Digital Design
Strategy Area Update

Md Anik Alam

DX Meeting, May 25, 2022

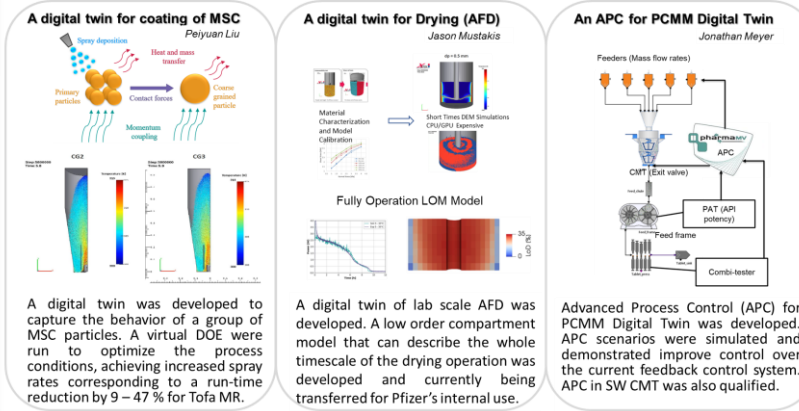Breakthroughs that change patients' lives
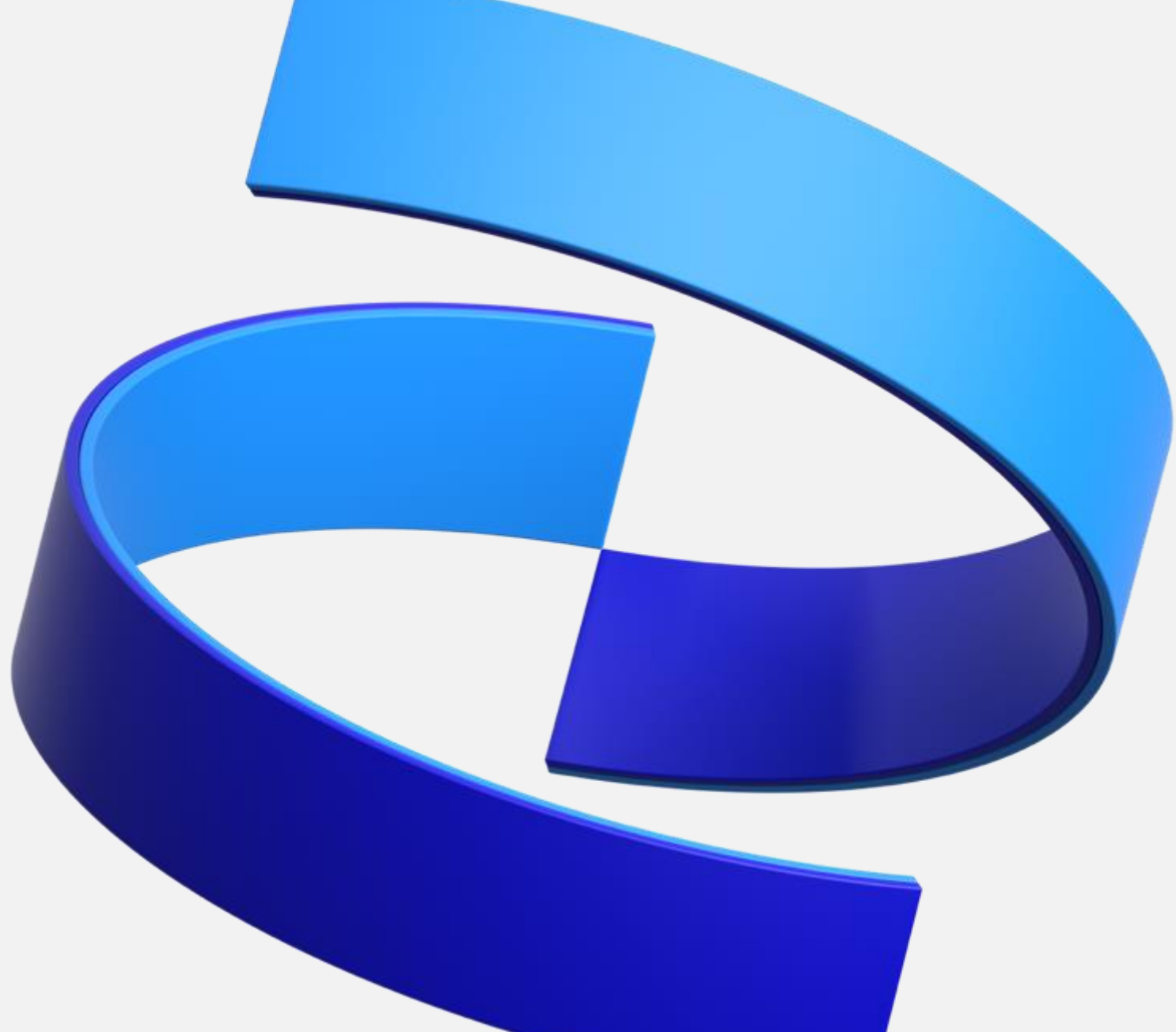
Digital Design
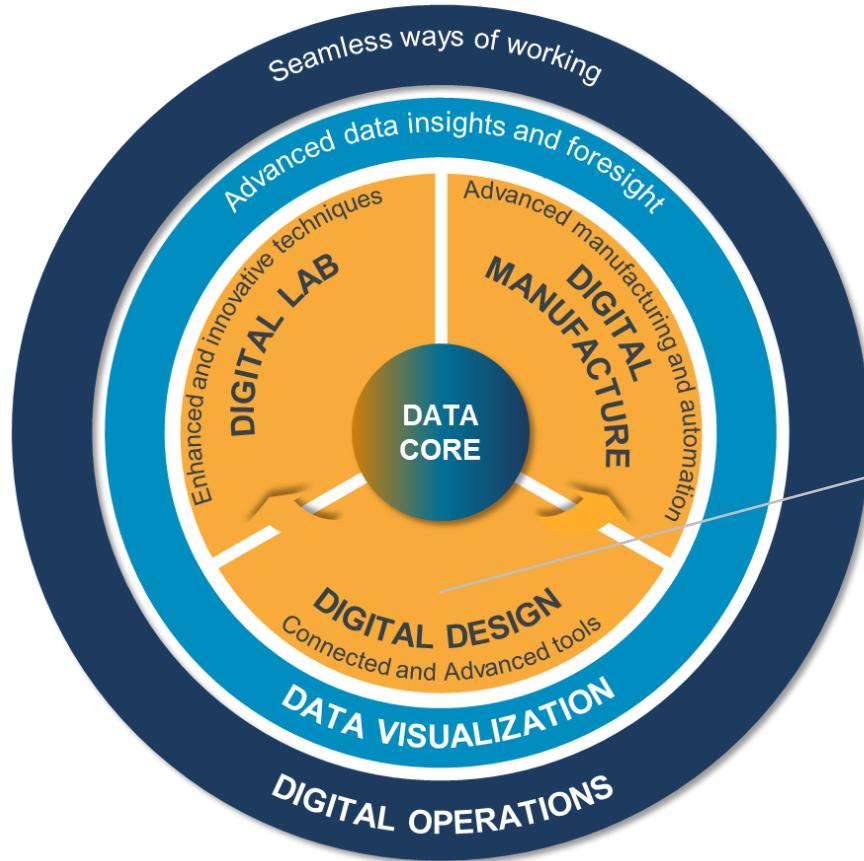
Our purpose..

An optimal combination of simulation and experiments to maximize efficiency and capability in PSSM drug development
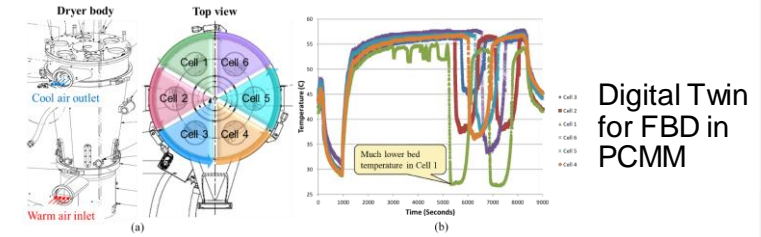
Re-organize Team

- Restructure team membership
- Team's website and channel
- Team's project and logistics
- Budget and funding
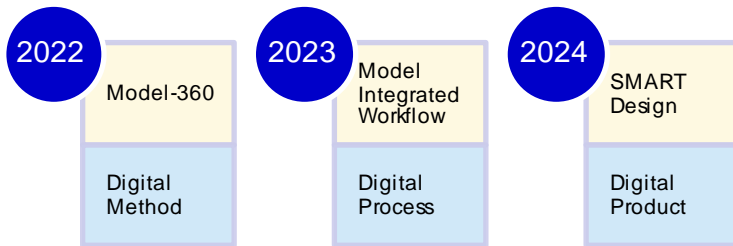- Rebuilding connections and collaboration

Project 2021 Deliverables

A digital twin for coating of MSC
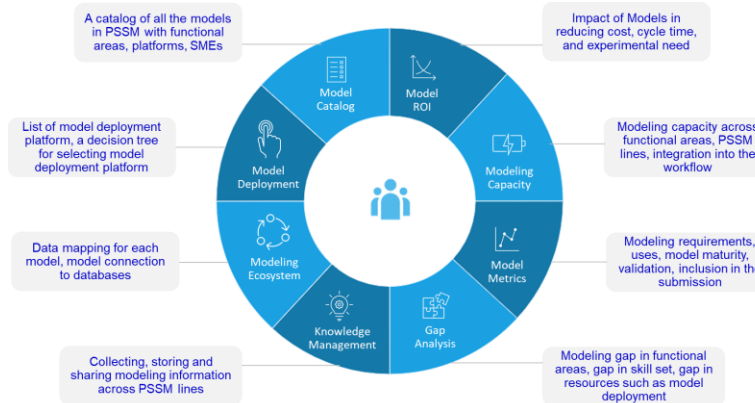*Peiyuan Liu*

A digital twin was developed to capture the behavior of a group of MSC particles. A virtual DOE were run to optimize the process conditions, achieving increased spray rates corresponding to a run-time reduction by 9 – 47 % for Tofa MR.

A digital twin for Drying (AFD)
Jason Mustakis

A digital twin of lab scale AFD was developed. A low order compartment model that can describe the whole timescale of the drying operation was developed and currently being transferred for Pfizer's internal use.

An APC for PCMM Digital Twin
Jonathan Meyer

Advanced Process Control (APC) for PCMM Digital Twin was developed. APC scenarios were simulated and demonstrated improve control over the current feedback control system. APC in SW CMT was also qualified.

First Quarter 2022 Funding

Digital Twin for FBD in PCMM

M-STAR CFD simulation

MedeA materials design

3-Year Roadmap

2022	2023	2024
Model-360	Model Integrated Workflow	SMART Design
Digital Method	Digital Process	Digital Product

Model-360

- A catalog of all the models in PSSM with functional areas, platforms, SMEs
- Impact of Models in reducing cost, cycle time, and experimental need
- List of model deployment platform, a decision tree for selecting model deployment platform
- Modeling capacity across functional areas, PSSM lines, integration into the workflow
- Data mapping for each model, model connection to databases
- Modeling requirements, uses, model maturity, validation, inclusion in the submission
- Collecting, storing and sharing modeling information across PSSM lines
- Modeling gap in functional areas, gap in skill set, gap in resources such as model deployment

(center labels: Model Catalog, Model ROI, Modeling Capacity, Model Metrics, Gap Analysis, Knowledge Management, Modeling Ecosystem, Model Deployment)

Modeling Deployment Service

Document key configurations & Create deployment Package → Deploy/ Upgrade → Publish
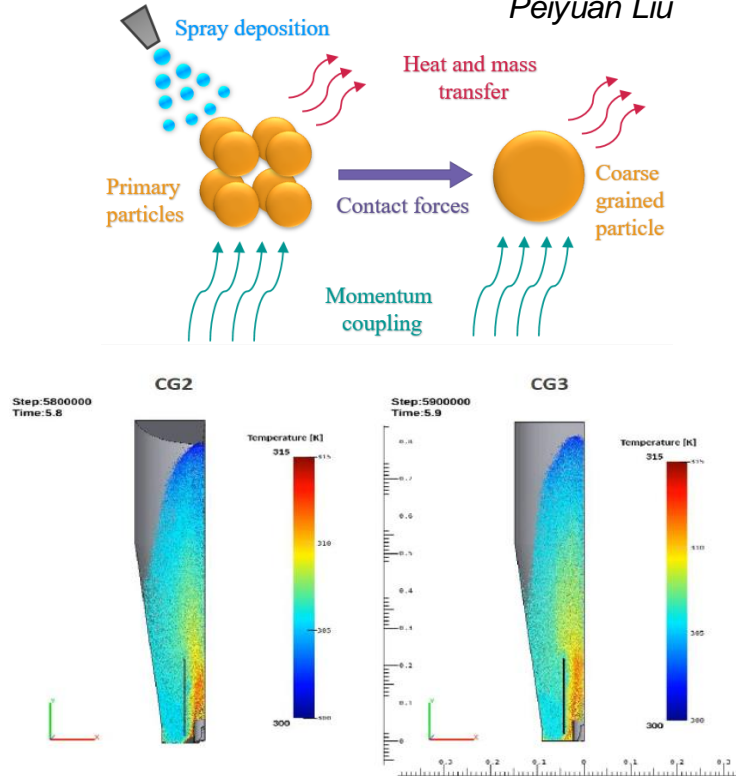
Digital Design Team Structure
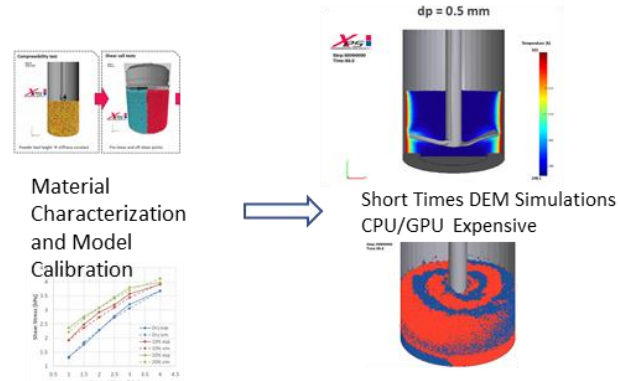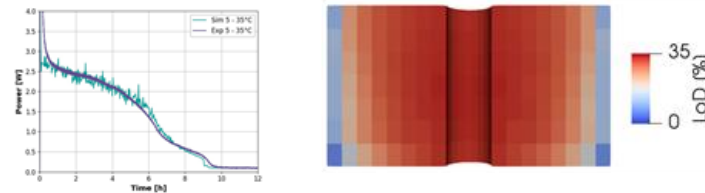
A digital twin for coating of MSC

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A digital twin for Drying (AFD)

Jason Mustakis

Material Characterization and Model Calibration

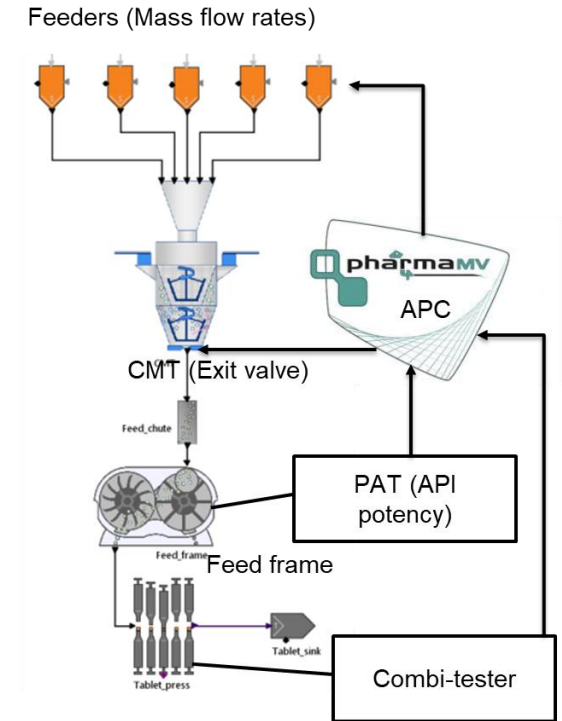Short Times DEM Simulations CPU/GPU Expensive

Fully Operation LOM Model

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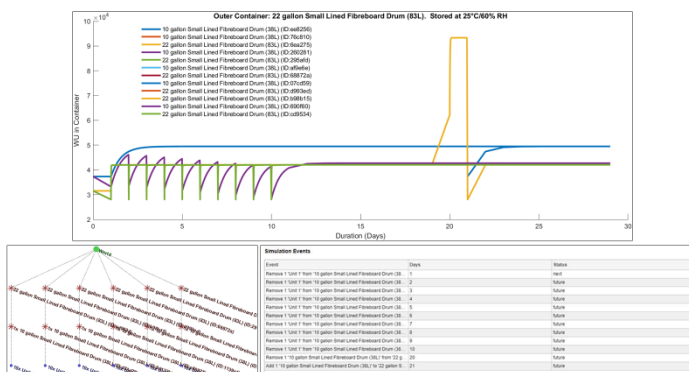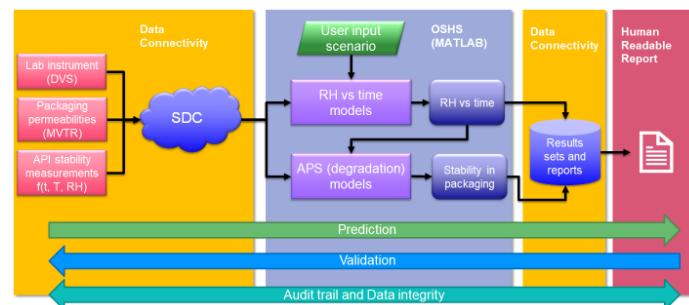
An APC for PCMM Digital Twin

Jonathan Meyer

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A Product Humidity Simulation

James Kimber

A graphically-driven packaging humidity simulation is built with robust differential solver, allowing for simulations of various packaging, arrangements, conditions and events.

Dispersion of floating solids in liquids

Work in progress..

Terminal Sterilization

Work in progress..

Computational modeling on the segmented fluid bed dryer in PCMM wet granulation (2022)
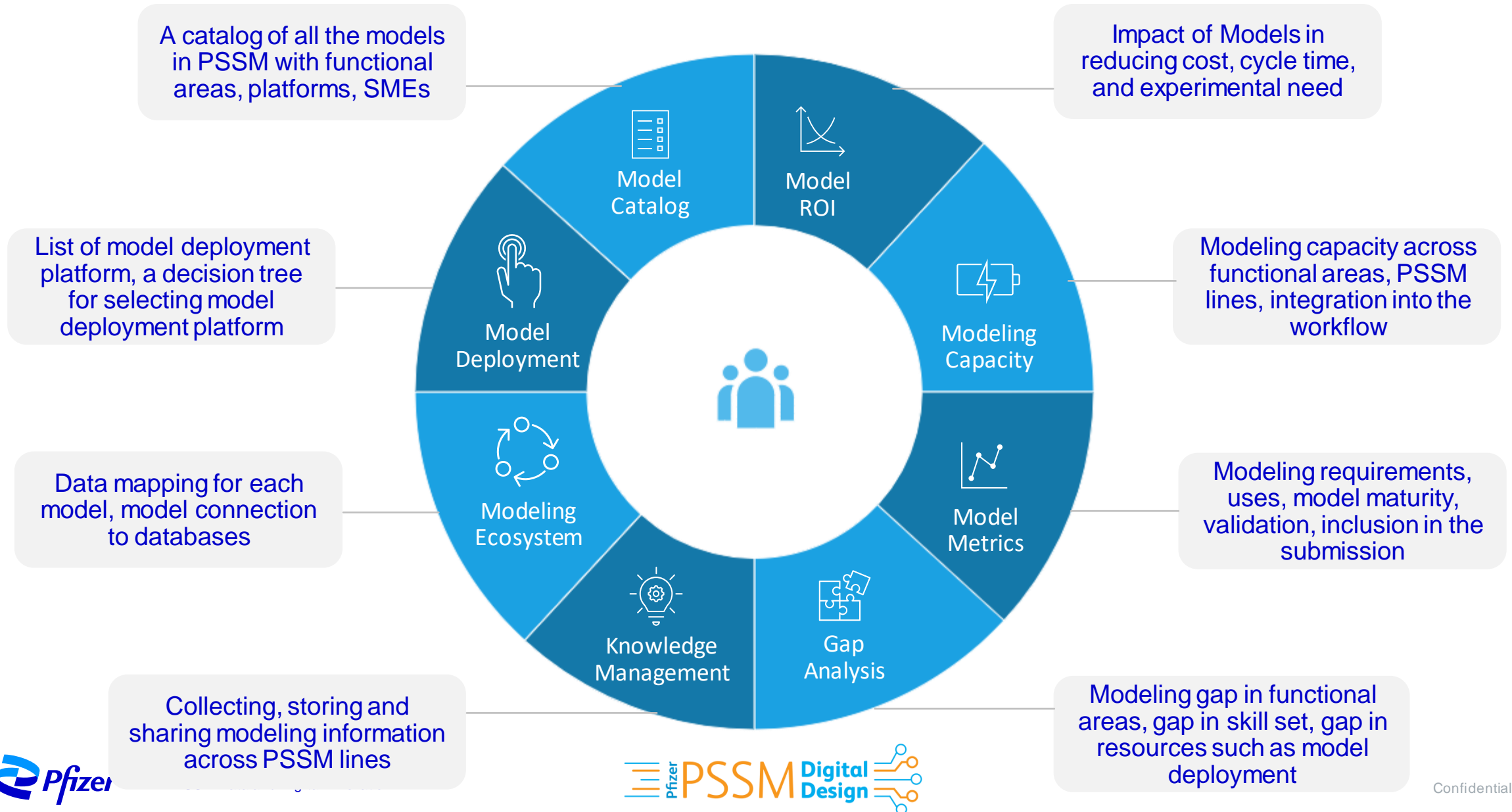
Project lead: Peiyuan Liu

- Project goal
  - Develop digital twin based on **CFD/CFD-DEM simulations** to guide the determination of robust operations for the fluid bed dryer in **PCMM wet granulation line**, focusing on mitigating the well-reported "cell-to-cell variability
  - Support the strategic goals of **DPD to transition from batch to continuous processing**, enhancing process readiness for programs with high drug loading formulations (e.g. CDK4, EZH2i).

- Status
  - Scheduled to kick off on May 9

- (Expected) Outcomes
  - Isolate the root-cause of the cell-to-cell variability
  - Design effective mitigation strategies towards a robust a fluid bed drying process

- Next Step
  - Leverage the high-fidelity information from the digital twin to drive the iteration of a (computationally efficient) reduced-order model (ROM) following an internal work (e.g. by relaxing the ROM assumptions to integrate more realistic physical conditions), which will be eventually implemented to accelerate process development for the fluid bed dryer in PCMM wet granulation

- Abstracts (both text and graphical)

Courtesy: Peiyuan Liu
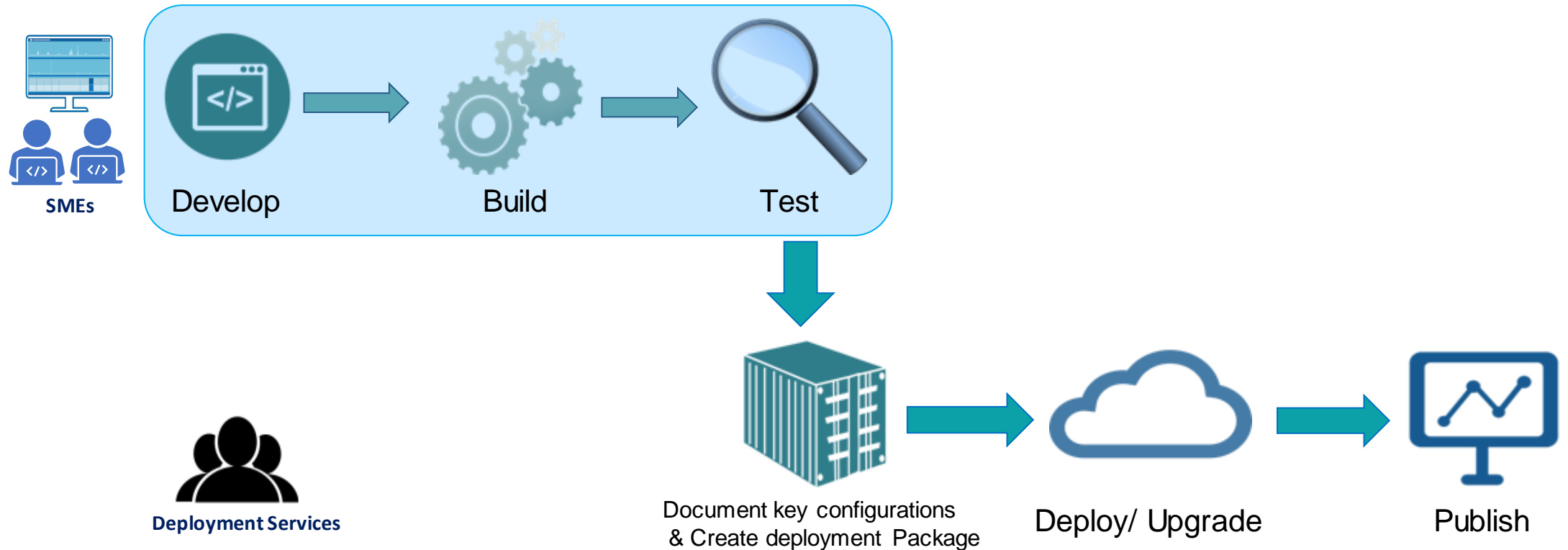
Roadmap (2022-2024)

	2022	**2023**	**2024**
DIGITAL MANUFACTURE	**Electronic Batch Records** Digitize instructions for batch and continuous manufacturing **Installation / configuration of OSI PI** Implement OSI PI across all PSSM sites with a consistent security and support strategy	**Robotic Process Automation** Implement RPA for automating repetitive tasks (e.g. materials management functions) **E-Validation** Digitize and streamline paperless validation operations in manufacturing	**Digital Twin implementation** Implement digital twins for identified manufacturing processes and equipment **Digital Tech Transfer** Digitize the knowledge exchange across the Co-Dev continuum
DIGITAL LAB	**Sample Management** Implement a digital solution for sample and inventory management **Digital Recipes** Design and enable digitized recipes for experimentation and data collection	**Experimental vs. Predicted** Integrate lab data with related modeling data (e.g. solubility, formulation etc.) **Remote instrument control and data analysis** Provide infrastructure for controlling instruments and analyzing data remotely	**Modern access interfaces** Implement mobile, voice, sensor based interfaces to access instruments and data **Digital Twins** Implement digital twins for diverse lab processes (e.g. dissolution)
DIGITAL DESIGN	**Model-360^0** A 360 view of all PSSM models to address the knowledge gaps around modeling resources, capacity, and opportunity in PSSM **Digital Method** Drive Digital transformation of selected methods including Digital Solubility, Digital Stability and Digital Dissolution in collaboration with PSSM lines	**Integrated Workflow** Integration of modeling and simulation to the current PSSM workflows to understand gaps and opportunities to drive efficiency **Digital Process** Drive Digital transformation of selected processes including Digital Drying, Digital Coating and Digital Granulation in collaboration with PSSM lines	**SMART Design** Enable data science tools to design optimal balance between modeling and experiment to increase capacity and efficiency in drug development **Digital Product** Drive Digital transformation of selected products including Digital API, Digital Formulation, and Digital Pills in collaboration with PSSM lines
DATA CORE	**Scientific information library in SDC & ACD Labs** Continue to publish new datasets (characterization, spectroscopy etc.) **Data Analytics Workbench** Select and implement data analytics platform with connections to systems	**Interactive Data Catalog** Publish information about where data is available and how to access it **OSI PI manufacturing data strategy** Define and align data flows from all OSI PI installs with SDC and Enterprise PI	**Topic oriented databases** Replace Excel and local databases (solubility etc.) with centralized, cloud based databases **Access to PGS data** Seamless access to manufacturing data from PGS systems (e.g. Catalyst, LIMS, Batch Records)

Courtesy: Vijay Bulusu

PSSM Model -360

A catalog of all the models in PSSM with functional areas, platforms, SMEs

Impact of Models in reducing cost, cycle time, and experimental need

List of model deployment platform, a decision tree for selecting model deployment platform

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Wheel segments:
- Model Catalog
- Model ROI
- Modeling Capacity
- Model Metrics
- Gap Analysis
- Knowledge Management
- Modeling Ecosystem
- Model Deployment

Pfizer

PSSM Digital Design

Manage Deployment and Publishing

SMEs

Develop → Build → Test

Deployment Services

Document key configurations & Create deployment Package → Deploy/ Upgrade → Publish

Assist PSSM modeling community to package, publish, and deploy models. Document knowledge/ configuration about the model, required input data, run criterion etc. in a centralized knowledgebase Link.

PSSM Data and Digital Innovation

Pfizer PSSM Digital Design

Courtesy: Rajesh Mishra

PSSM Digital Solubility Charter

Scope

- Coordinate communication and information sharing in PSSM
- Identify representatives and facilitate collaboration between departments
- Collect, develop, and distribute best practice guides for using solubility tools
- Collate list of databases and tools with appropriate key headings for tool awareness and understanding

Team Meeting	Sponsor Updates
Frequency: Monthly	Frequency: Monthly
Topics: •Review goal progress •Evaluate new opportunities & next steps	Topics: •Endorse proposals •Progress updates

LT Sponsor

Martyn Ticehurst and Jason Mustakis

Program Lead

Sadia Rahman

Team Members

Core	Ad Hoc
Sadia Rahman (DPD)	Ke Wang (Stats)
Aleksei Boldin (IPPD/Stats)	
Daniel Opoku (IPPD)	
Giselle Reyes (CRD)	

S1 funding Request:
- XX $$
- XX $$

2022 Milestones	2022 Deliverables	Due date
Cross PSSM Database development (S1)	Team to identify key stakeholders from each line and create sub-team	March- April 22
	Coordinate sub-team to create list of current databases and future needs	May-June 22
	Align and encourage end point of data capture/data format for database to one place	S2
	Evaluate the 5-year plan with needs and align each lines goals	S2
Coordinate/unify cross PSSM activity in common methodology/tool e.g. SAFT and Cosmotherm, statistical tools	Team to identify key stakeholders for each line and create sub-team	March- April 22
	Coordinate sub-team to summarise solubility prediction tools/activity mapping/database for each line. Sub team to agree on key information to include e.g. the usage and number of users for each tools, for QM tools to list basis set used, used in late/early-stage work (web page)	May-June 22
	Evaluate the 5-year plan with needs and align each lines goals	S2
Develop strategy for ionic solids solubility modelling (e.g. surfactants/CD models) (S2)	Team to identify key stakeholders in this area and evaluate key technologies and gaps area	June 22
	Establish areas to reach out to external collaborators/submit proposal	June 22

Courtesy: Andrew Derrick

Section Divider

Optional Subtitle

Thank You