



Automate engineering processes at scale

pSeven Enterprise

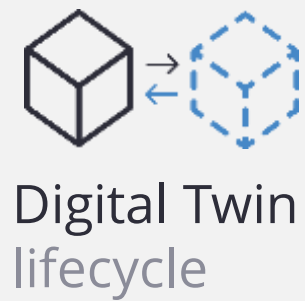
Low-code platform
to enable Digital Twins at scale

Sergey Morozov, President

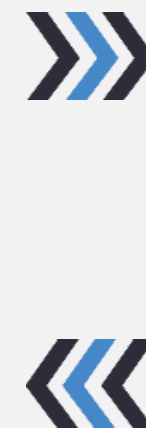
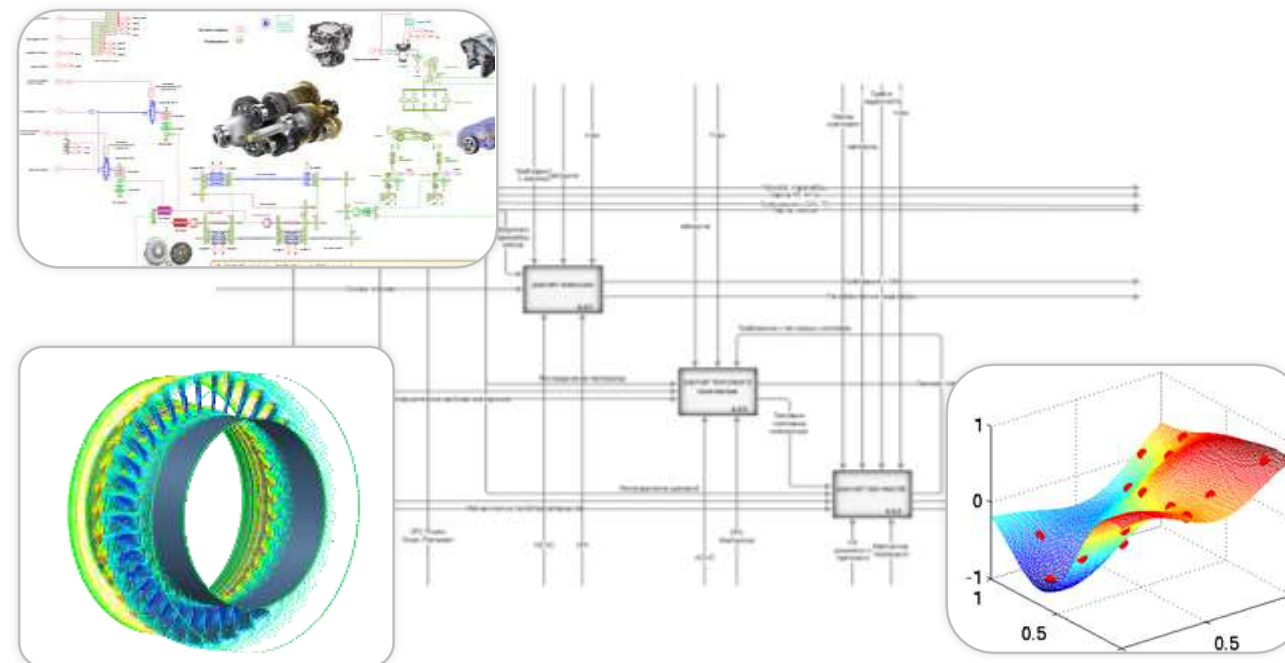
segey.morozov@pseven.io



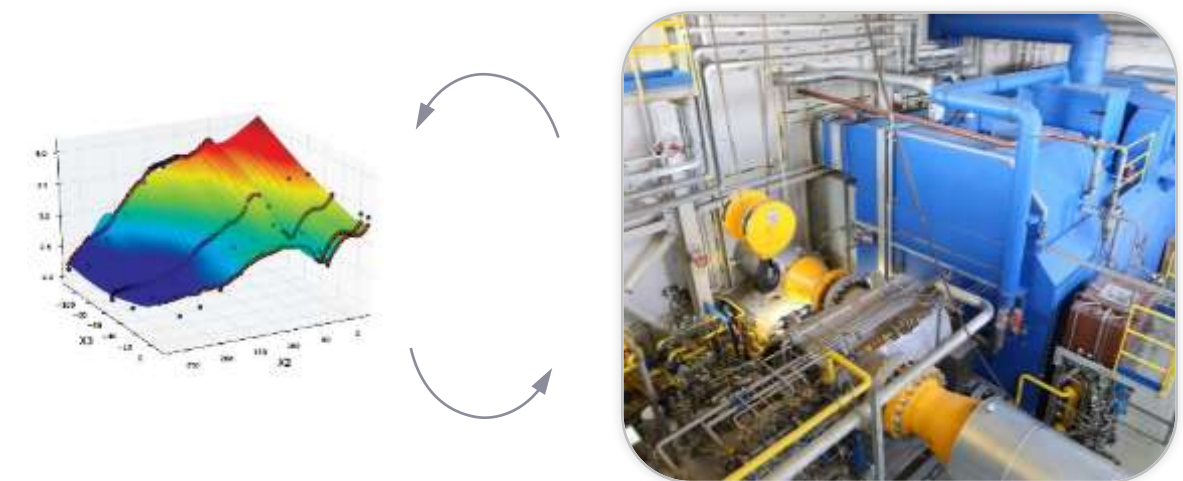
What is a Digital Twin?



Digital Twin prototype of the product/process

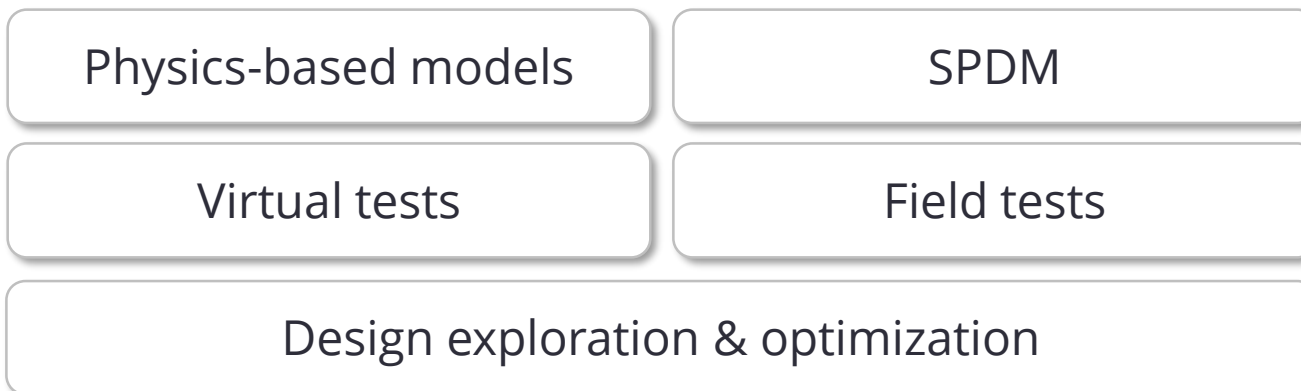


Digital Twin instances connected to the physical assets

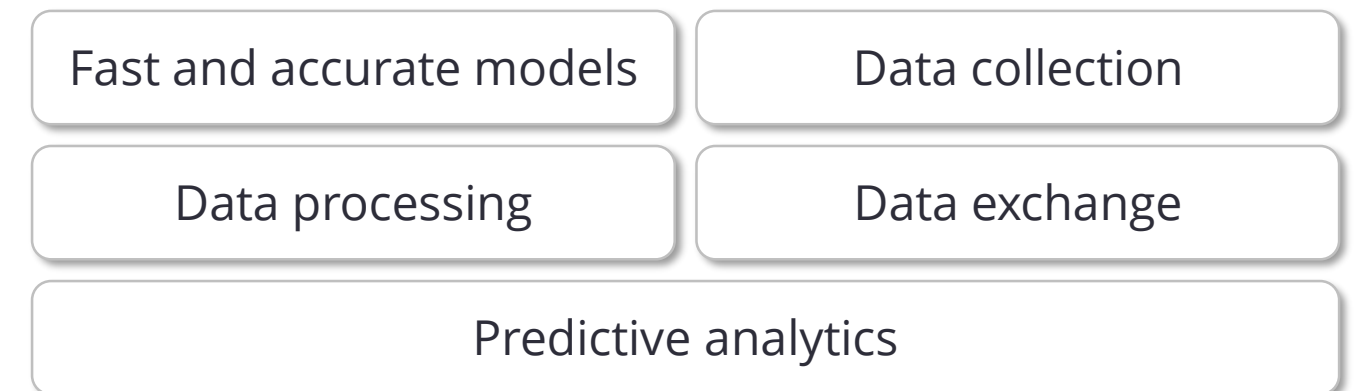


Product/process lifecycle

Design stage



Operation stage

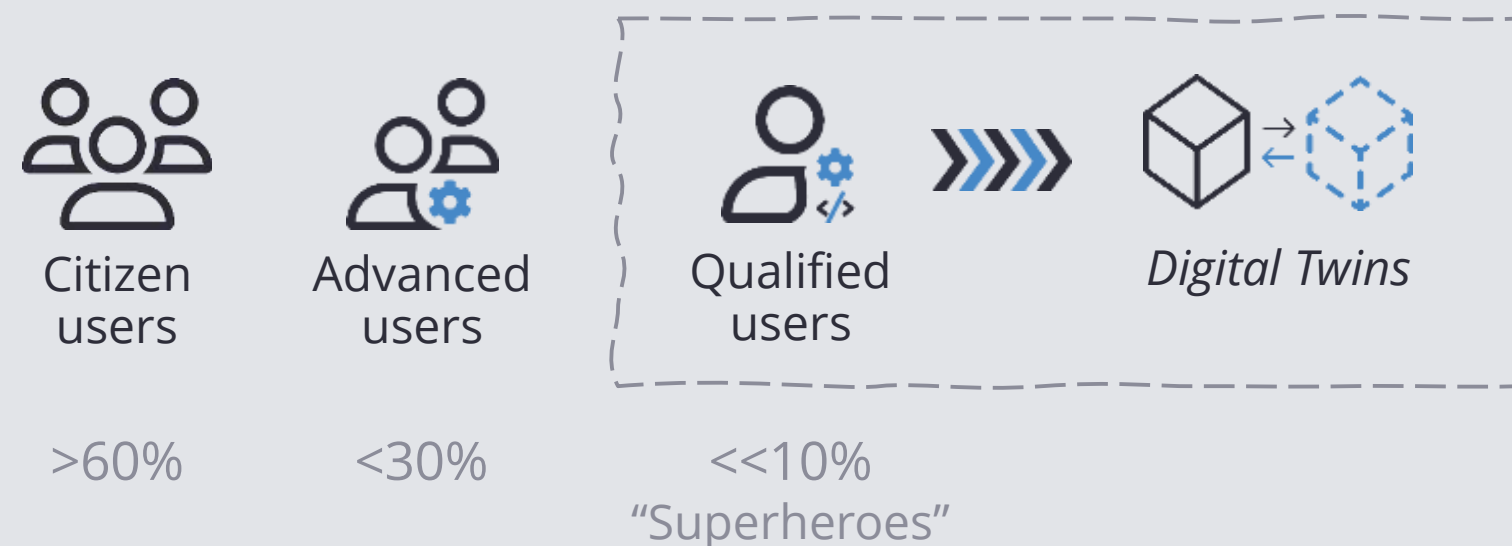




Adoption of Digital Twin strategy

Challenge

- Even in big enterprises, the number of **qualified engineers** is not enough to implement the Digital Twin strategy:
 - The task usually lands on the tables of already busy qualified engineers, the others are not involved due to high level of the required expertise (subject + simulation + programming).
 - The developed approaches are hard to scale as is.
 - Just increasing the headcount doesn't help.



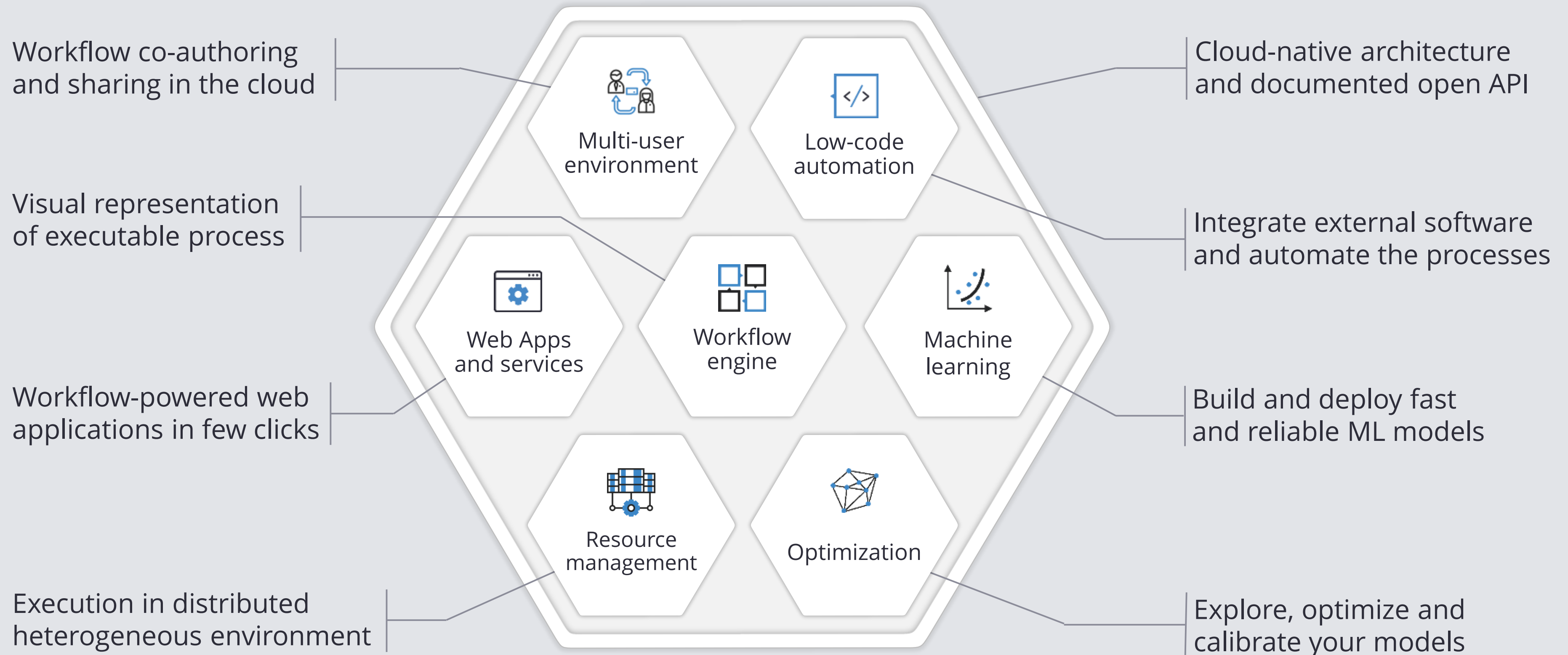
Solution

- Low-code collaborative engineering platform and split of responsibilities:
 - Professional developers build reusable components (**hard-code**).
 - Qualified users develop and manage automated workflows (**low-code**).
 - Other users run workflows as is or with slight adjustments (**no-code**).





pSeven Enterprise: All you need to power up Digital Twins





Capture and transfer knowledge

- Formalize and maintain complex multidisciplinary engineering processes at scale.
- Share, reuse and maintain knowledge easily with low-code approach.

Automate repetitive tasks

- Accelerate product development cycle through productivity gain.
- Reduce time-to-market with standardization and democratization.

Enable Digital Twin strategy

- Bridge the gap between engineering and operations.
- Make better and faster operational decisions.

3x productivity gain reported



Low-code automation platform

- Powerful workflow engine:
 - Visual representation of executable processes
 - Multi-level (nested) workflows
 - Centralized & customizable block library
 - Everything is done in the cloud → No need to move files
- Low-code approach:



- Faster implementation and development of MVPs



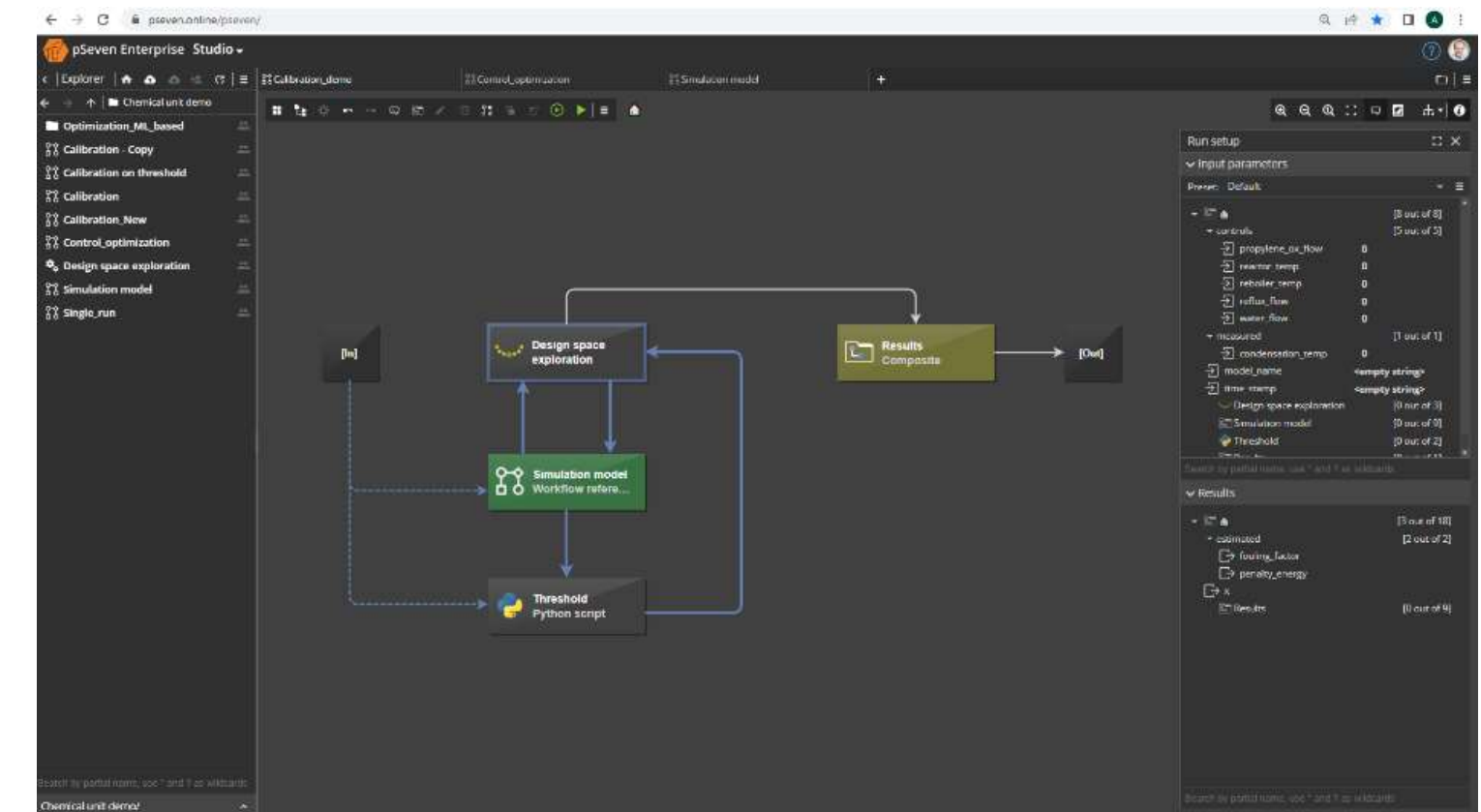
- Logic is always open for inspection and revision



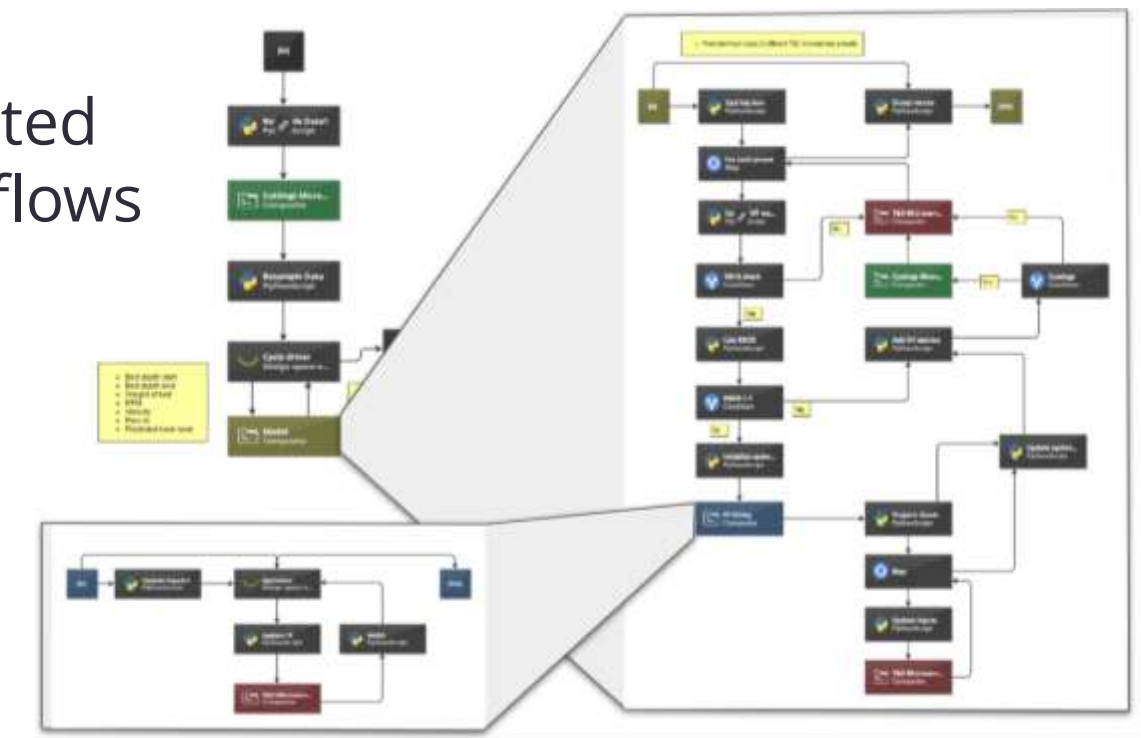
- Flexible depth and order of automation

Accelerate development cycle

Visual representation of executable processes



Nested workflows



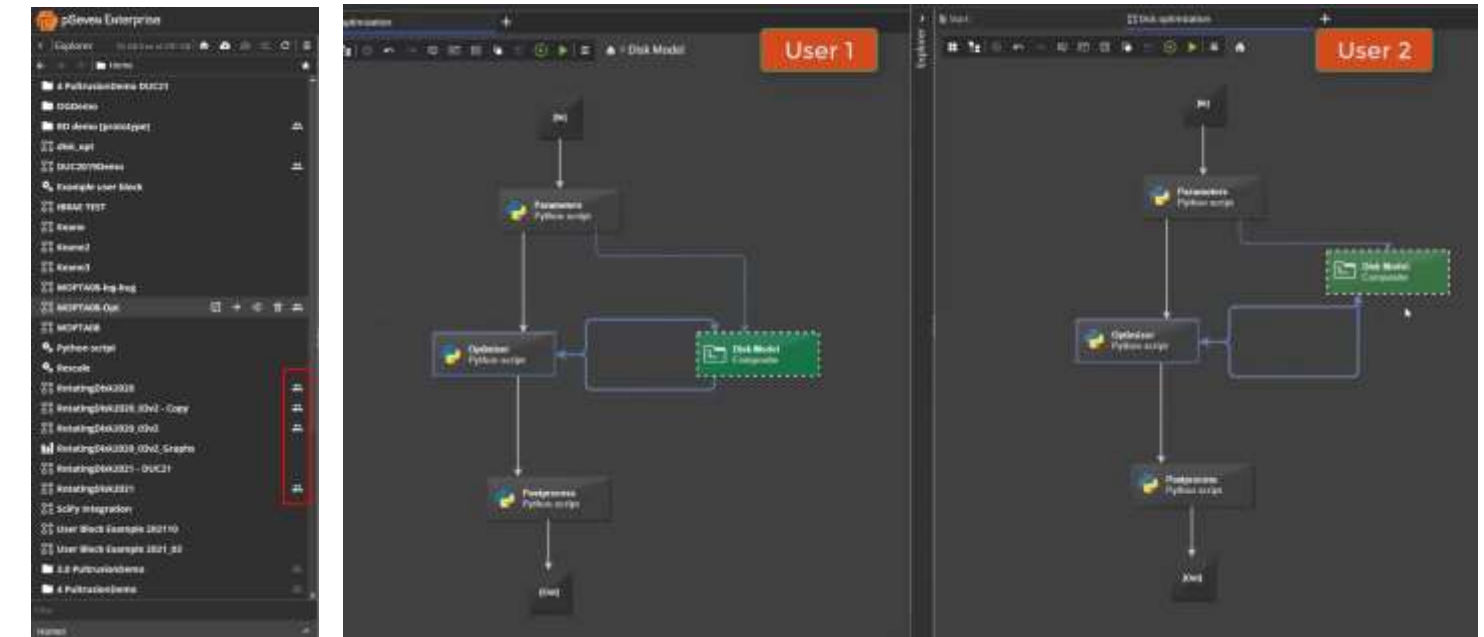


Collaborative engineering

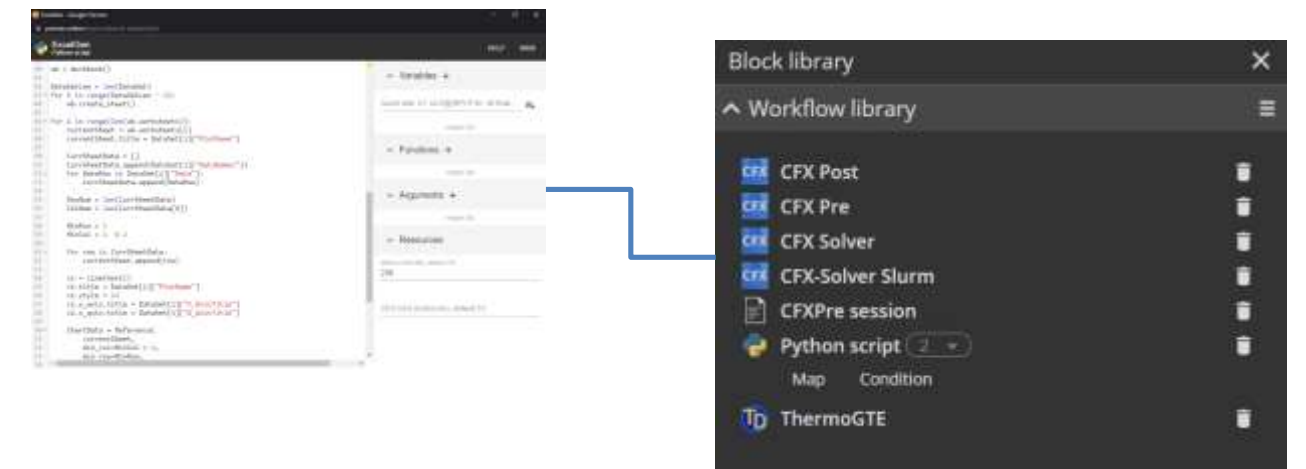
- Centralized architecture enabling collaboration:
 - Multi-user environment with roles
 - Co-authoring in real-time
 - Workflow sharing and aggregation
- Integration with other collaborative environments:
 - SPDM, PLM etc.

Share knowledge and maintain it easily

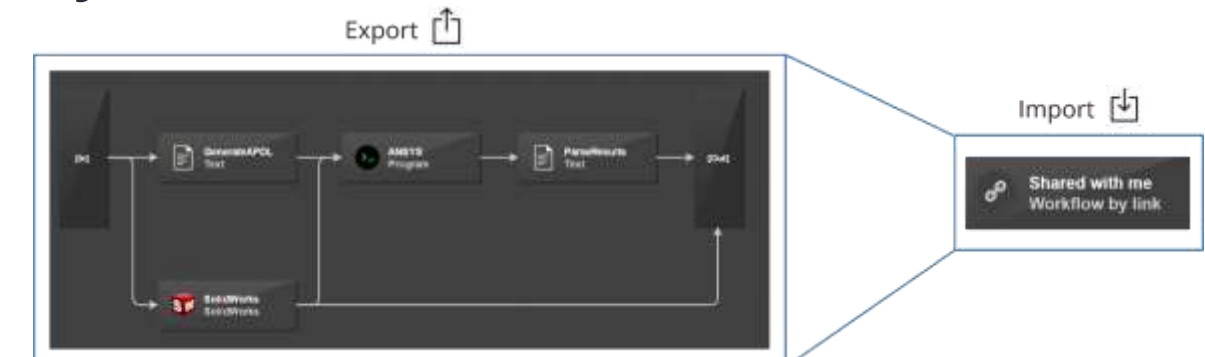
Co-authoring



Reuse blocks

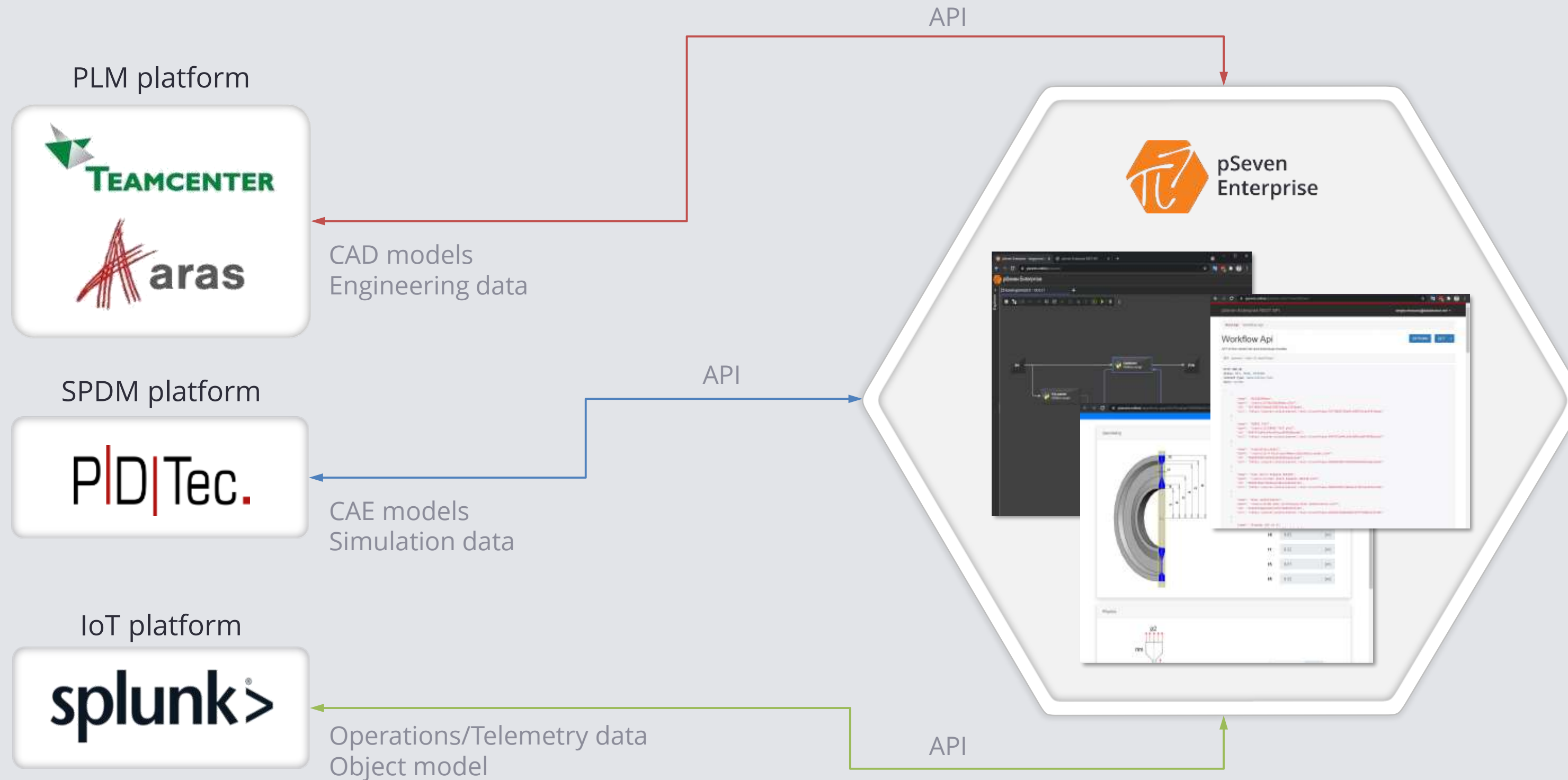


Workflow sharing by reference/link





Integrate with other enterprise IT platforms



Above are examples of platforms with which integration has already been implemented.
You can easily create an integration with your platform of choice.

Interoperability

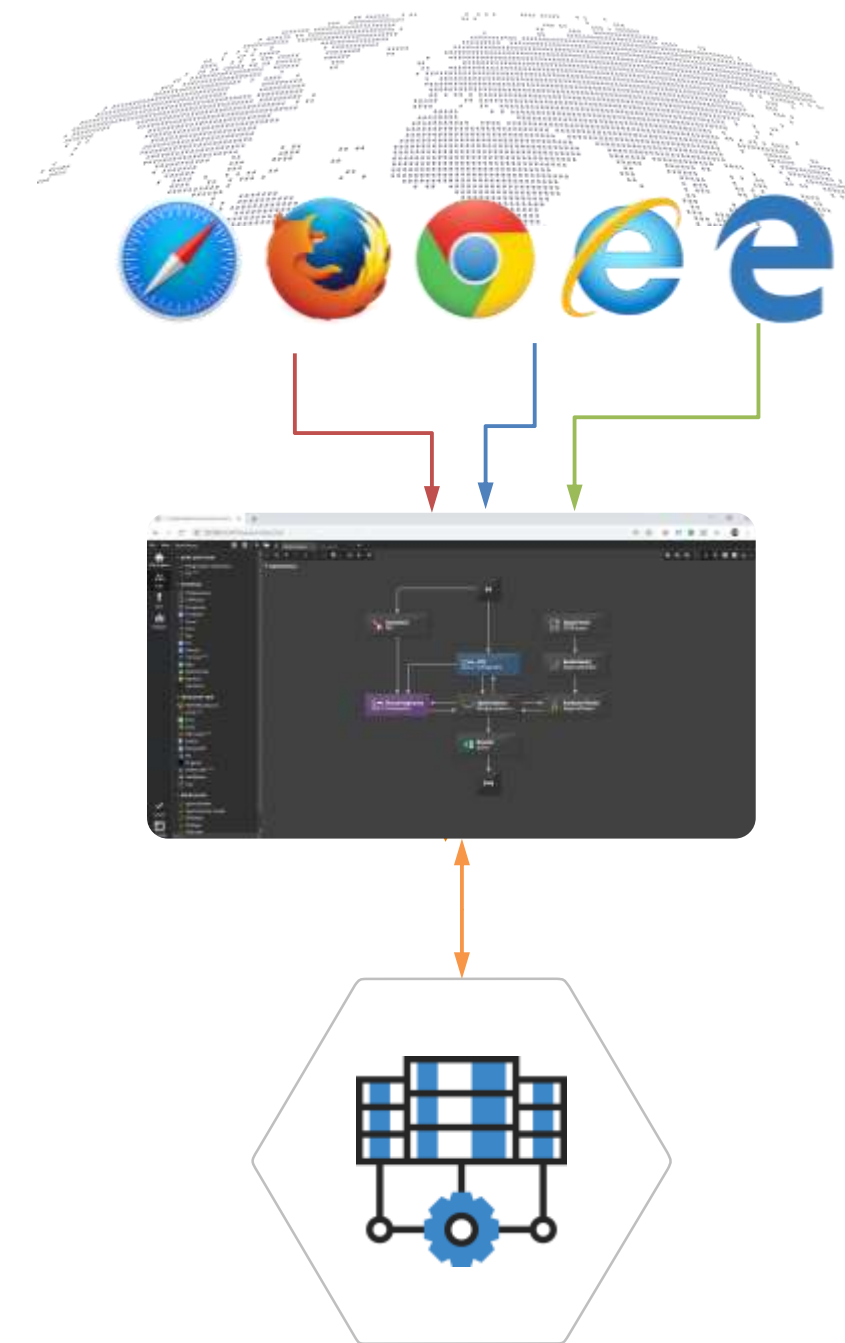


Cloud-native and accessible

- Cloud-native architecture:
 - One installation to support
 - Access from any browser and any device
 - Thin client is enough
- Runs in a predefined and well-controlled IT environment:
 - On-premises (Kubernetes)
 - Private cloud (AWS, Digital Ocean, Azure, Huawei Cloud etc.)



Access from anywhere



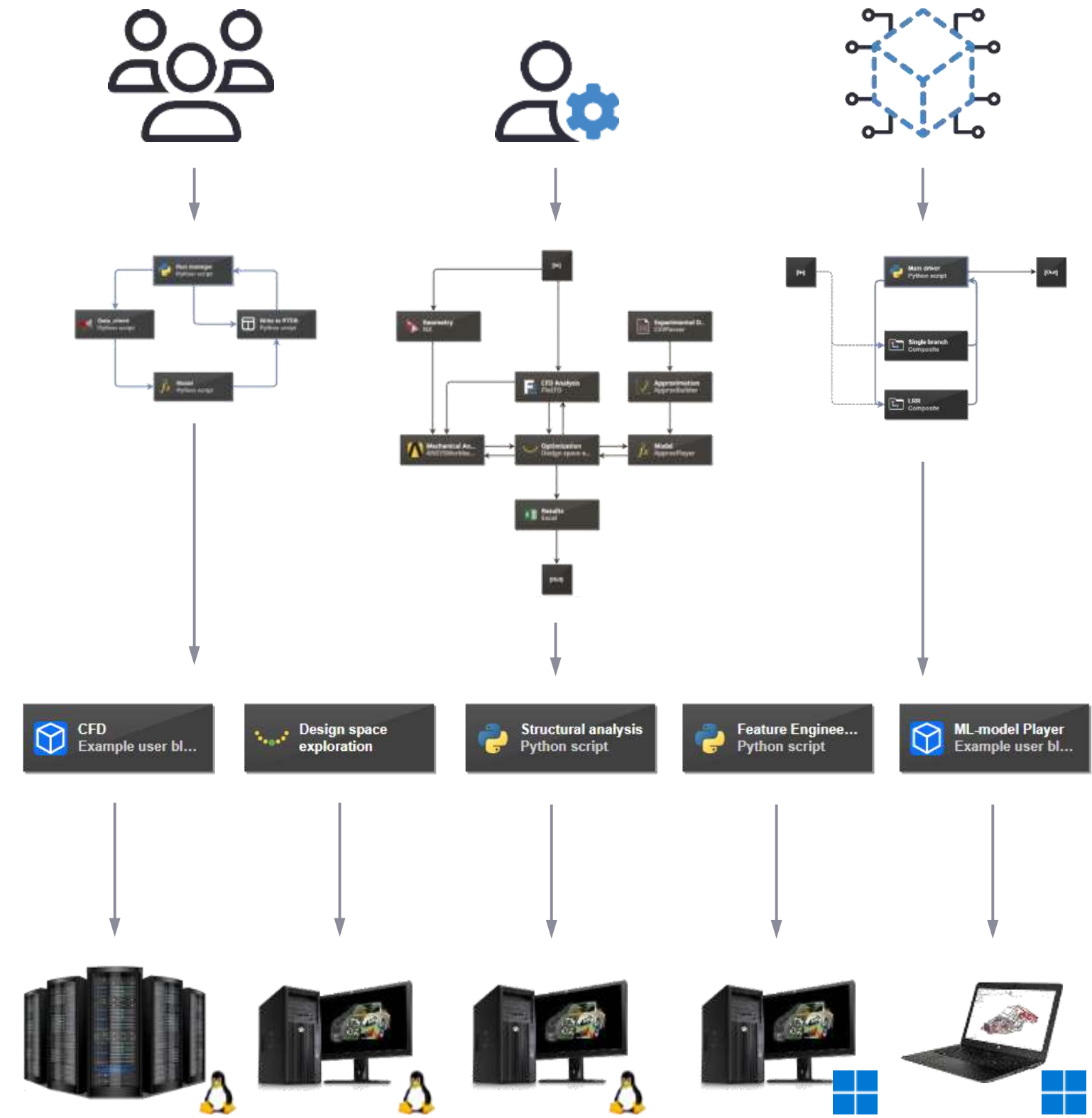
- Access through any browser
- pSeven Enterprise web interface
- On-premises Private or public cloud
-  **kubernetes**



Resource management

- Execution:
 - Support of distributed heterogeneous environments
 - Run blocks on Linux nodes and external Windows machines
- Management:
 - Many users can run many resource-intensive workflows at the same time
 - pSeven Enterprise manages computing resources automatically
 - Number of simultaneously running workflows is limited only by your license and computational resources
- Monitoring:
 - Status of all running processes is presented on a dashboard

Scalability



- Managed and scheduled resources

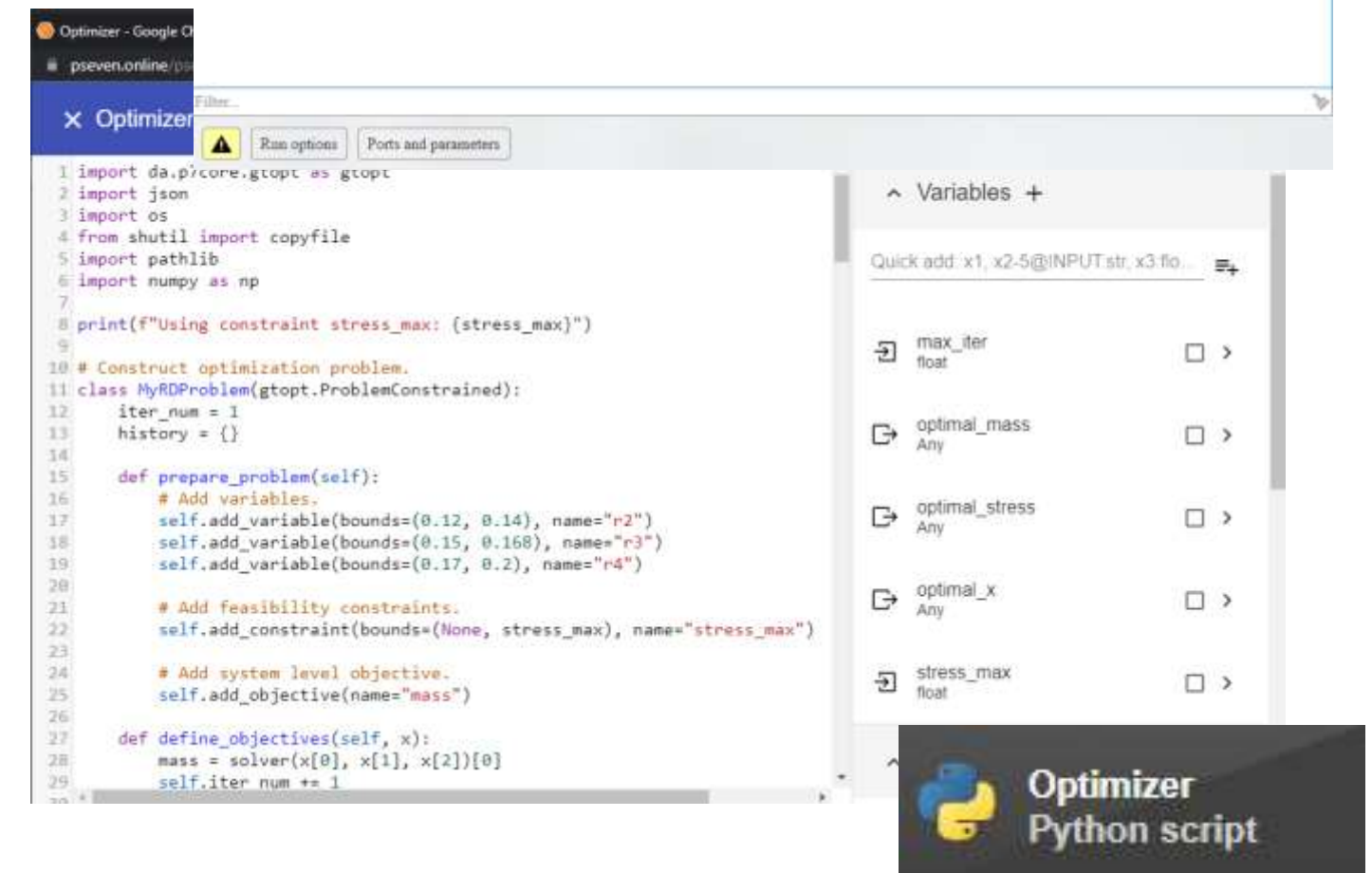
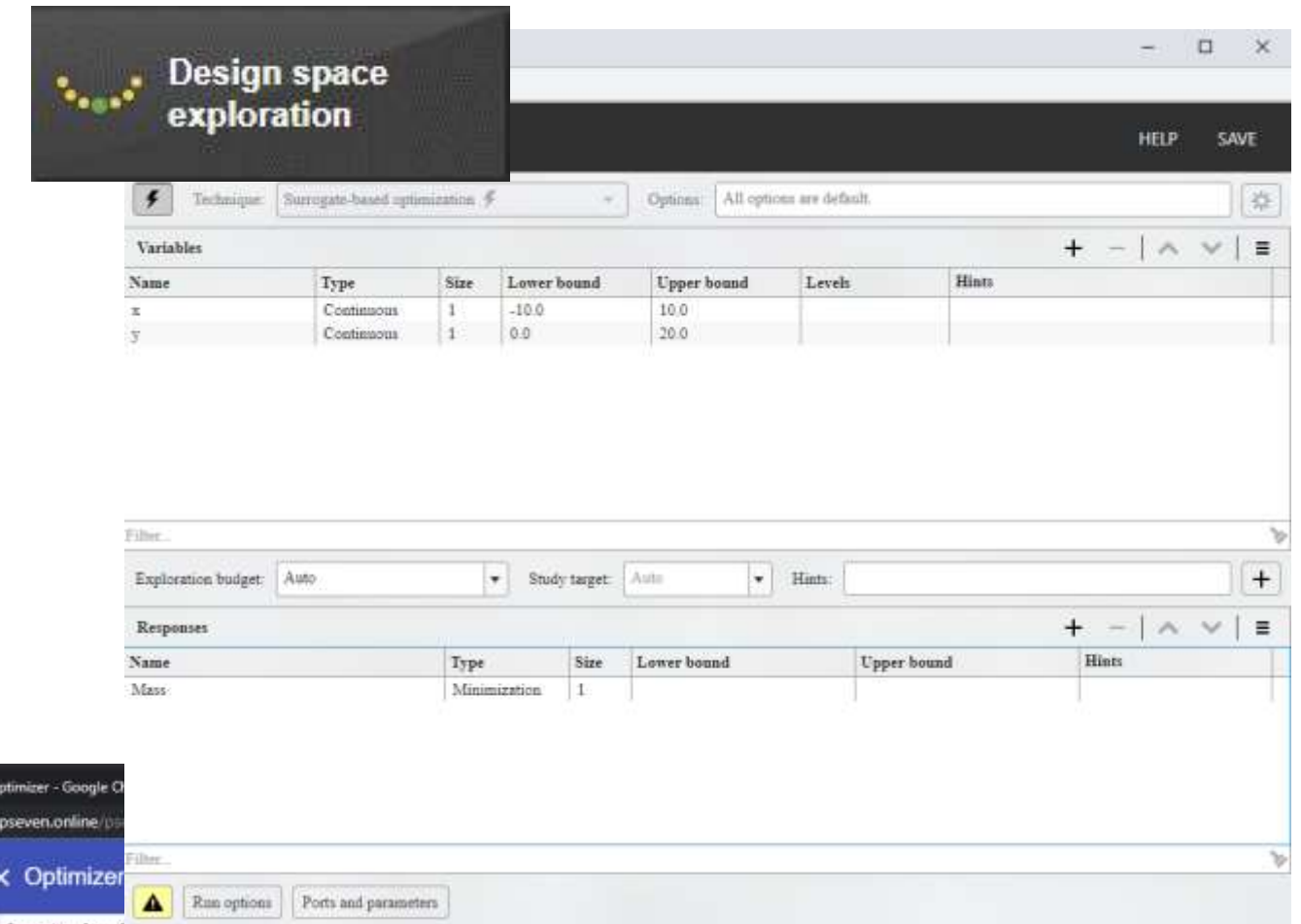


Machine learning and optimization

- Use industry proven **pSeven Core** algorithms:
 - Efficient proprietary machine learning algorithms
 - Dedicated Design Space Exploration block:
 - Powerful single- and multi-objective Optimization algorithms
 - DoE and Adaptive DoE
 - Model identification, calibration and adaptation
 - SmartSelection**, an AI technology for automatic selection and tuning of algorithms
- Use your favorite Python optimization/ML library:



Performance





Customizable block library

- Formalize software connectors and their logic
- Deploy and manage all your simulation and ML models from a single platform



integration block SAVE

Document path
C:\Hysys_Integration\Gas_unit.hsc Apply

Document tree

- Streams
 - Feed_1
 - Feed_2
 - Feed_vapour
 - Feed_liquid
 - Cooled_feed_vapour
 - Product_gas
 - Subcooled_feed_vapour
 - Bottoms
 - Top_Gas
 - Mixed_feed
 - 1
 - 2
 - Column_feed
 - 1
 - 2
 - Energy_0-100
 - Energy_0-1
 - Energy_0-2
- UnitOperations
 - MIX-100
 - V-100
 - E-100
 - E-101
 - V-101
 - T-100
 - DEW
 - MIX-101

Ports

Name	Tree node	Direction	Value
MassFlow	(Streams,Feed_1,MassFlow)	→	7856.79708565 kg/h
Pressure	(Streams,Feed_1,Pressure)	→	4008.055215400001 kPa
Temperature	(Streams,Feed_1,Temperature)	→	15.531597236000001 C
MassFlow	(Streams,Feed_2,MassFlow)	→	4969.175535 kg/h
Temperature	(Streams,Feed_2,Temperature)	→	15.475328786 C
Pressure	(Streams,Feed_2,Pressure)	→	4005.08371045 kPa
Temperature	(Streams,Subcooled_feed_vapour,Temperature)	→	-19.309882257 C
Dew_diff	(UnitOperations,DEW,Dew_diff)	↔	24.577594937454336 EU

Standardization and extension

Plug & Play standardized blocks

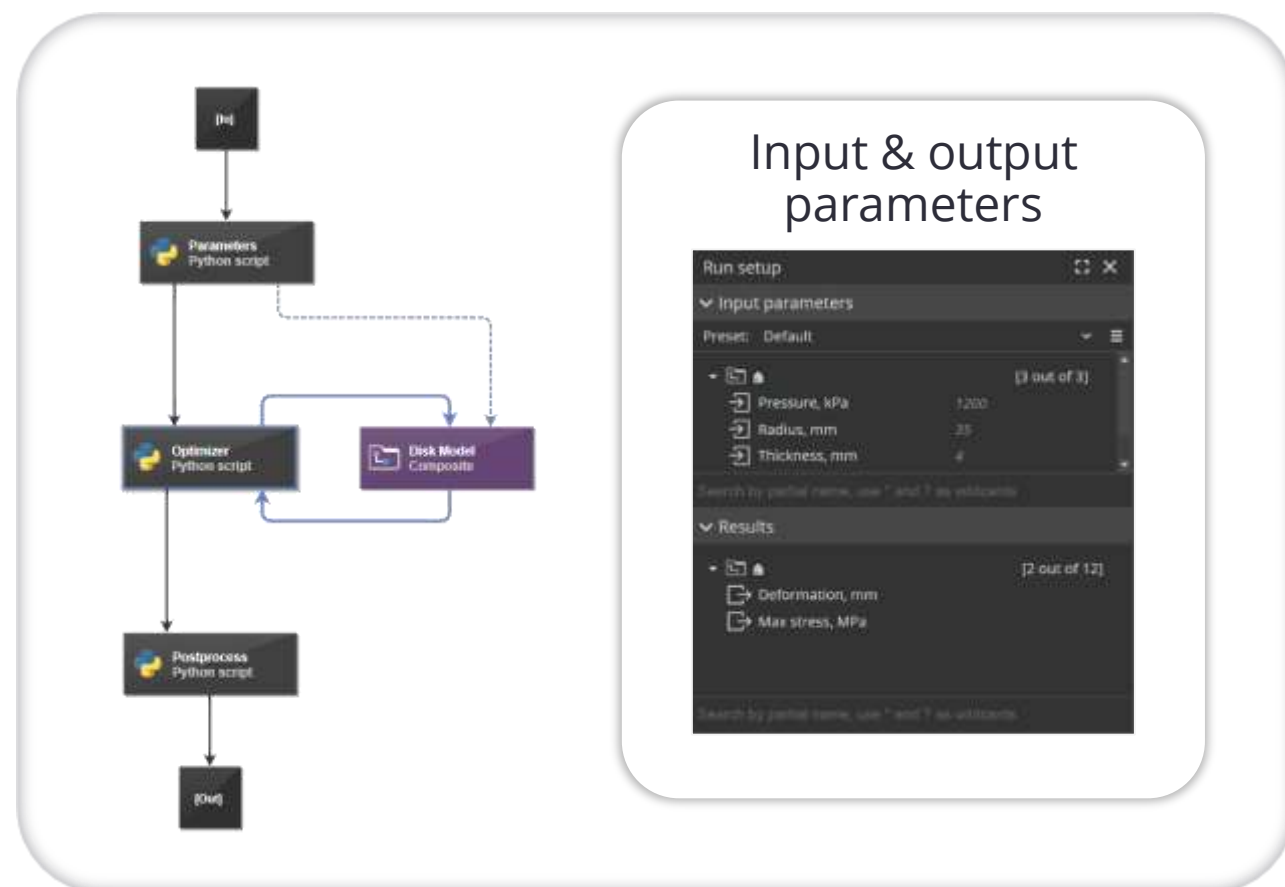
- ANSYS Workbench
- Excel
- Sim model



Easily share engineering workflows as Web Apps

- Qualified users build engineering workflows and share them as simple Web Apps with others.
- Create easy-to-use **engineering calculators** and hide the unneeded complexity.

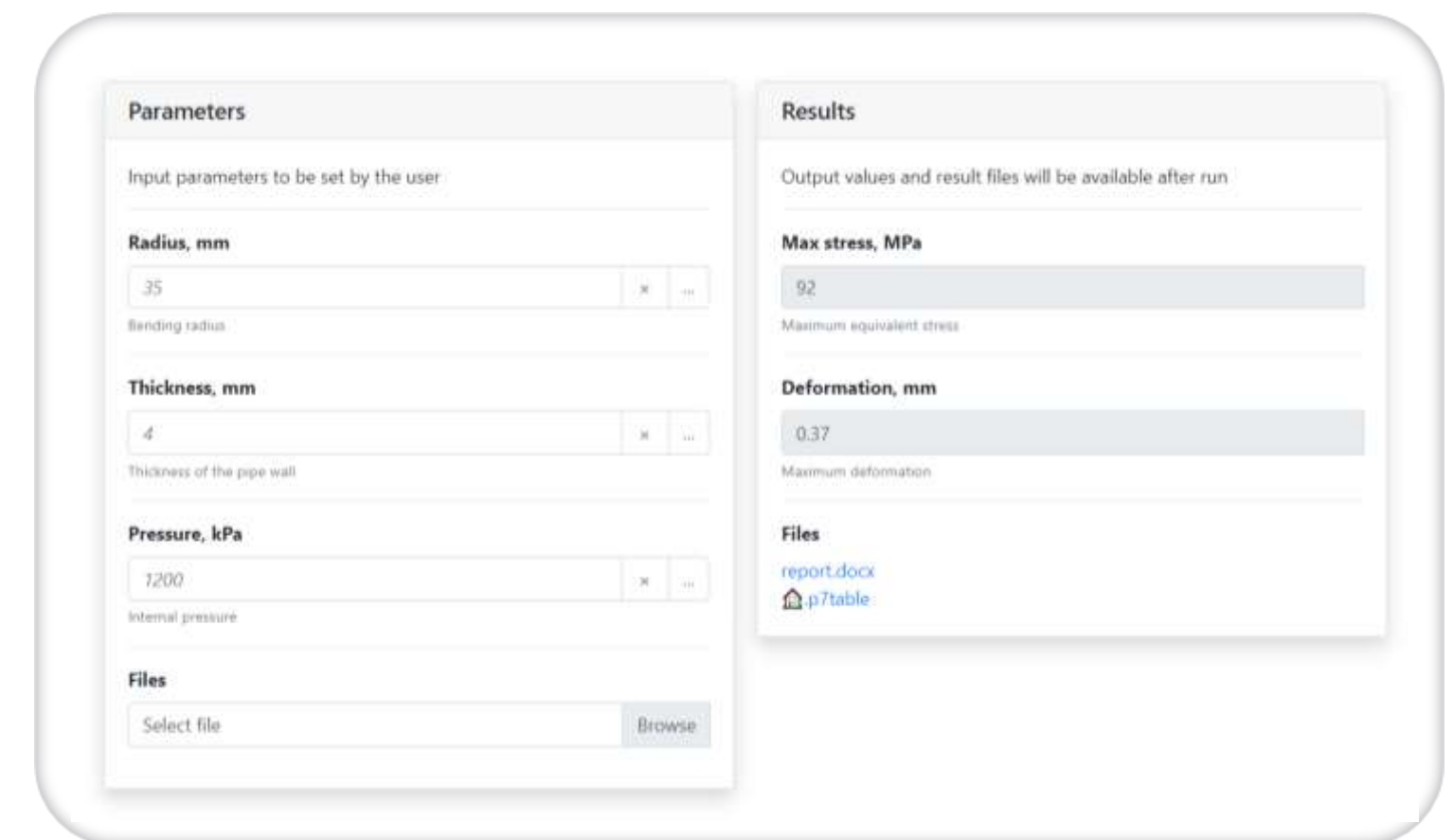
- Prepare a workflow (by advanced users)



- Create a Web App in few clicks



- GUI is generated automatically (for citizen users)



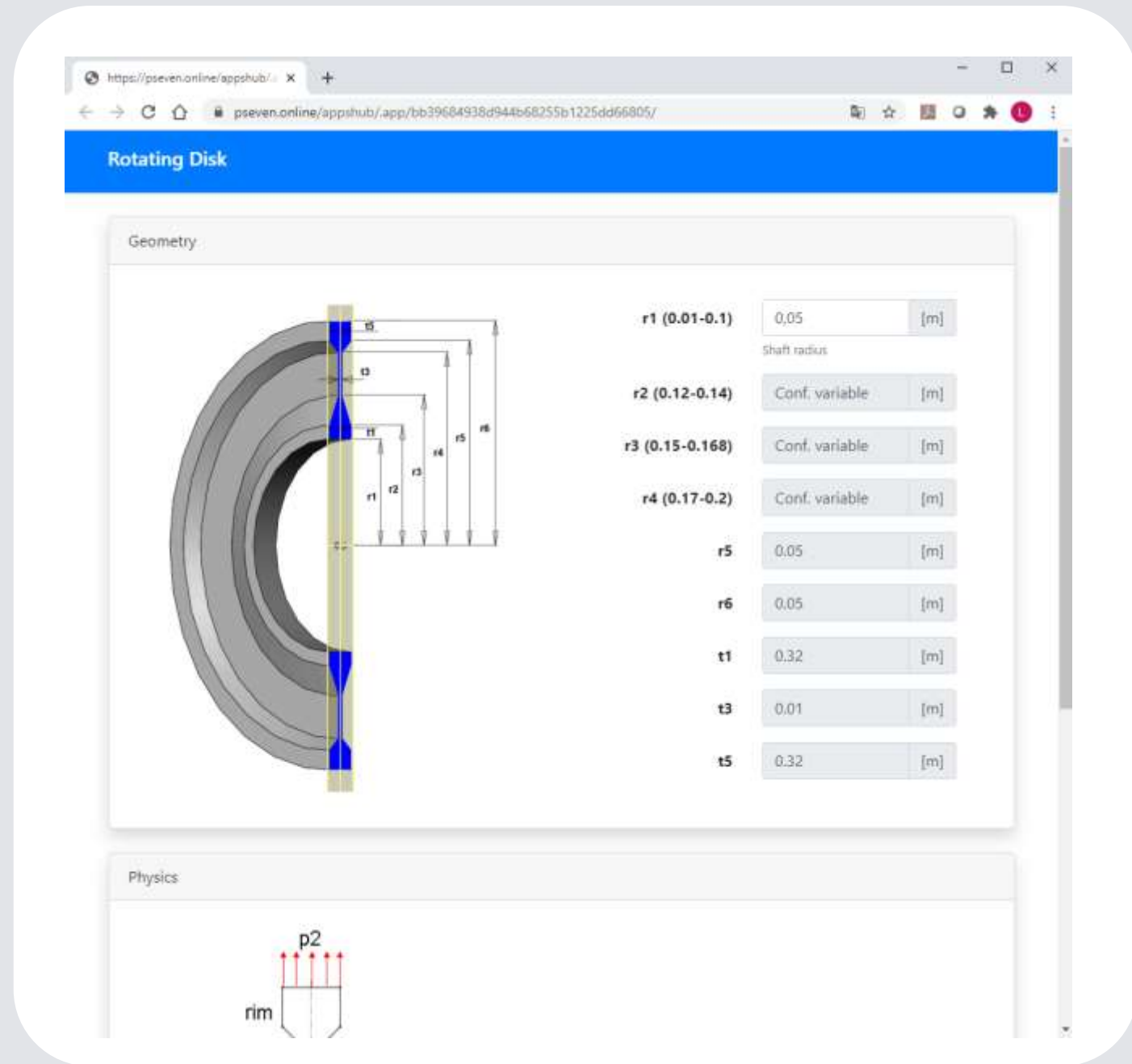
Democratization



Web App default GUI can be customized

- Develop a custom GUI for an App

- Explore result in any browser



- Run on server



Bring advanced methods to citizen users



Gallery of Web Apps and services - AppsHub

Workflows and models as Web Apps

L/D Modeling
modeling@adesign.net
Train an approximation model of an airfoil with variable parameters to estimate the lift coefficient and drag coefficient.
32 days ago 311

Turbine Disk Optimization
engineering@adesign.net
Optimize performance characteristics of the rotating disk in a gas turbine engine using a FEM solver.
34 days ago 67

Bistable MEMS
mde@mems-sol.com
Optimize shape design of a bistable micro-electro-mechanical system (MEMS) switch.
34 days ago 34

Three-Section Beam
engineering@adesign.net
Minimize the mass of a three-section beam subject to a rigidity constraint using a FEM solver.
58 days ago 138

Heat Exchanger
ae@datadvance.net
Optimize hydraulic resistance and geometry of a heat exchanger with a required cooling rate.
61 days ago 53

Single Cylinder
public@dasba.net
Optimize torque and mass of a single cylinder gasoline engine simulated with Amesim.
67 days ago 86

Workflows and models as services (access via REST API)

Compressor #4
Sergey Morozov (sergey.morozov@datadvance.net)
Compressor #4 (updated ML model)
a few seconds ago

Compressor #3
Sergey Morozov (sergey.morozov@datadvance.net)
Compressor #3 (advanced ML model)
a few seconds ago

Compressor #2
Sergey Morozov (sergey.morozov@datadvance.net)
Compressor #2
2 minutes ago

Compress #1
Sergey Morozov (sergey.morozov@datadvance.net)
Compressor #1
2 minutes ago

Streamline operations

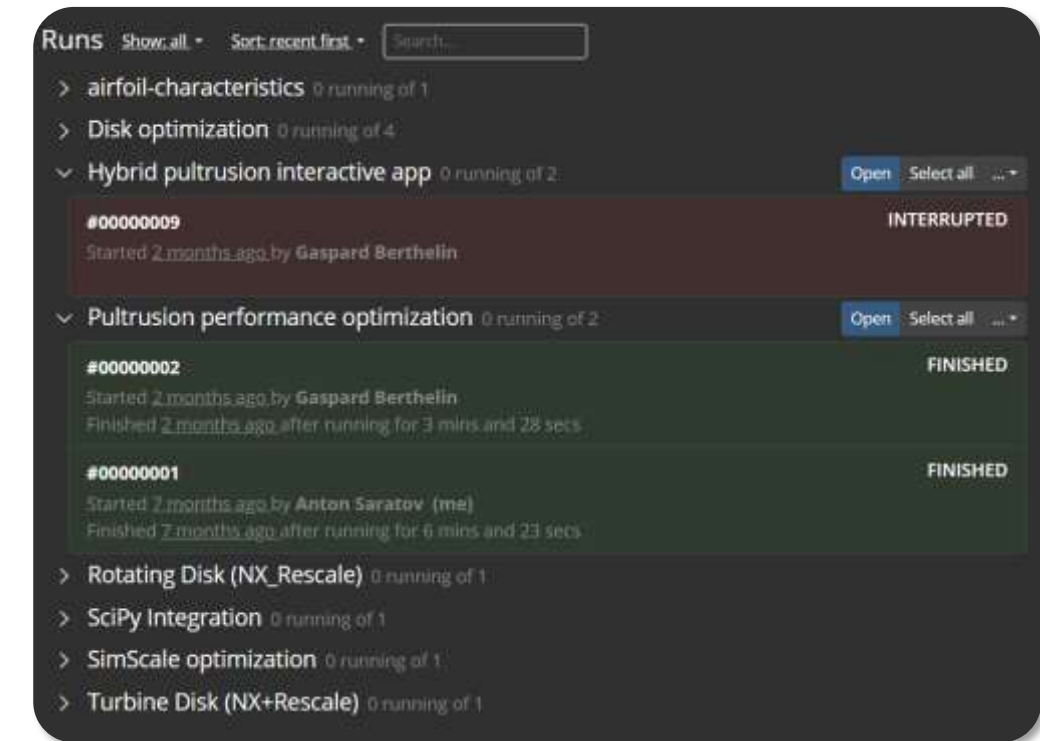


Service orchestration

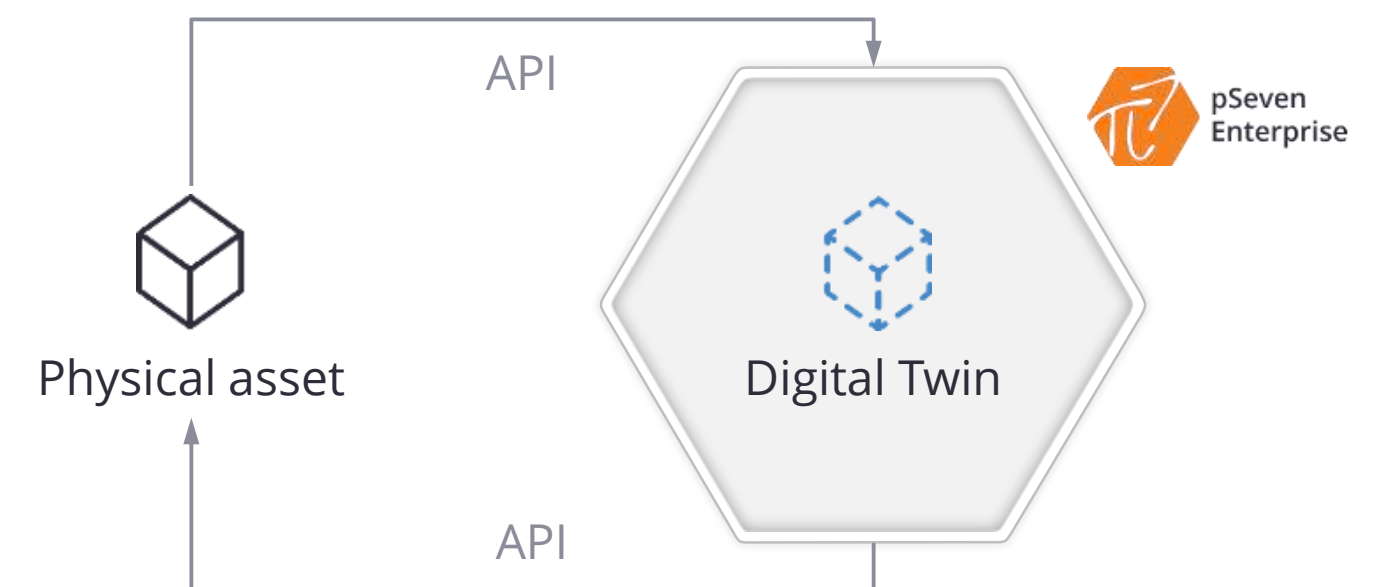
- Every workflow can be considered as a **web service** or **model as a service** with REST API.
- Full control over runs:
 - Who, when, run status etc.
- Execution on event and on schedule:
 - Example: the physical asset sends new input data to its Digital Twin for status update and/or for results that are used as input for the physical asset itself.

Transparency

Run manager

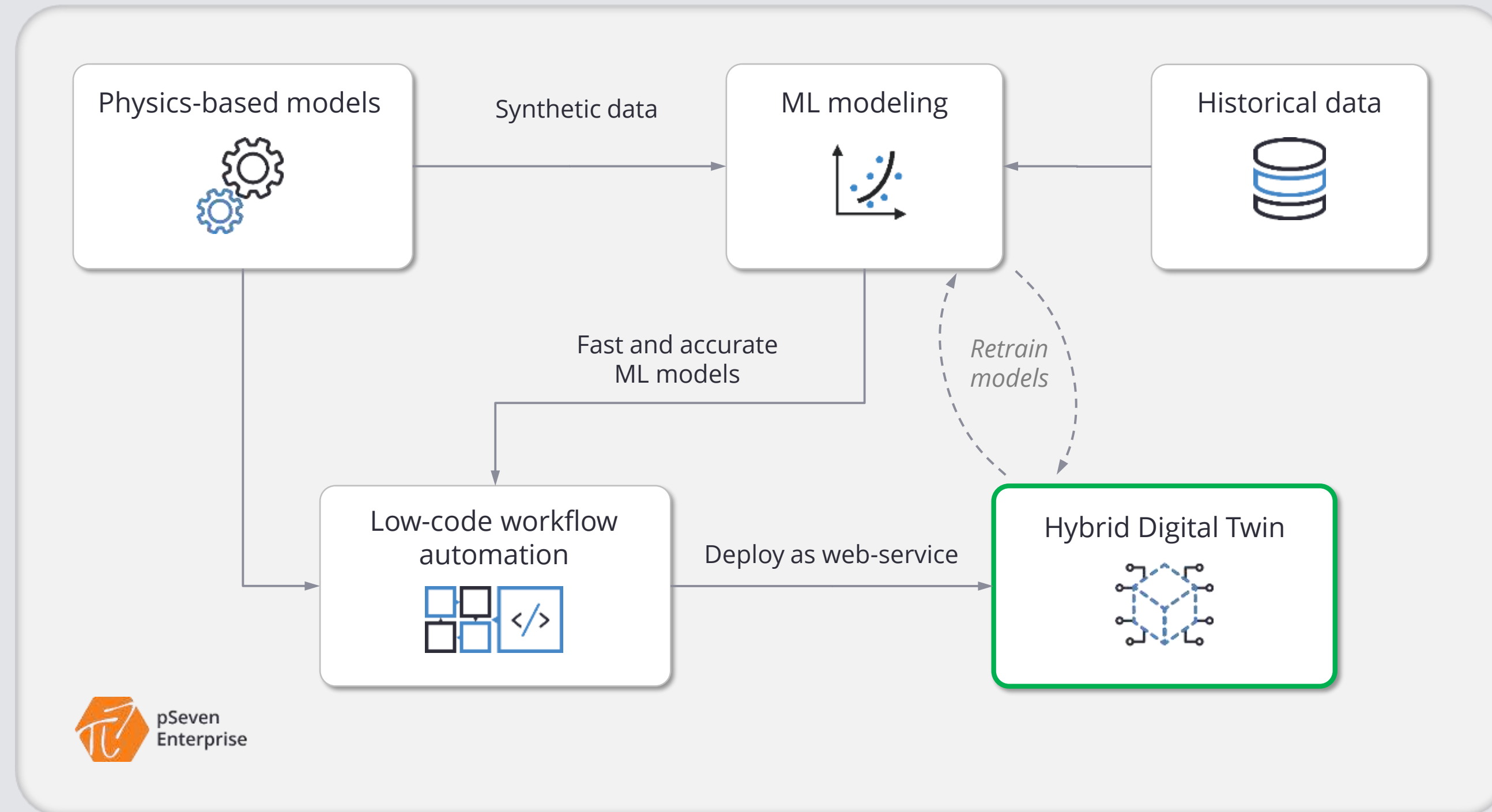


Digital Twin data exchange





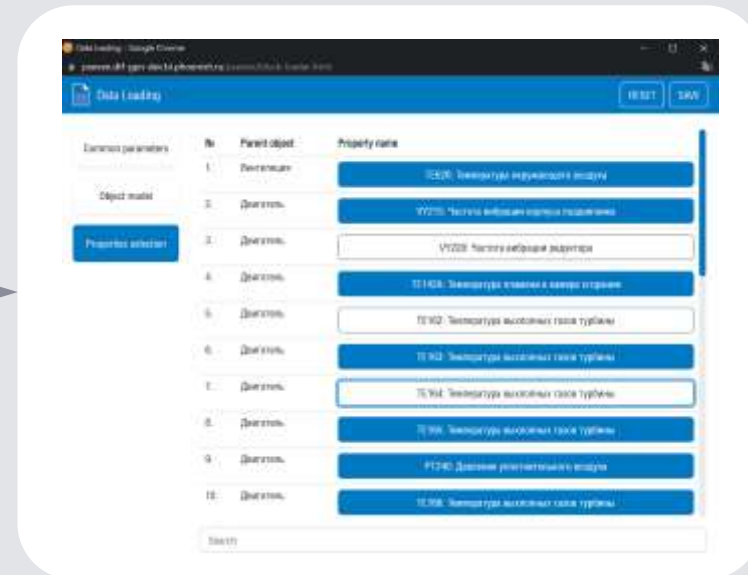
Assembling Hybrid Digital Twins in pSeven Enterprise



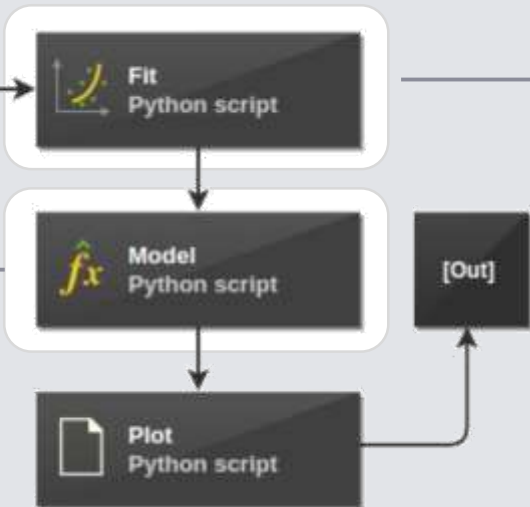
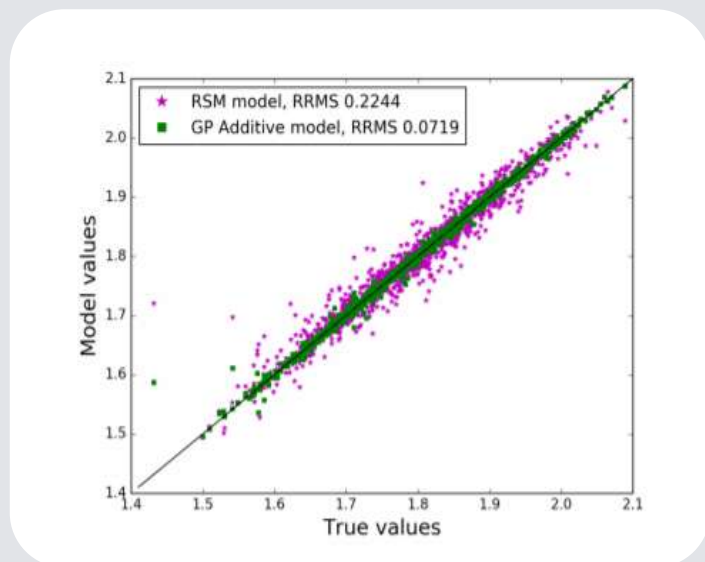


Deliver automated workflows across the enterprise

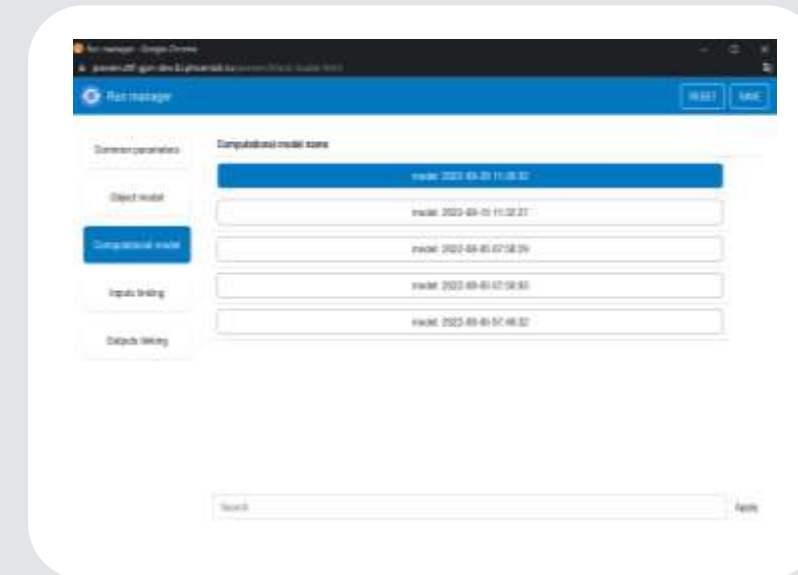
1. Create workflow



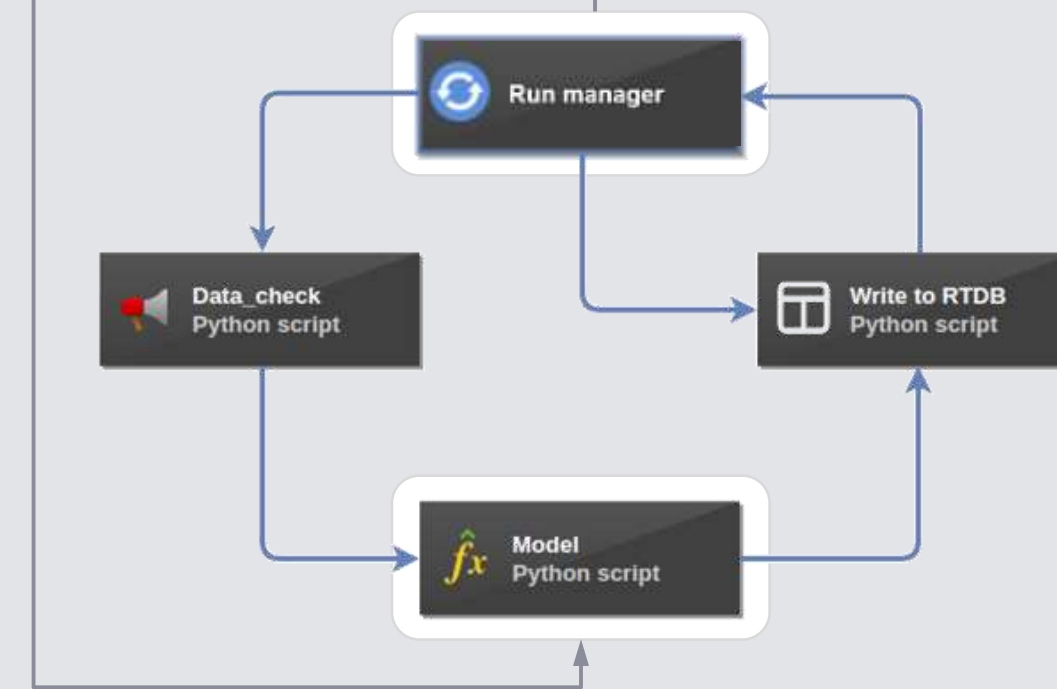
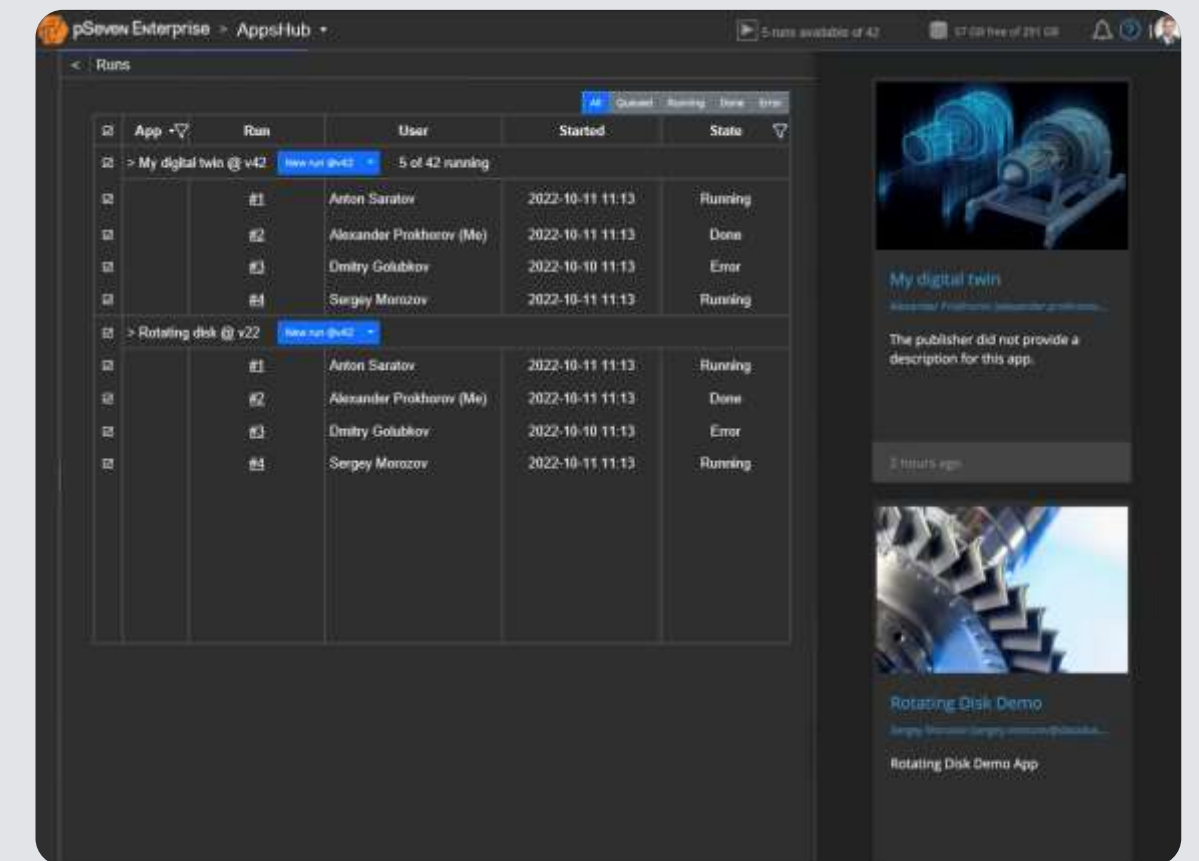
2. Validate model



3. Deploy as service

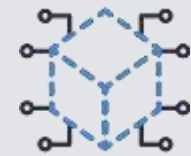


4. Manage lifecycle

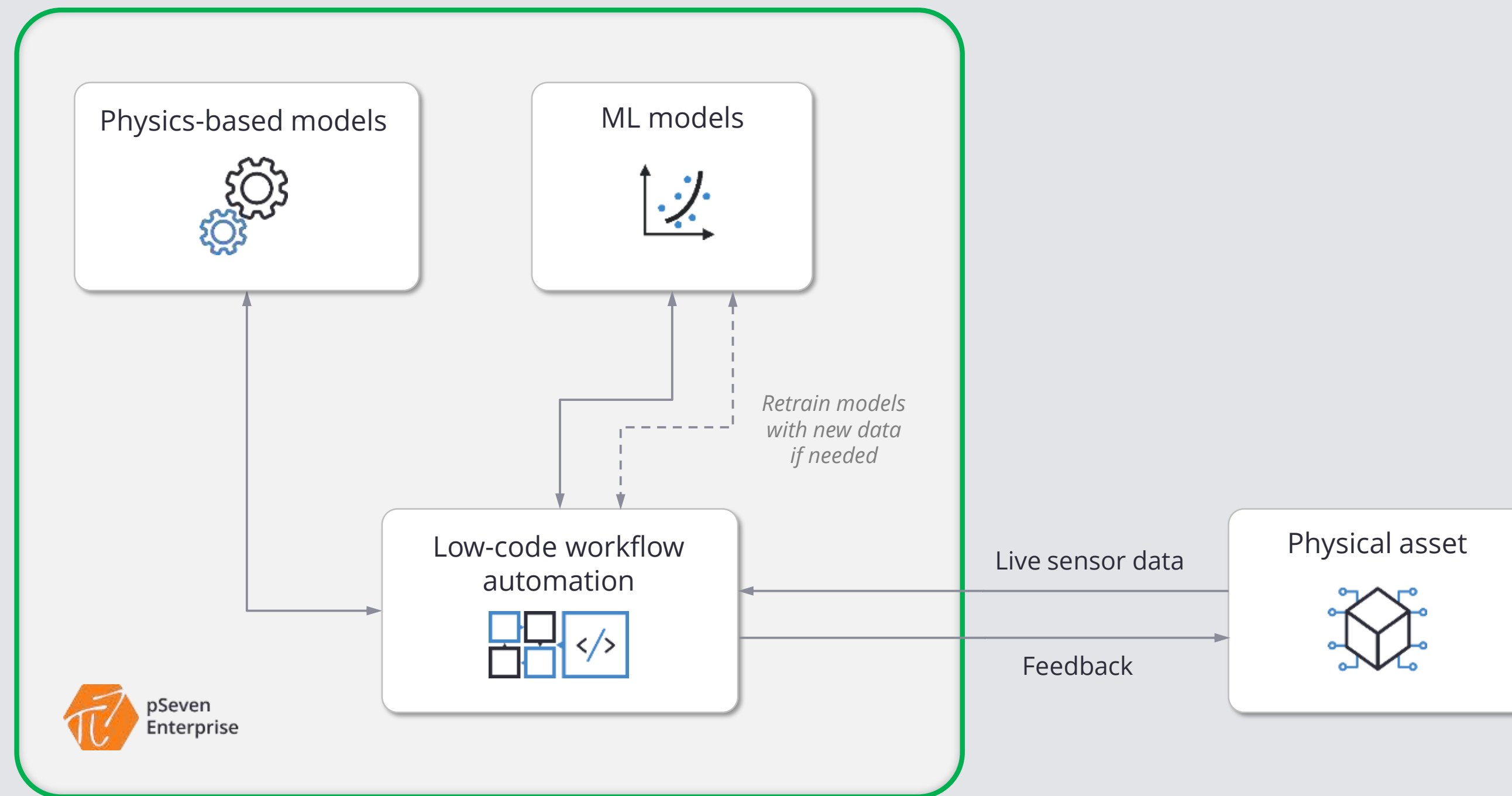




Operating Hybrid Digital Twins in pSeven Enterprise



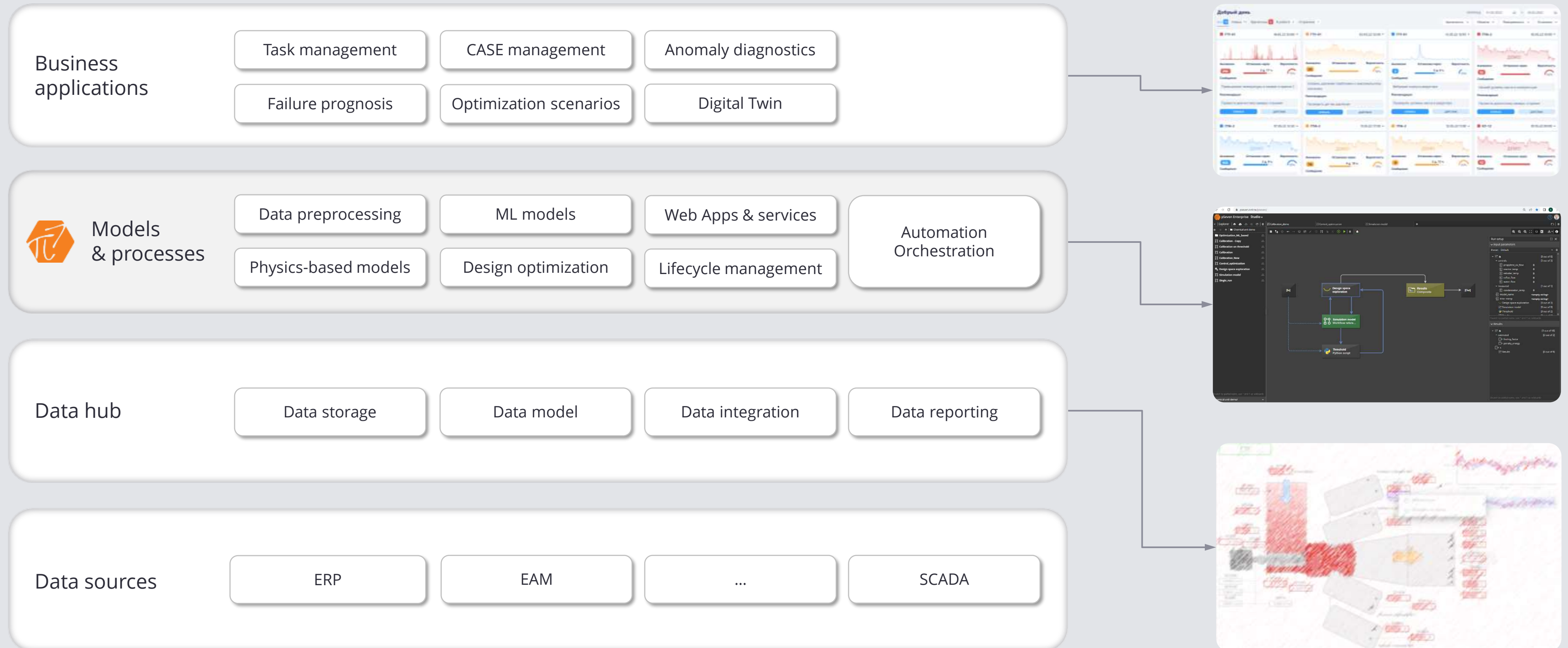
Online Hybrid Digital Twin



Bridge the gap between engineering and operations



Typical solution architecture for the Digital Twin





Benefits from pSeven Enterprise adoption



Productivity gain

Reduce delivery time through automation of repetitive tasks



Flexibility

Improve flexibility of operations with low-code approach



Better designs

Improve product/process quality with optimization

THANK YOU

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