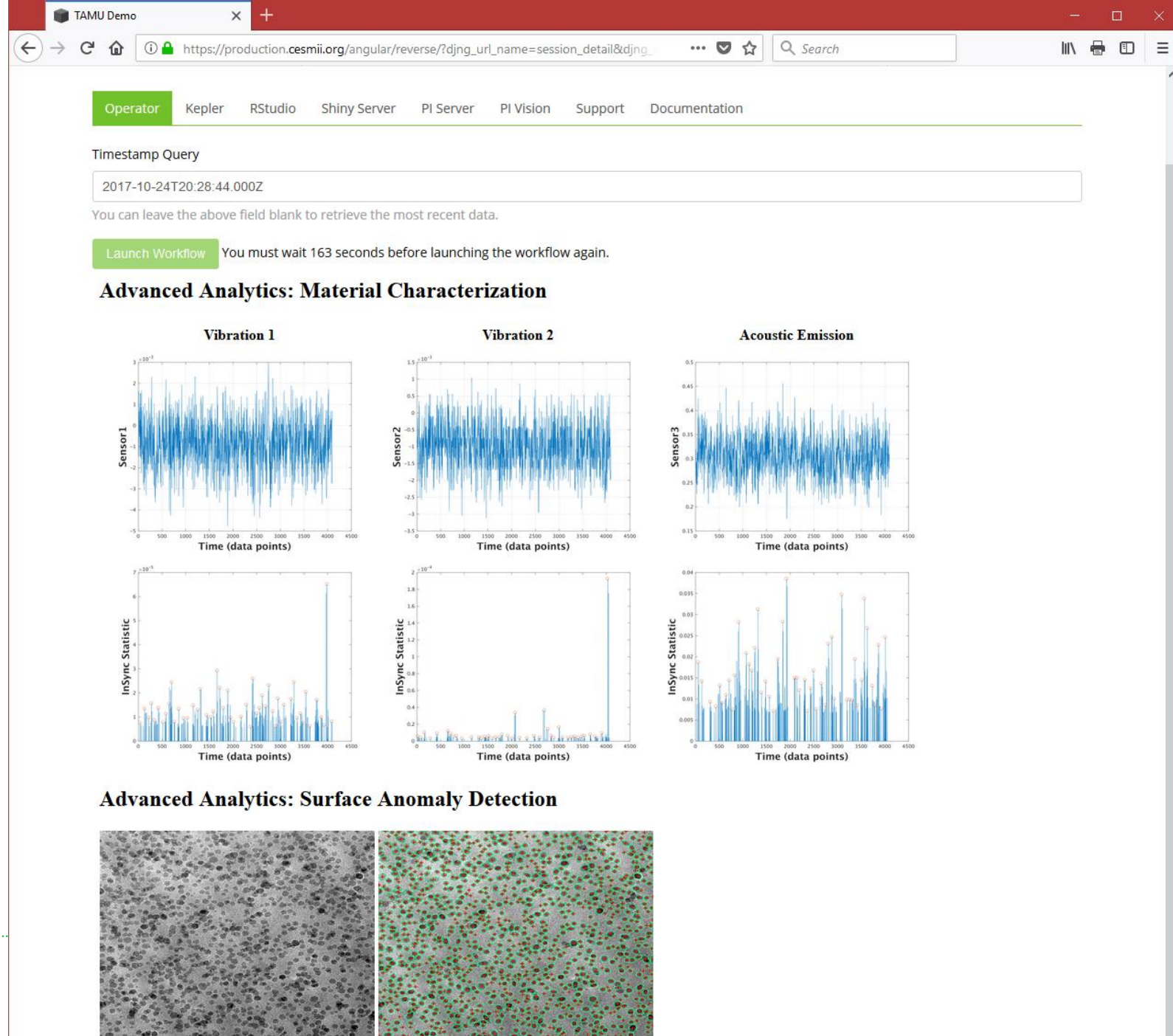
Advanced Analytics: Material Characterization

Vibration 1	Vibration 2	Acoustic Emission
Data processing...	Data processing...	Data processing...
Data processing...	Data processing...	Data processing...

Advanced Analytics: Surface Anomaly Detection

	Data processing...
---	--------------------

Finally,
The Results!



Conclusion



- Implement Sensor Wrapper to gather data on site
- Create Smart Manufacturing infrastructure to enable use of advanced analytics
- Provide feedback required to improve material/part quality while reducing time and energy costs

Conclusion: What Value was Achieved?

- The Smart Solution: Manage properties in real-time across the operations in this application
- Added to the SM Platform™ Portfolio: demonstrated the utility of cloud orchestration (regardless of where your “cloud” is)
- Created additional avenues for better operational information (real-time material property management across multiple systems)
- Created reusable SM Products™
 - Sensor wrappers for commercial products
 - Analytic tools for materials characterization
 - Configurable Workflow (hardware, software, and connectors)

Contact: Dean Schneider

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