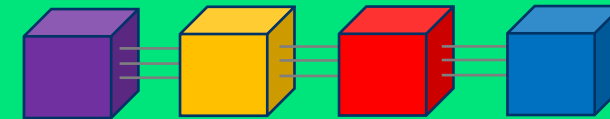


Holistic Process Modelling

*A Solution and a Modelling Platform
to build and host **End-2-End** Digital Twins
for Entire Pharmaceutical Production Processes*

As simple as Stacking Lego Blocks



Presenter: Tobias Eilert

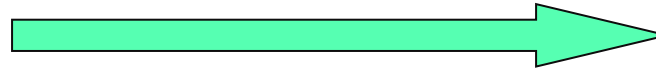
Matrix Team Members: Christine Babel, Jessica Siebert, Marius Brockhoff, Lukas Madenach

Steering Committee: Timo Bailer, Hermann Schuchnigg, Joachim Baer

Life forward

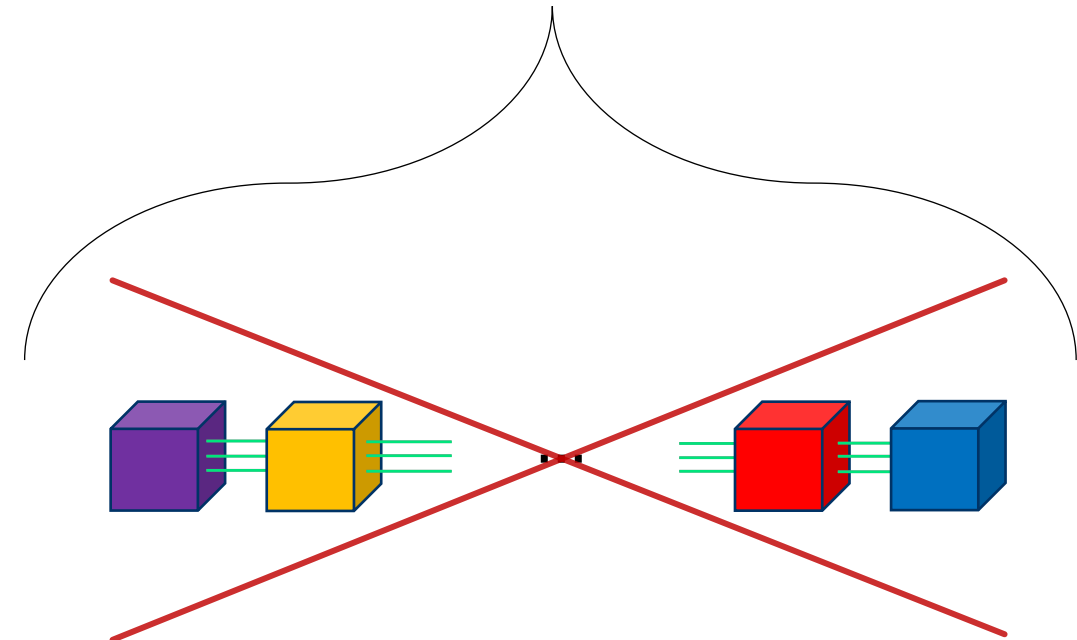
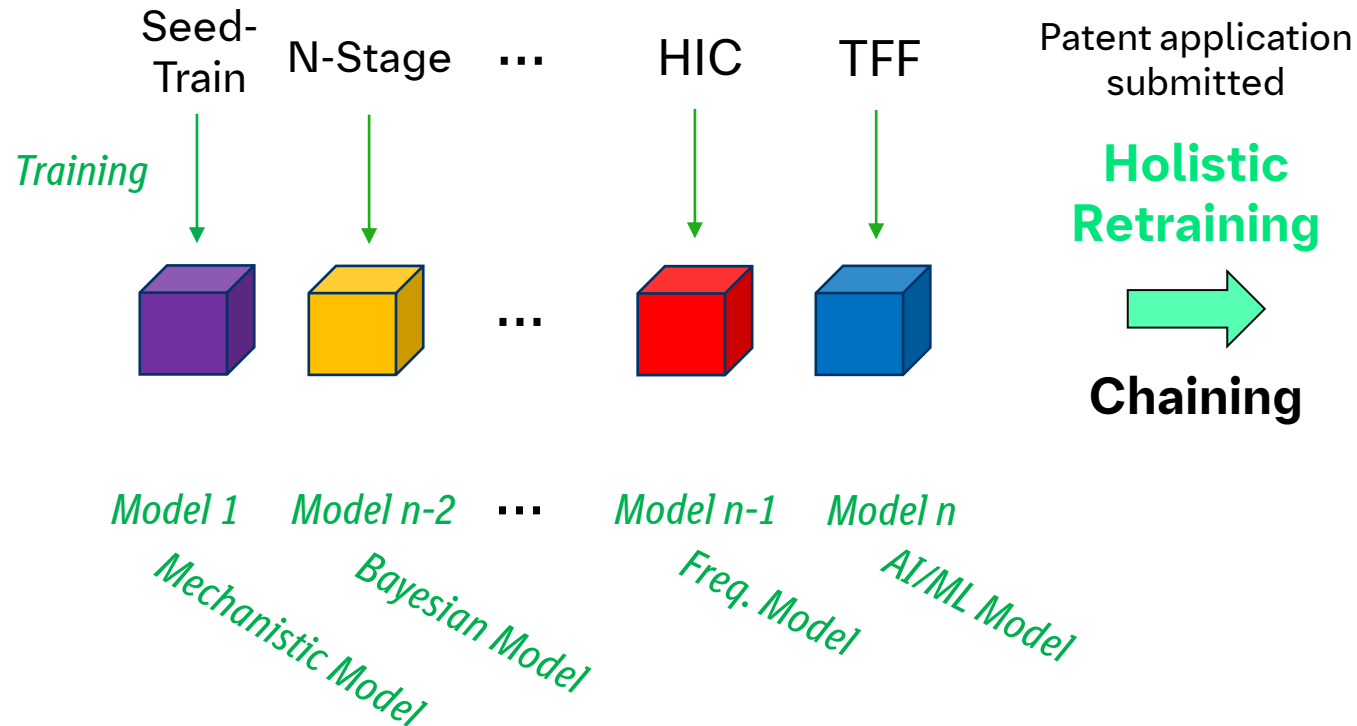
Idea of Holistic Process Modelling

One Process



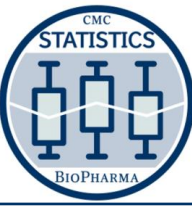
One Model

n Unit Operations



→ **Model-Agnostic**

Why *E2E* Digital Twins?



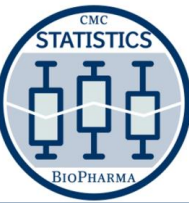
Development

- Support SDM, PCS & PPQ
- PAR-Setting
- Process Optimization
- Process Transfer

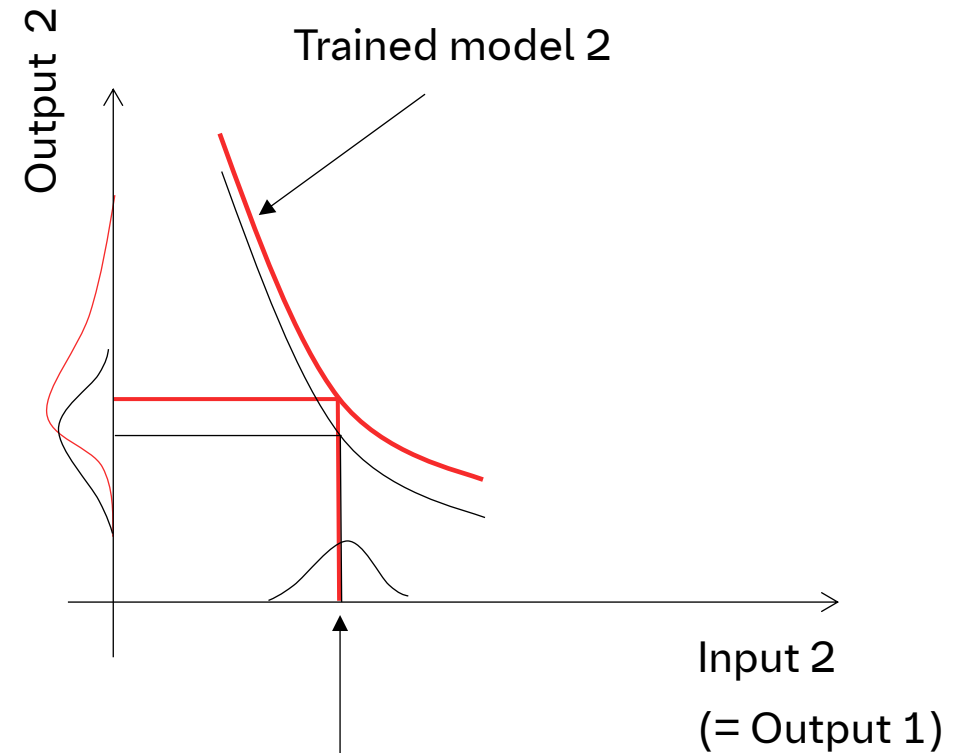
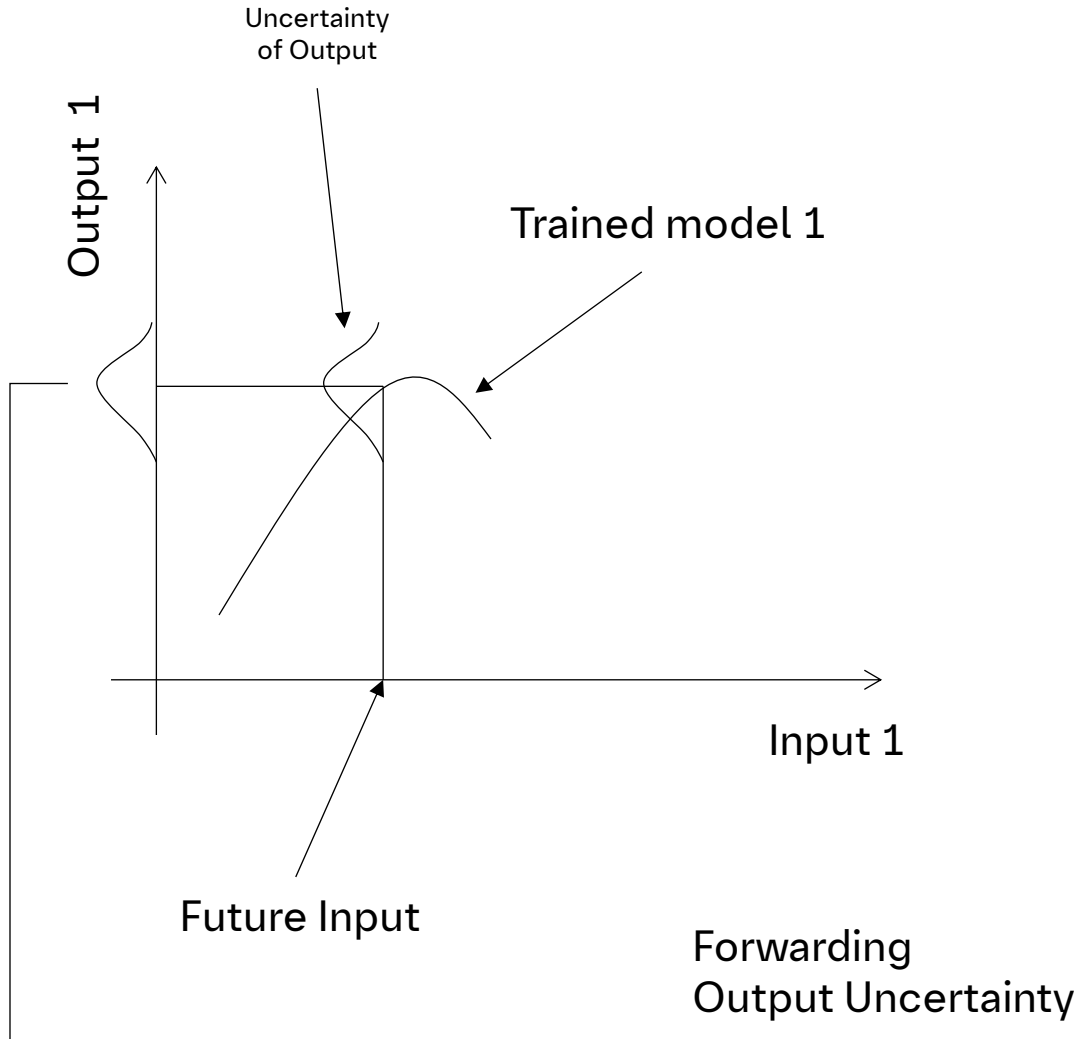
Operations

- Process Transfer
- Process Control
- Process Steering
- Troubleshooting

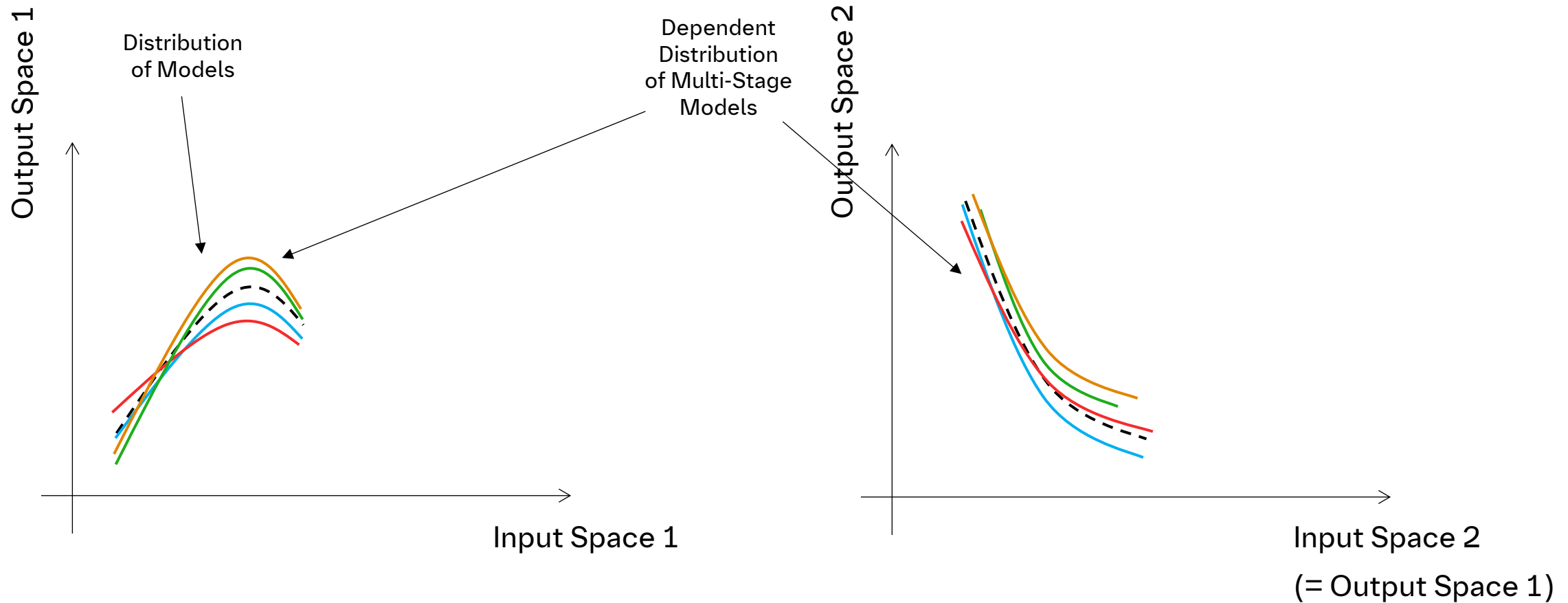
Current State in Literature



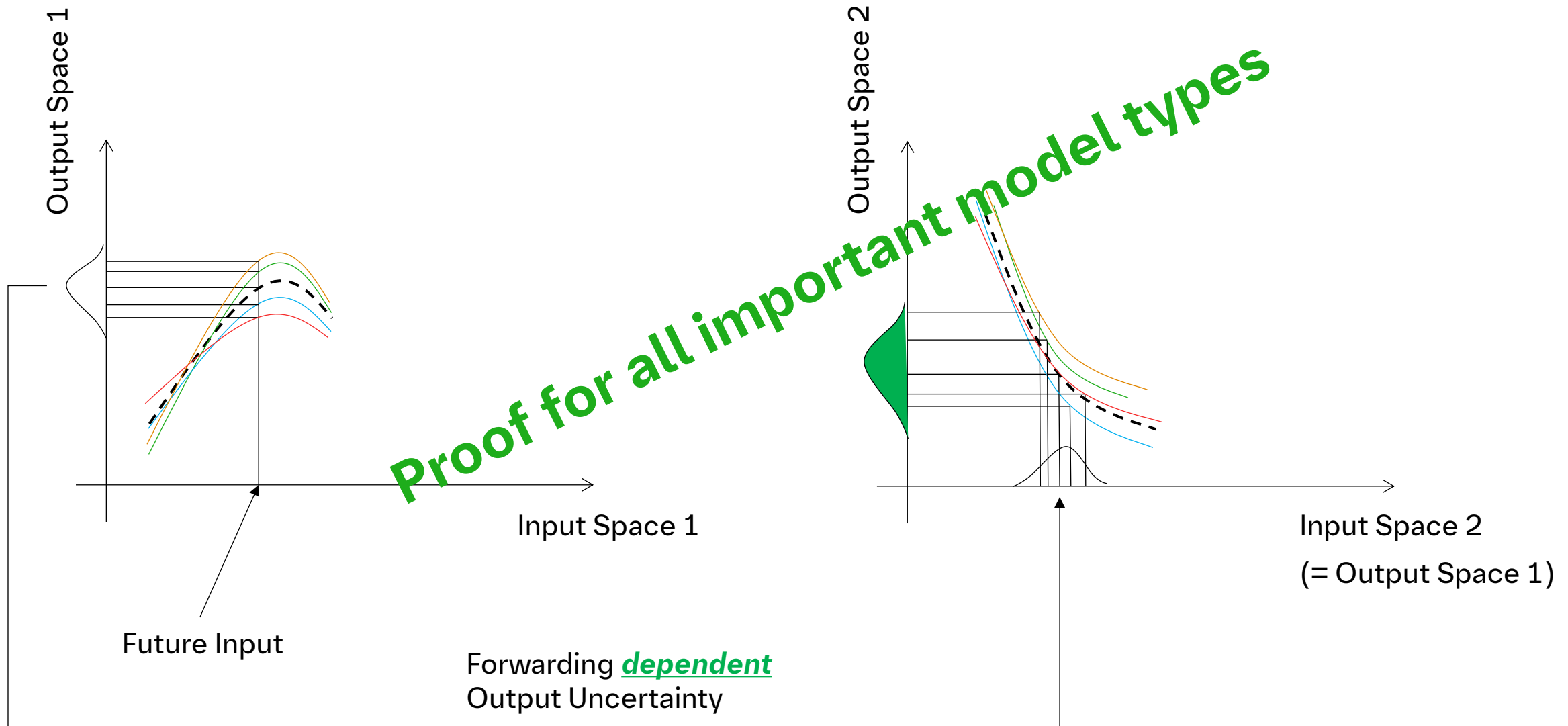
Current State in Literature



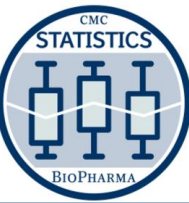
Holistic Retraining



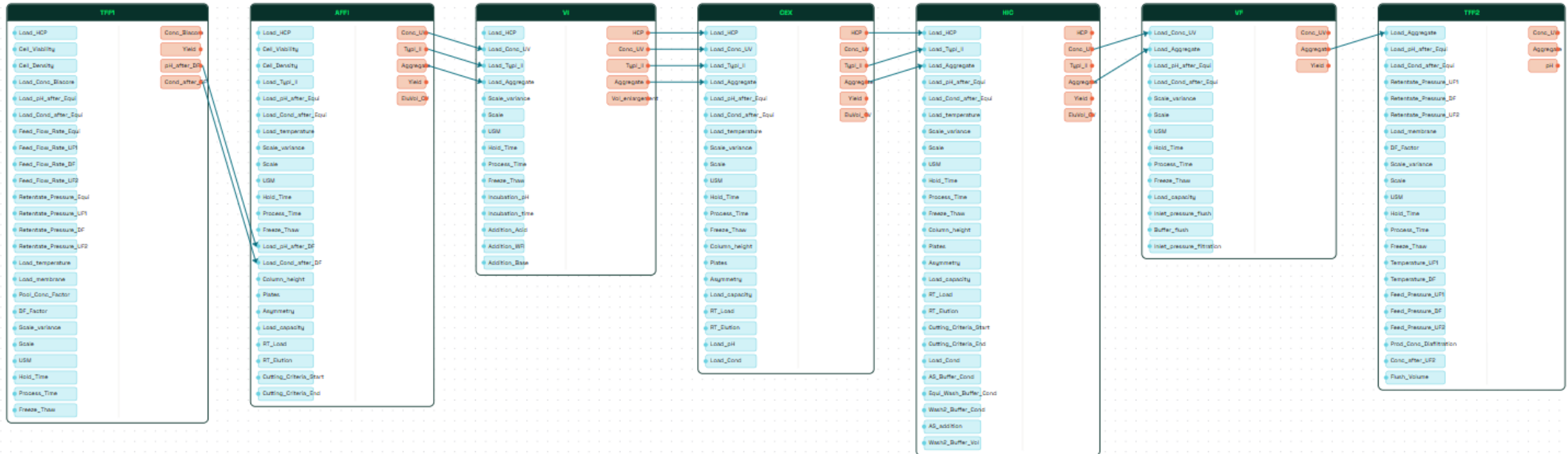
Holistic Prediction



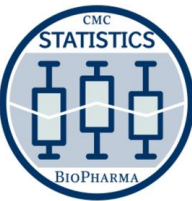
Platform Overview



Define your holistic process



Platform Overview



Model Specification

Configure UO and per-output methods.

> TFF1 linear_regression 4 outputs

Submit Fit

* Number of runs: 250 * Test size: 0.10 Submit

Effects

Main

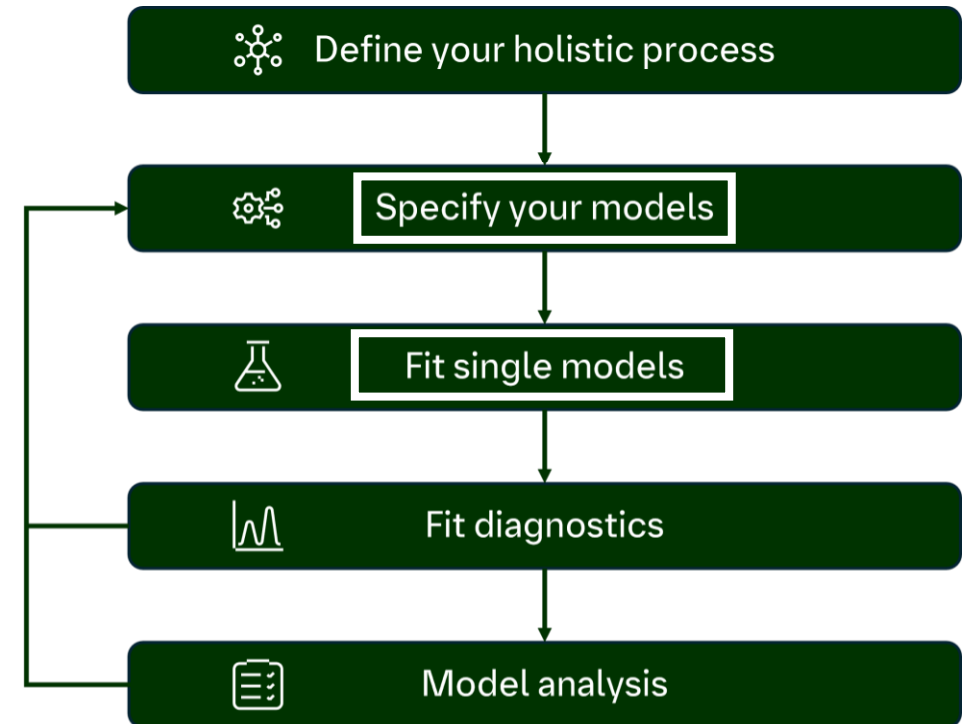
Selection criterion

AICc

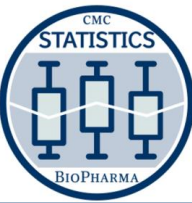
Direction

Backward

Feature Selection Strategy ⓘ



Platform Overview



Diagnostics

Explore diagnostic metrics and visualizations for individual models.

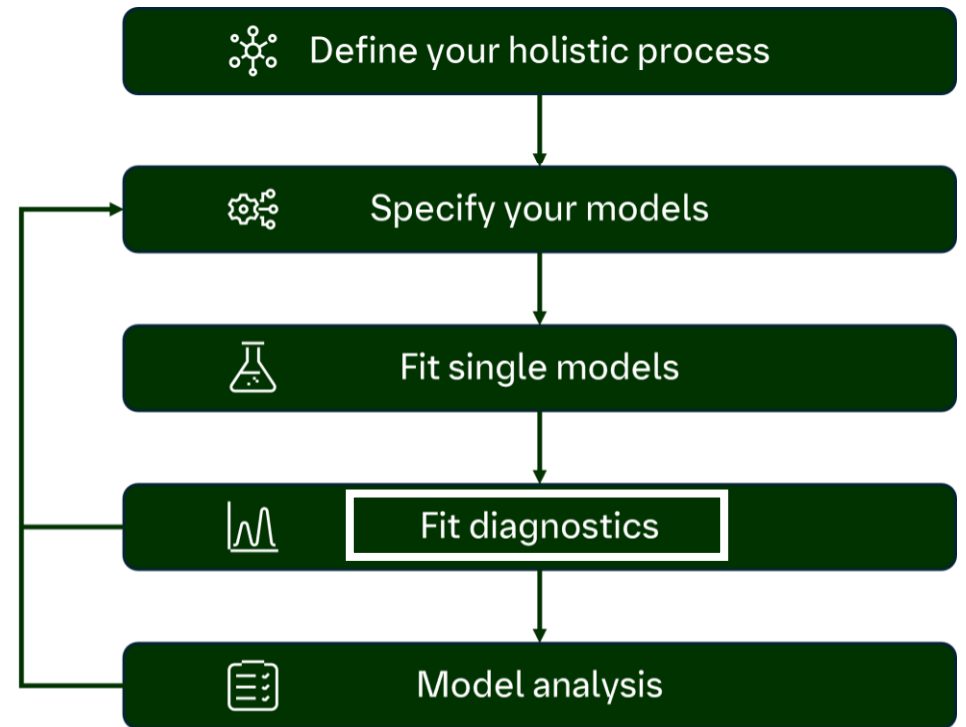
> TFF1 4 models

> AFFI 5 models

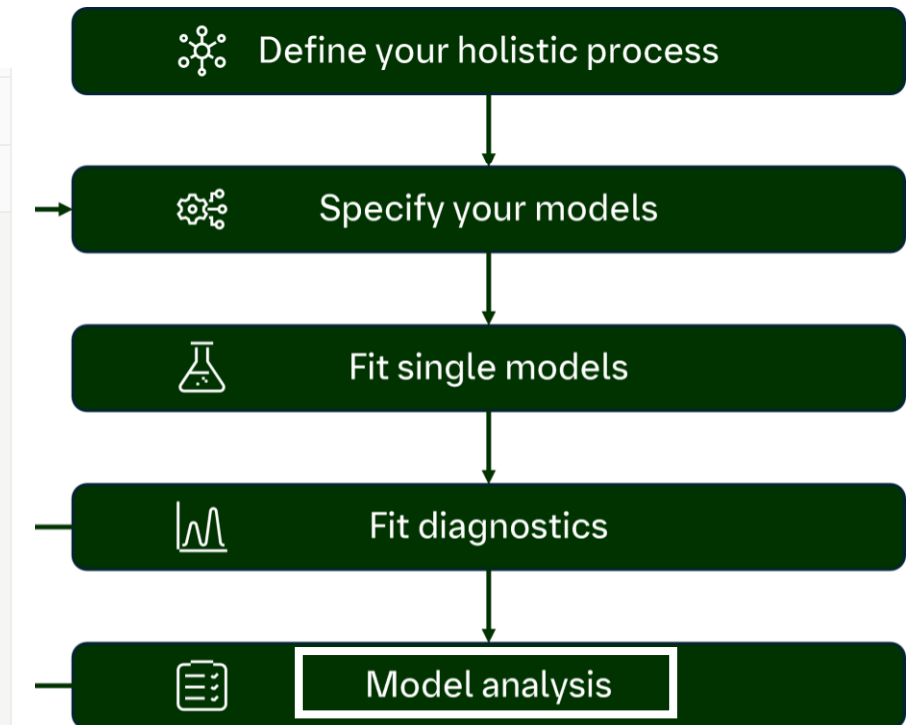
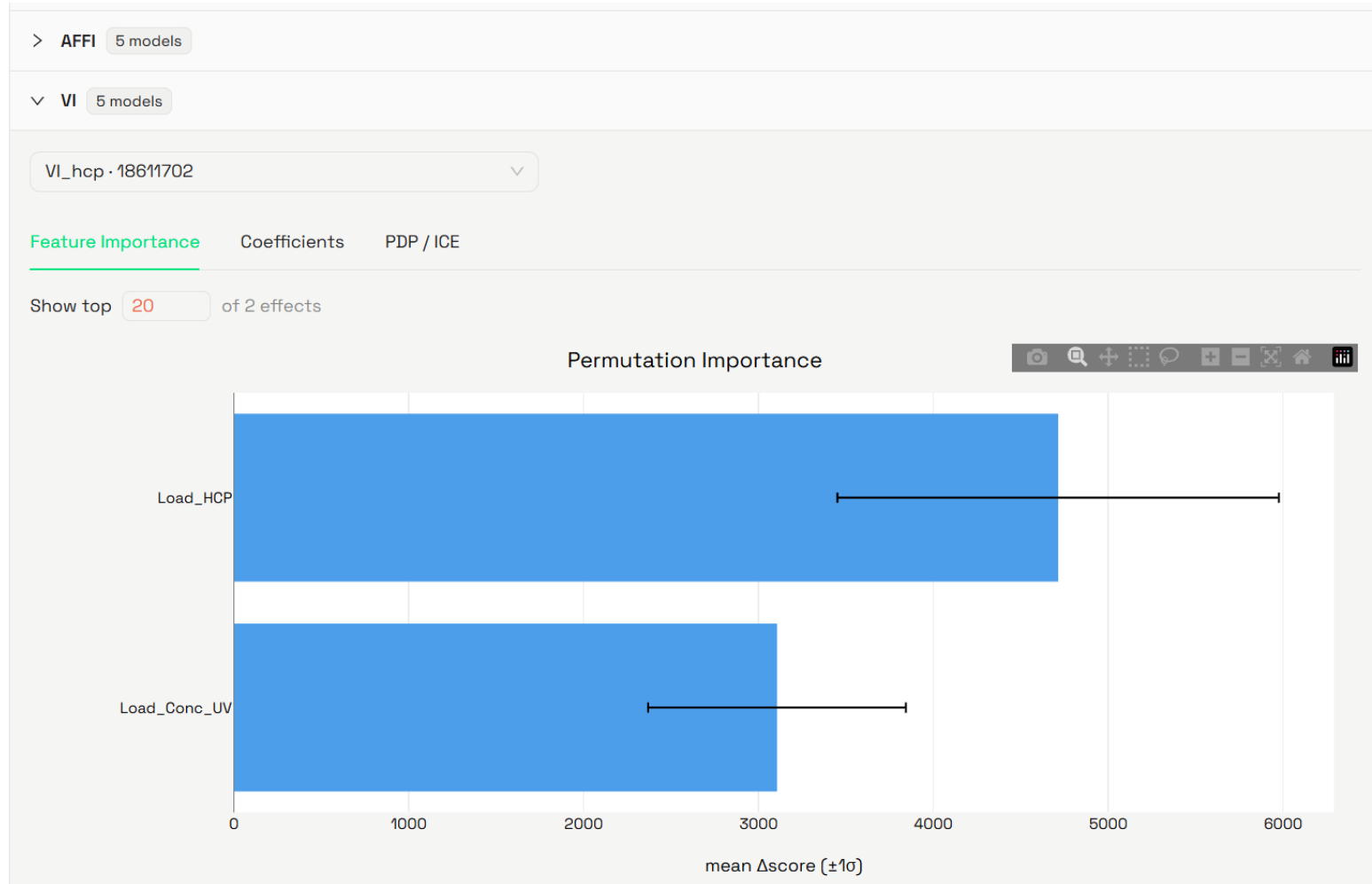
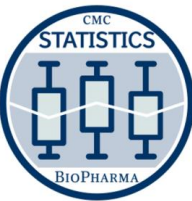
▼ VI 5 models

Overview Fit Results

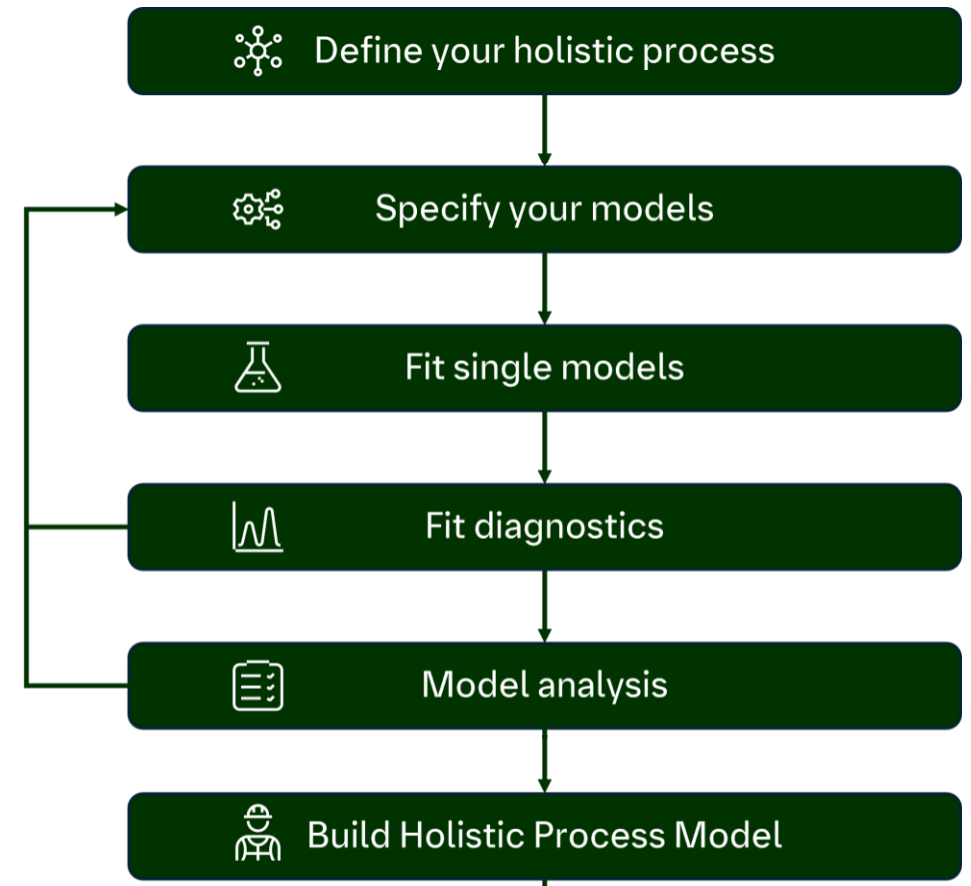
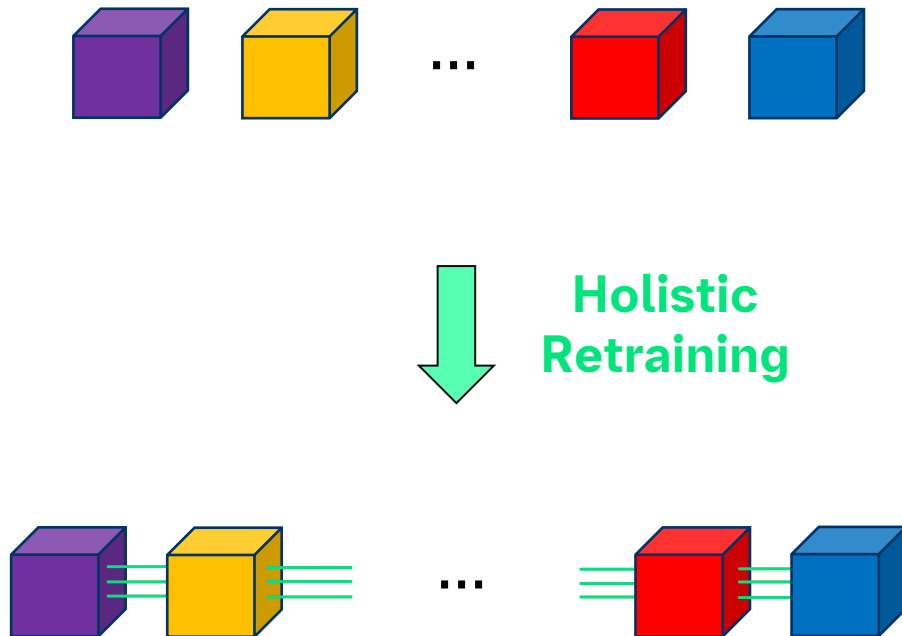
Model	R ² (full)	RMSE (full)	Pred R ² (CV)	R ² SD (CV)	Pred RMSE (CV)	RMSE SD (CV)
VI_hcp	0.7644	43.2071	0.5729	0.3178	46.6732	10.2497
VI_aggregate	0.6754	0.6701	0.2526	0.6050	0.7649	0.1431
VI_vol_enlargement	0.9700	0.2470	0.8589	0.1438	0.2926	0.0627
VI_conc_uv	0.9715	0.0365	0.9566	0.0400	0.0347	0.0115
VI_typi_ii	0.8412	0.9954	0.6301	0.2683	1.0616	0.2426



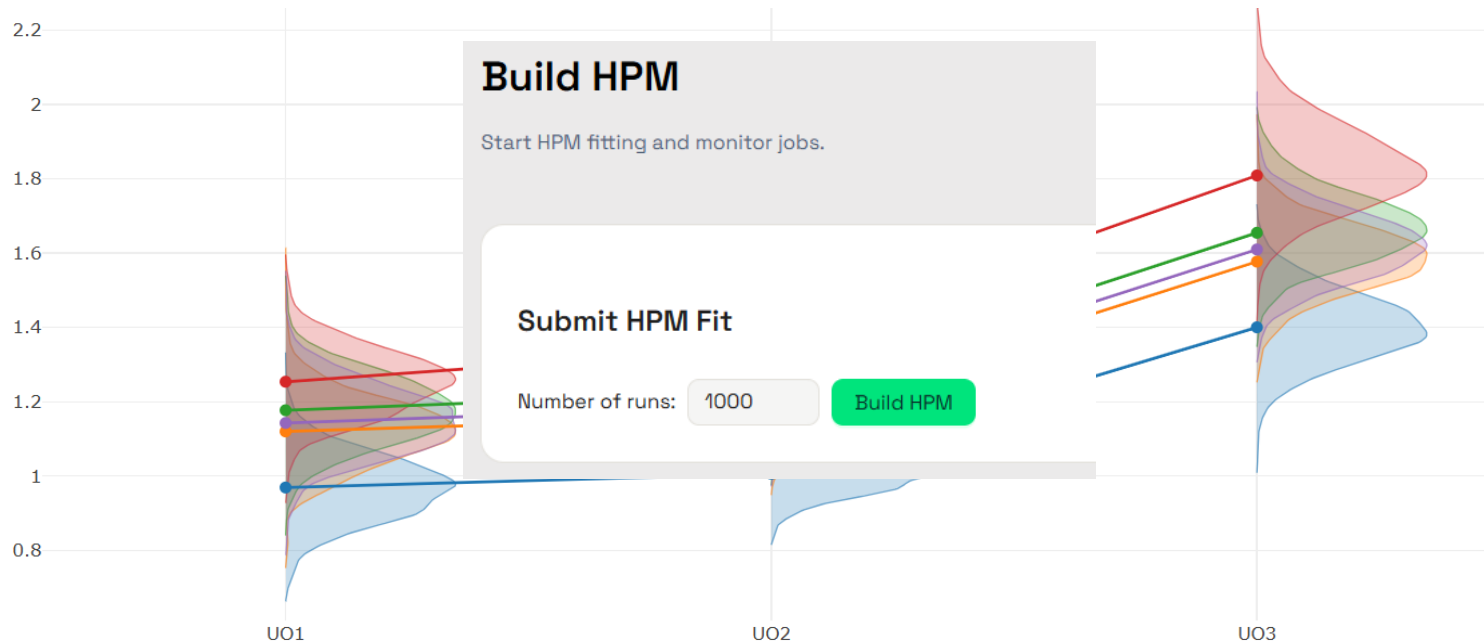
Platform Overview



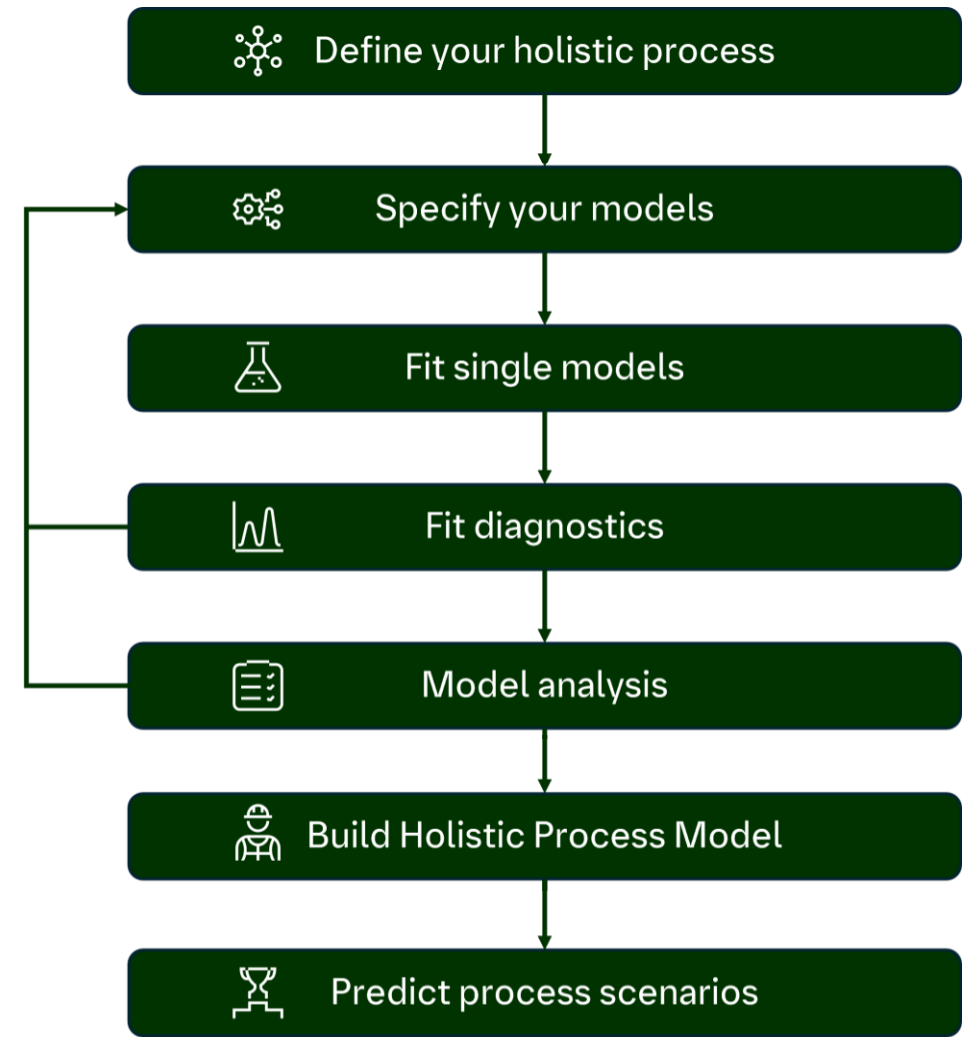
Platform Overview



Platform Overview



→ Holistic Process Optimization
→ Holistic PAR Setting



CMC Statistics BioPharma



THE RIGHT PEOPLE DO THE RIGHT STATISTICS

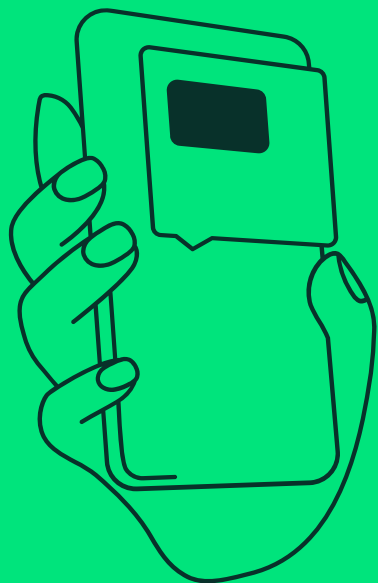
 CMCSTAT/

 STATACADEMY/

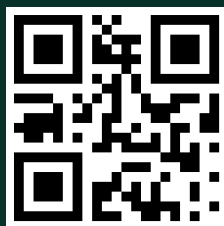


Thank You for Your Attention!

	Head of CMC Statistics BioPharma	Timo Bailer
	DMSO CMC Statistics, Statistics Academy Lead	Tobias Eilert
Core Topics – StatME	Process • Development, Modelling, Validation, Transfer	Tobias Eilert, David Weigt, Franziska Bott
	Analytical Methods • Development, Validation, Transfer	Anton Fischer, Bertram Tschiderer, Conny Olz, Simon Fink
	Justification of Specification & Stability	Kristina Missbach, Timo Bailer
P-Stat	TPA-03: ACTIVA	David Weigt
	TPA-07: Product support	Kristina Missbach
	IFNB1-03: Product support	Anton Fischer
	MABLES (Machine Learning Blending Software)	Tobias Eilert
	HPM (Holistic Process Modelling) holistic SMART PD	Lukas Madenach, Tobias Eilert



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Bioexcellence@boehringer-ingenelheim.com



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