pSeven Enterprise: new features and plans overview

Anton Saratov
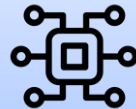Head of Application Engineering

DUC 2022

pSeveN Enterprise

Key Platform Features

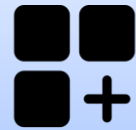**Intelligent automation and workflow orchestration**

Growing platform-native block library

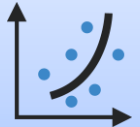**Custom integrations, algorithms and block library**

App Development and One-click Deployment

AppsHub

Interoperability / API

Machine Learning & Optimization

Multi-user collaborative environment

Cloud-native scaling

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Features of continuous manufacturing pultrusion process:

- Complicated physical and chemical processes, non-linear responses behaviour.
- Resource and time consuming (yet accurate) **simulation models** (in Abaqus) to determine the product characteristics for various process and material parameters
- Similar **(standard)** workflows for different product shapes

Goals:

- **Fast prediction** of expected final product properties for various parameters of the process directly in the lab→ **Predictive Quality**
- Evaluation of **optimal process setup** for best performance (production speed) under technological constraints→ **Optimization**
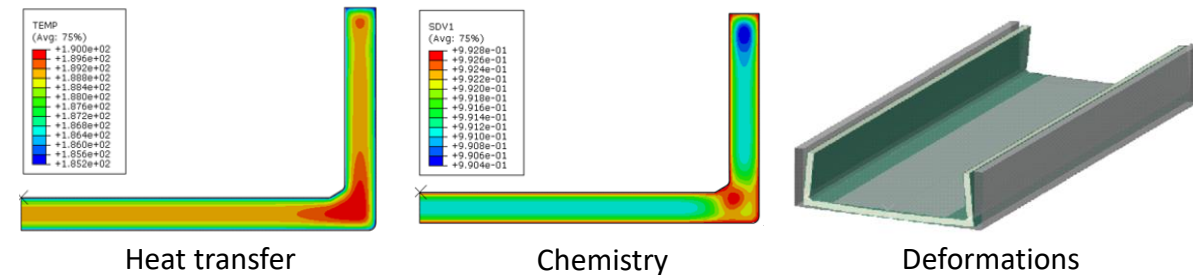
Process and material parameters:

- Pulling speed U (directly translates into production speed)
- Initial material temperature T0 (can be determined from external sensors)
- Die chambers temperatures T1 и T2
- Material properties (out of the scope in the demo)
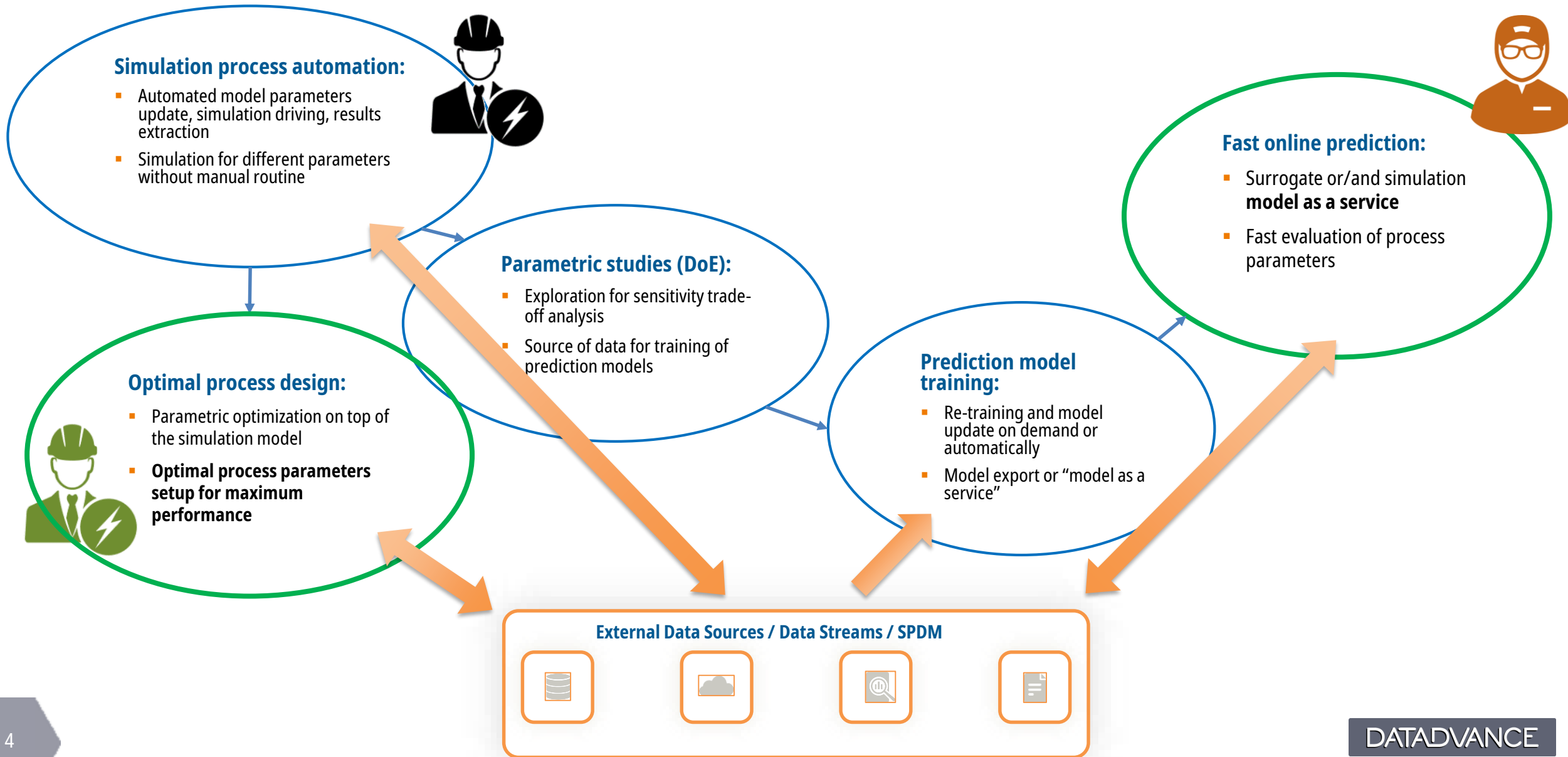
Product properties (quality criterion):

- Polymerization rate / Cure (the higher the better, in percent)
- Maximum temperature in the product (must be less than critical)
- Stress limitations
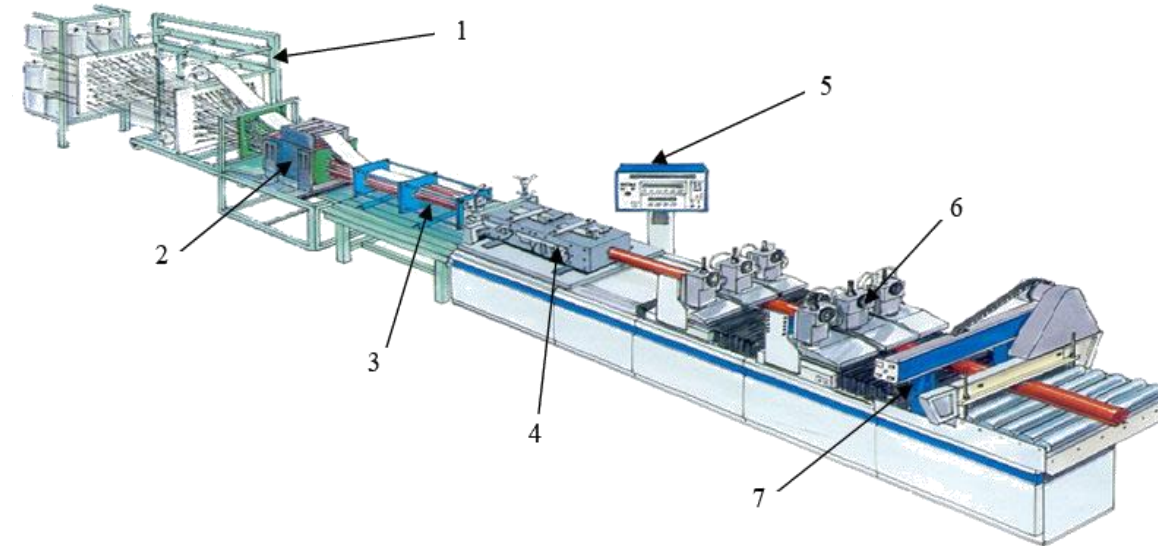
Pultrusion stand scheme. 1 - Feeder of the fiber. 2 - Polymer fusion. 3 – Forming (folder). 4 – Die chamber. 5 - Control station. 6 - Pulling mechanism. 7 - Cut-off point

Heat transfer   Chemistry   Deformations

* Based on joint project of Datadvance, Skoltech и Apatek
https://www.datadvance.net/blog/use-cases/optimization-of-pultrusion-of-glass-fiber-reinforced-profile.html

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Live demo : scenarios

Simulation process automation:
- Automated model parameters update, simulation driving, results extraction
- Simulation for different parameters without manual routine

Parametric studies (DoE):
- Exploration for sensitivity trade-off analysis
- Source of data for training of prediction models

Fast online prediction:
- Surrogate or/and simulation **model as a service**
- Fast evaluation of process parameters

Optimal process design:
- Parametric optimization on top of the simulation model
- **Optimal process parameters setup for maximum performance**

Prediction model training:
- Re-training and model update on demand or automatically
- Model export or "model as a service"

External Data Sources / Data Streams / SPDM

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Capture and re-use your processes, collaborate, share and deploy at scale

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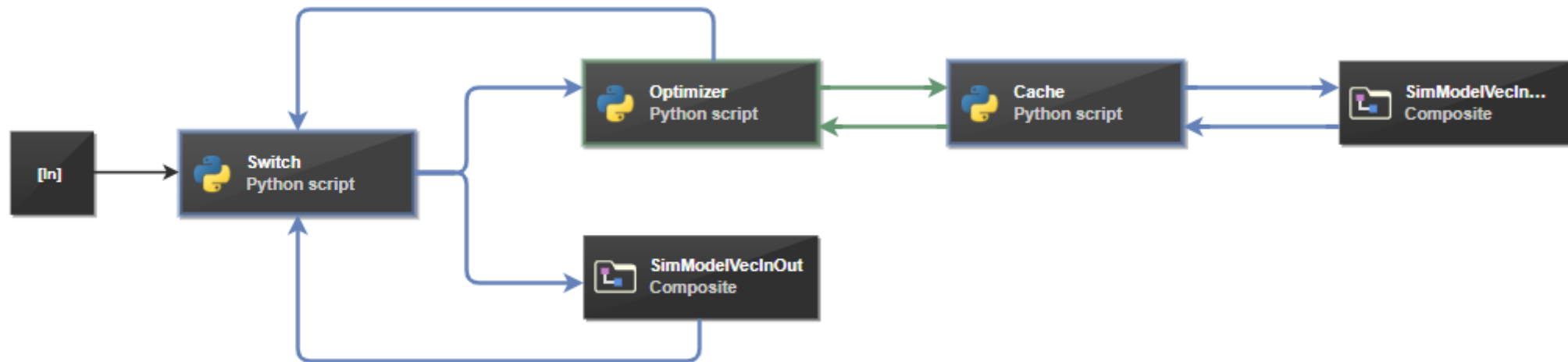
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All Simulation, Data Analytics and Optimization Tasks can be Routinely Automated!

Powerful full-cloud workflow authoring and orchestration engine

Full-fledge visual low-code programming:

- Intuitive and visual definition of complex processes

- Implementation of logic operations and nested loops

- Automatic parallelization and workflow encapsulation

- Local and remote execution in heterogeneous environment: cloud + extension node (including Windows!)

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Recent user experience improvements:

- Automated cycle recognition with color highlight

- Ports connections validation in info panel

- Improved link dialog & autolinking

- On-click batch mode in Composite

- New data editor widget & useful datatypes (Table)

- Run status coloring indication

- **(!)** Email notifications
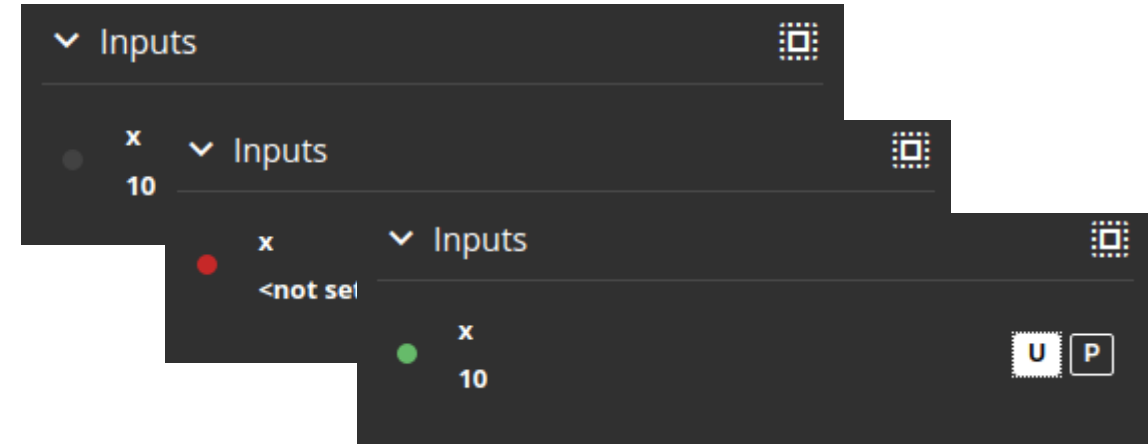
Performance improvements:

- Up to x10 speedup data transfer for specific data types and huge data

- Significant reduction of disk consumption with auxiliary files (logs etc.) – both in runtime and after run

- **(!)** New execution strategy: "on-demand" – blocks initialize just before execution (contrary to "all-at-once")

- User or block developer can set the expected memory consumption limit to effectively utilize cluster resources

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Block library and custom blocks

## Design space exploration block

- All features of DSE block in Enterprise

- Autogenerated resulting datasets to import into reports

PythonScript block improvements:

- Testing mode during Edit

- Code editor features: search, highlight under cursor, Ctrl+/ to comment out the code, etc...

- In-block caching

- Huge list of available modules and ability to add your own

Custom block development:

- New typesystem: Matrix, Table, Tables with fixed columns, Vector

- "Assets" – general block data (or shared code) storage at platform level

- Block publishing. Permissions to access block code

- Simplified custom block template for blocks without Edit mode

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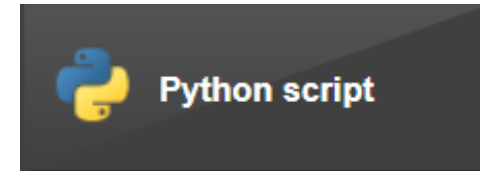
Upcoming features and blocks

Upcoming blocks:

- Loop: while- and for- cycles

- Text: interactive substitution/parsing block

- Program: command line execution block for Windows nodes

- Approx Builder/Player

- UQ

Workflow, orchestration and usability:

- More improvements in Data editor (extended copy-paste etc.)

- Extended resource management, monitoring

- Notification panel (events, runs etc.)

Custom blocks:

- Brand-new custom block example/template

- Deep customization of environment (custom images support)
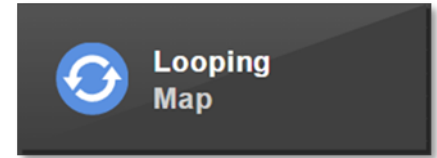
Looping Map

5 runs available of 42   57 GB free of 291 GB

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Capture and **re-use your processes, collaborate, share** and deploy at scale

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pSeven users can share their workflows and data with others

But what if the sub-workflow is maintained by one person and used by others?

Workflow-by-link mechanism allows to refer, not to copy:

- Special block, similar to Composite, to link workflow "as block"

- Allows to link own and shared workflows and apps

- Automated propagation of in/out ports

- Batch execution support

- Consistency verification

Expected in 2022.11
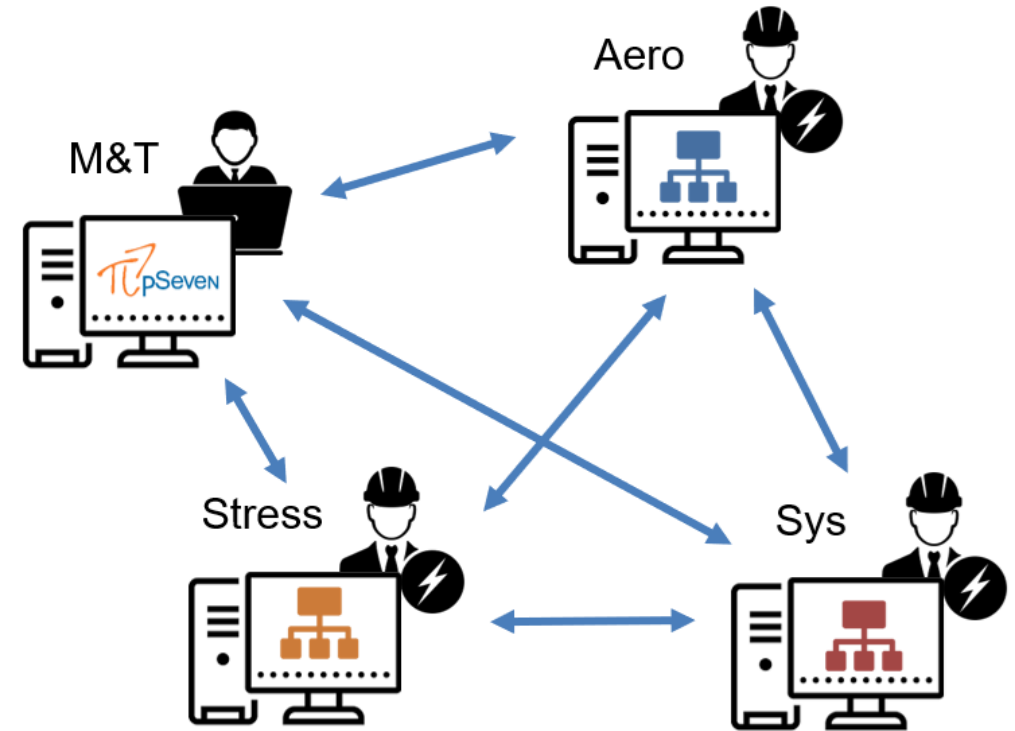
Upcoming: workflow snapshots & apps versions

**External references to the workflows requires the versioning mechanism**

One of the next big features is "snapshots" – captured workflow states, accessible later:

- Full workflow setup and state can be saved as workflow version

- On-demand or on-event (like "snapshot when published to AppsHub")

- Propagated to workflow-by-link – a reference can be set to a particular version

- Easy revert to previous version without loosing current progress

- AppsHub apps will also receive versions, updated once the app is re-published
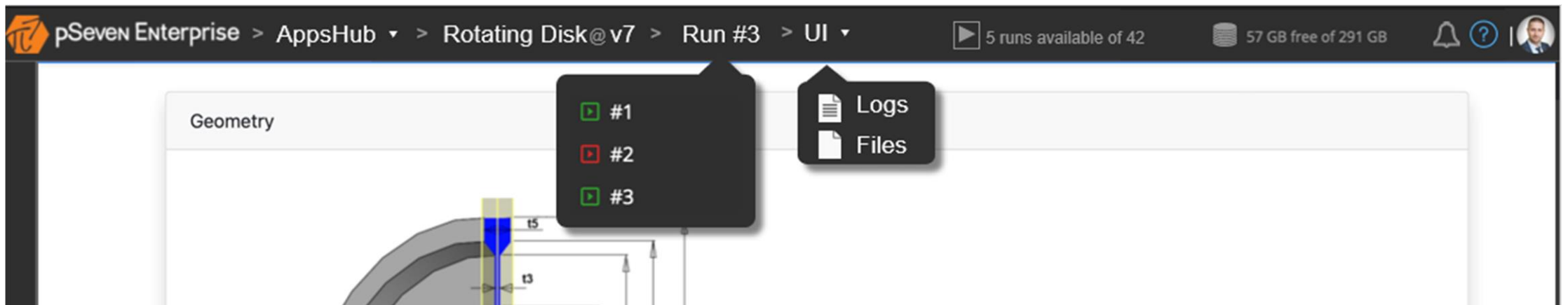
Capture and re-use your processes, collaborate, **share and deploy at scale**

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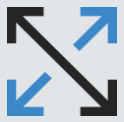
Interaction with external platforms as a part of bigger ecosystem puts additional requirements on security, IT policies and integration

Keycloack integration - open-source identity and access management solution:
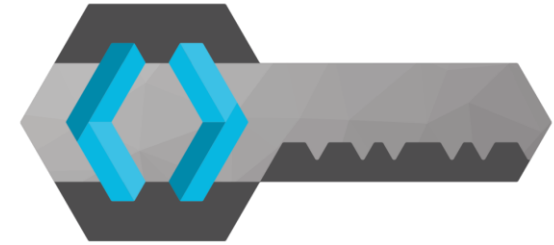
- Enabling SSO

- Two-factor authorization

- User profiles synchronization with corporate LDAP\Active directory

NFSv4 support

User policies:

- Disk space quotas

- Block access rights

- Studio/AppsHub access

And even branding!

Authenticator

1. Install one of the following applications on your mobile:
   - FreeOTP
   - Google Authenticator

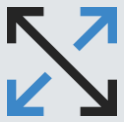2. Open the application and scan the barcode:

Unable to scan?

3. Enter the one-time code provided by the application and click Save to finish the setup.

Provide a Device Name to help you manage your OTP devices.

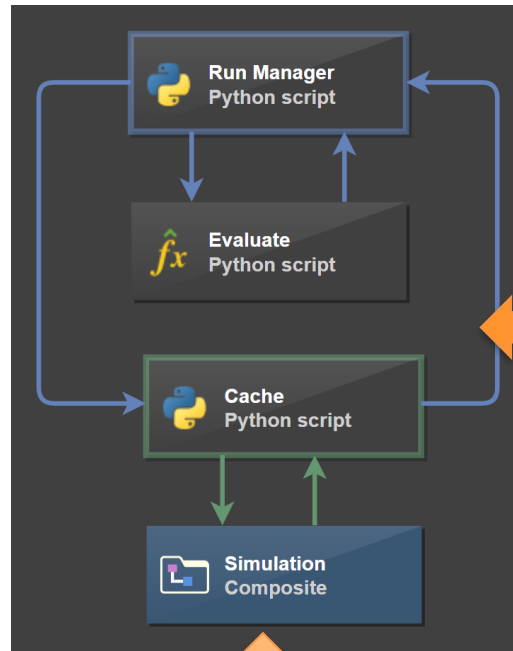One-time code *

Active Directory

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REST API enables external integrations:

- Workflow as a service
- App as a service from AppsHub

- Including almost interactive exchange thanks to "waiting workflow" concept

Various applications:

- Integration with DBs and data streams
- On-demand and even on-event calculations
- Predictions and simulations, or hybrid mixtures
- Optimization for digital twins with initialization by online data

PultrusionApp

Input settings — ROD

Pultrusion process parameters

V, [mm/s] — 1

T0, [C] — 30

T1, [C] — 135

T2, [C] — 160

Results

Model Response

Cure, [%] — 3.5 +- 1.4

Tmax, [C] — 159.06 +- 0.18

Model Inputs

V, [mm/s] — 1

T0, [C] — 30

T1, [C] — 135

T2, [C] — 160

Run Manager — Python script

Evaluate — Python script

Cache — Python script

Simulation — Composite

```
2022-09-20 10:27:45,776 - root - DEBUG - Getting workflow by ID 'd9cfab525ad4429187ca65ca81d7c0fb'...
2022-09-20 10:27:49,199 - root - DEBUG - Creating a new workflow run...
2022-09-20 10:27:49,508 - root - DEBUG - Waiting for run 'CONFIGURATION' state...
2022-09-20 10:27:50,620 - root - DEBUG - Pulling REST API...(INITIALIZING)
2022-09-20 10:27:55,981 - root - DEBUG - Pulling REST API...(CONFIGURATION)
2022-09-20 10:27:56,961 - root - DEBUG - Pulling REST API...(SUBMITTING)
2022-09-20 10:28:02,280 - root - DEBUG - Pulling REST API...(QUEUED_TO_RUN)
2022-09-20 10:28:07,561 - root - DEBUG - Pulling REST API...(QUEUED_TO_RUN)
2022-09-20 10:28:12,929 - root - DEBUG - Pulling REST API...(QUEUED_TO_RUN)
2022-09-20 10:28:18,278 - root - DEBUG - Pulling REST API...(QUEUED_TO_RUN)
2022-09-20 10:28:23,689 - root - DEBUG - Pulling REST API...(QUEUED_TO_RUN)
2022-09-20 10:28:29,091 - root - DEBUG - Pulling REST API...(QUEUED_TO_RUN)
2022-09-20 10:28:34,399 - root - DEBUG - Pulling REST API...(QUEUED_TO_RUN)
2022-09-20 10:28:39,750 - root - DEBUG - Pulling REST API...(RUNNING)
2022-09-20 10:28:39,752 - root - DEBUG - Send message_push request.
2022-09-20 10:28:40,073 - root - DEBUG - Message was sent successfully!
2022-09-20 10:28:40,074 - root - DEBUG - Waiting model evaluation...
2022-09-20 10:29:17,449 - root - DEBUG - Response was obtained successfully!
2022-09-20 10:29:17,450 - root - INFO - Evaluation results:
2022-09-20 10:29:17,455 - root - INFO - {'predictions': [[153.96729427809908, 0.07225355848569076], [155.108103941
3976, 3.073532323080719e-05]], 'ae': [[0, 0], [0, 0]], 'message': 'Results got from [solver, solver]', 'status': [
'done', 'done']}
2022-09-20 10:29:17,456 - root - DEBUG - Send interruption request.
2022-09-20 10:29:17,735 - root - DEBUG - Interruption request was sent successfully!
```

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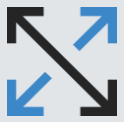
Massive development and deployment of workflows "as services" requires centralized control.

Run center will appear by the end of 2022 to address this need:

- Single control point (list)

- Status and versions of the services in use

- Filtering and tracking

- Deployment options: start/stop, scheduling

- Auto-restart for "waiting workflows"

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