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The PROTAC® Company

D360 integration with Core Platform for Science – the challenges of science in the cloud

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Integrating a Cloud-Based LIMS with D360:

Understanding and Addressing

Its Unique Challenges

Today Goals:
- Educate UGM attendees who may be on a similar journey
- Promote the need for better interoperability between these platforms

"Behind every cloud
is another cloud."
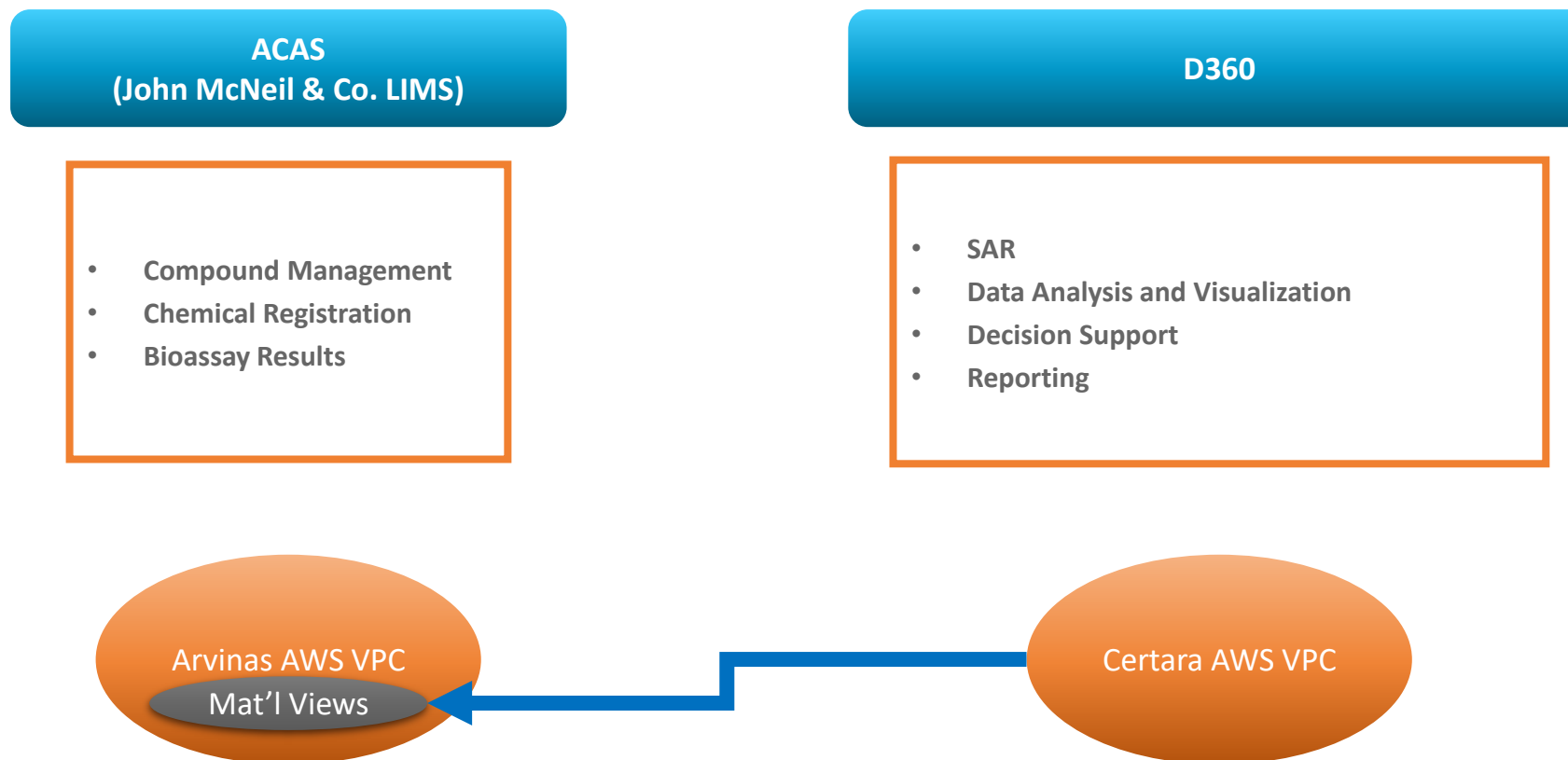- Judy Garland

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Agenda

- Arvinas Overview

- Arvinas Legacy LIMS/D360 Architecture

- Arvinas PFS LIMS/D360 Implementation

    - Goals

    - Architecture

    - Challenges

    - Solutions

- Arvinas PFS LIMS/D360 Current State
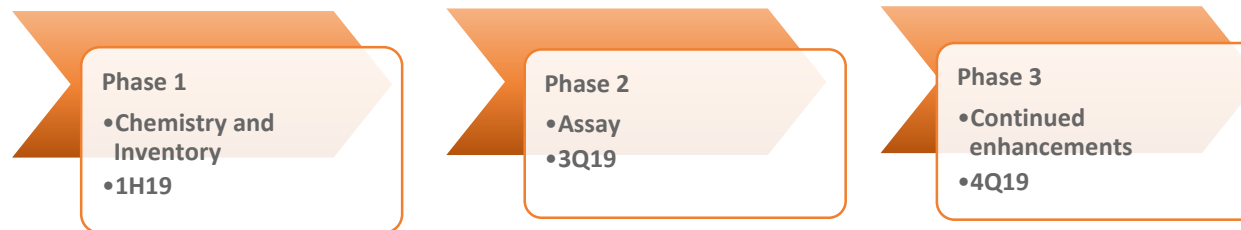
Arvinas - Overview

- Clinical-stage biopharmaceutical company

- Dedicated to improving the lives of patients suffering from debilitating and life-threatening diseases through the discovery, development, and commercialization of therapies to degrade disease-causing proteins.

- Based in New Haven, CT

- 120+ employees

- 3 dedicated IT staff

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Arvinas Legacy LIMS/D360 State in 4Q18

ACAS
(John McNeil & Co. LIMS)

- **Compound Management**
- **Chemical Registration**
- **Bioassay Results**

D360

- **SAR**
- **Data Analysis and Visualization**
- **Decision Support**
- **Reporting**

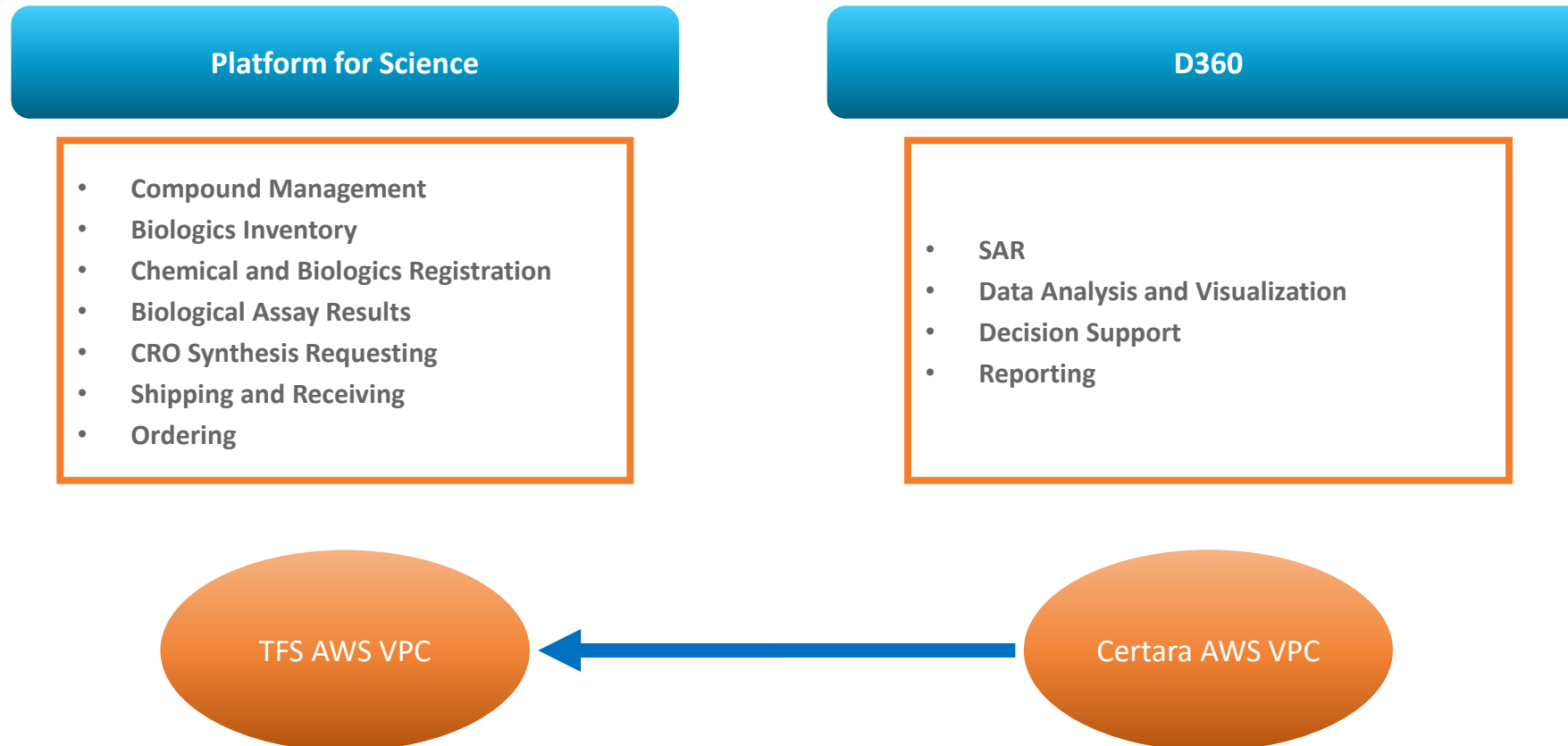Arvinas AWS VPC
Mat'l Views

Certara AWS VPC

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Arvinas LIMS Implementation Goals

- **Arvinas selected Thermo-Fisher's Platform for Science (PFS) for its next generation LIMS platform**

  - Supported platform
  - Expanded functionality
  - Growth potential

  - Maintain SaaS
  - Preserve existing D360 queries
  - Migrate all data from ACAS

Phase 1
- Chemistry and Inventory
- 1H19

Phase 2
- Assay
- 3Q19

Phase 3
- Continued enhancements
- 4Q19

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Arvinas PFS LIMS Planned Architecture

Platform for Science

- Compound Management
- Biologics Inventory
- Chemical and Biologics Registration
- Biological Assay Results
- CRO Synthesis Requesting
- Shipping and Receiving
- Ordering

D360

- SAR
- Data Analysis and Visualization
- Decision Support
- Reporting

TFS AWS VPC ← Certara AWS VPC

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- Software-as-a-Service Supported by Thermo-Fisher

- Thermo-Fisher's PFS Cloud Offering

  - Application and database hosted in AWS

    - Uses Amazon Relational Database Service (RDS) for Oracle

    - Lower cost compared to bring-your-own Oracle license

    - The streamlined RDS model has limited customization options but robust, automated maintenance.

- Configured for Arvinas' requirements

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The Arvinas Goal

- Ensure Arvinas scientists can continue to leverage the power D360, using data from PFS LIMS

- No changes to the D360 user experience

  - Queries maintained

  - Exact, Similarity, and Substructure searching

But different cloud-based Oracle database hosting scenarios can affect data integrations...

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The Arvinas Challenge

- D360 does not have chemical cartridge functionality

  - For the Arvinas Legacy LIMS/D360 integration, structure searching was supported via the Bingo cartridge installed within ACAS

- PFS has been integrated with D360, but only in on-premises scenarios or without structure searching

- PFS allows structure searching, but this is not exposed via API

- No direct PFS database access

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The AWS Oracle Database Host is Key

- Amazon RDS for is more cost-effective, but comes at a price

  - Full automated maintenance facilitates Oracle support activities, but

    - Limited options for an RDS environment

    - RDS doesn't support cartridges

- Amazon EC2 with Oracle SE2 or EE is more expensive, but offers options (with a caveat)

  - Full ability to perform installations

  - Cartridge support, but

    - No automated maintenance requires external Oracle administration resources

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Arvinas PFS LIMS/D360 Integration: Evaluation the Alternatives

- Move PFS from RDS to EC2

  - Not supported by TFS

- Add indexes to the PFS database and provide API access

  - Also not supported by TFS

- Build an Arvinas-managed middle-layer with cartridge

  - Access to PFS database for creation of materialized views, or

  - Full data replication

Arvinas PFS LIMS/D360 Integration: Alternatives within the Alternative

- Amazon RDS Option: Chemaxon Choral

  + Supports RDS – lower Oracle cost and doesn't require DBA resource

  + Vendor support

  x Licensing costs

  x New product

  x Still requires middle-tier; can't be hosted by TFS

- Amazon EC2 Option: Bingo cartridge

  + Developer experience; used in ACAS; no licensing

  x Limited support

- Amazon EC2 Option: Chemaxon Jchem cartridge

  - Not initially considered but being revisited
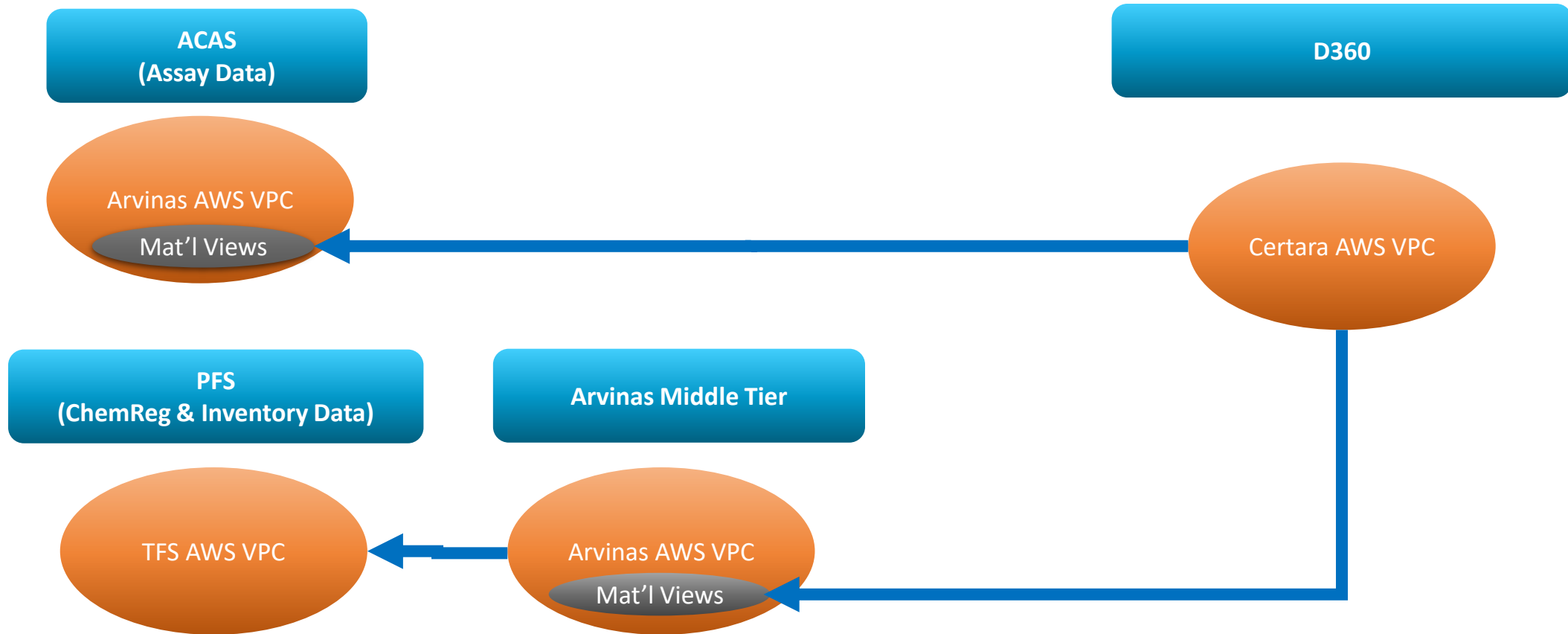
Alternatives with the Alternative: Oracle Options

- Oracle Standard Edition 2 (SE2) vs Enterprise Addition (EE)

  - Enterprise (EE) features not required for DB links or materialized views

  - EE provides better performance tuning and debugging tools

  - SE2 much cheaper - EE roughly 3x more expensive

- Hosting: AWS vs Oracle

  - Oracle supported hosting environment

  - Oracle-provided DBA support

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Arvinas PFS LIMS/D360 Integration: Current Solution Choices
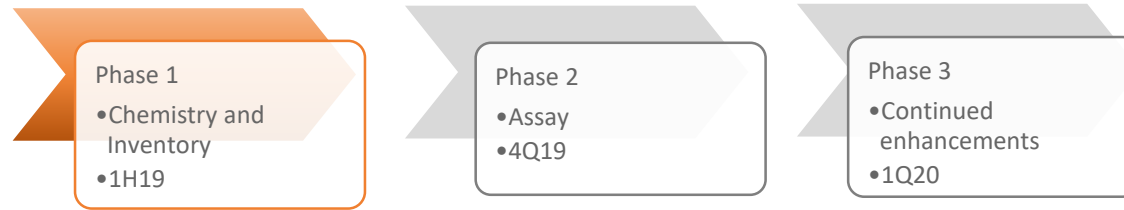
Data replication	==Materialized View==	Full Table Scans	TFS allowed the use of materialized views, which are significantly less performance intensive
Cartridge Solution	Choral	==Bingo==	Based on potential risk of the new Choral solution, developer experience with Bingo, and lower cost
Hosting	==AWS==	Oracle	Time to execute
Oracle Version	EE	==SE2==	Cost and unclear need for EE

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Arvinas PFS LIMS/D360 Integration: Current State

Arvinas PFS LIMS/D360 Integration: Results
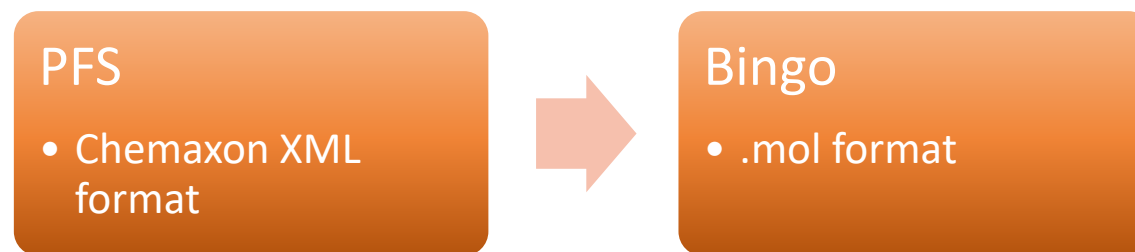
- Completed PFS LIMS Implementation Phase 1

Phase 1
- Chemistry and Inventory
- 1H19

Phase 2
- Assay
- 4Q19

Phase 3
- Continued enhancements
- 1Q20

- D360 queries preserved successfully

- Query performance improved

- Data challenges

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Arvinas PFS LIMS/D360 Integration: Data Challenges

ACAS
- .mol format

→

PFS
- Chemaxon XML format

→
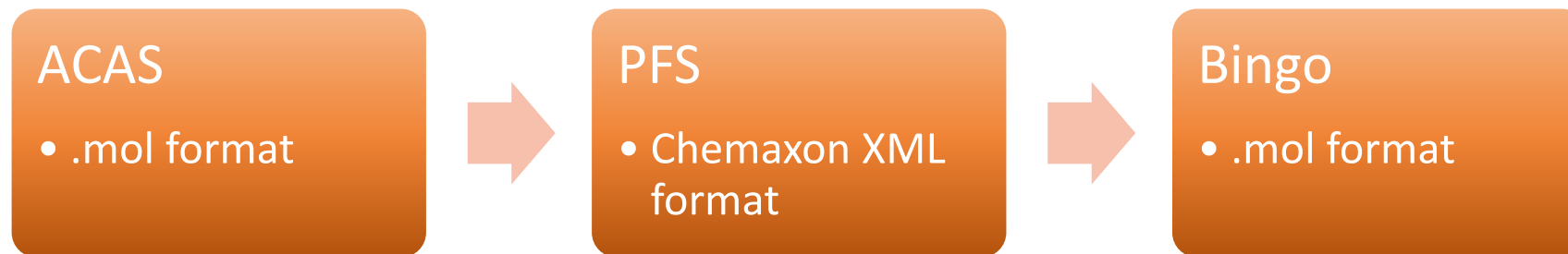
Bingo
- .mol format

▪ Data migration complicated because of two-step conversion process

PFS
- Chemaxon XML format

→

Bingo
- .mol format

▪ Ongoing challenge due to different formats

▪ Bingo stripping stereochemistry flags and mishandling axial chirality during XML conversion

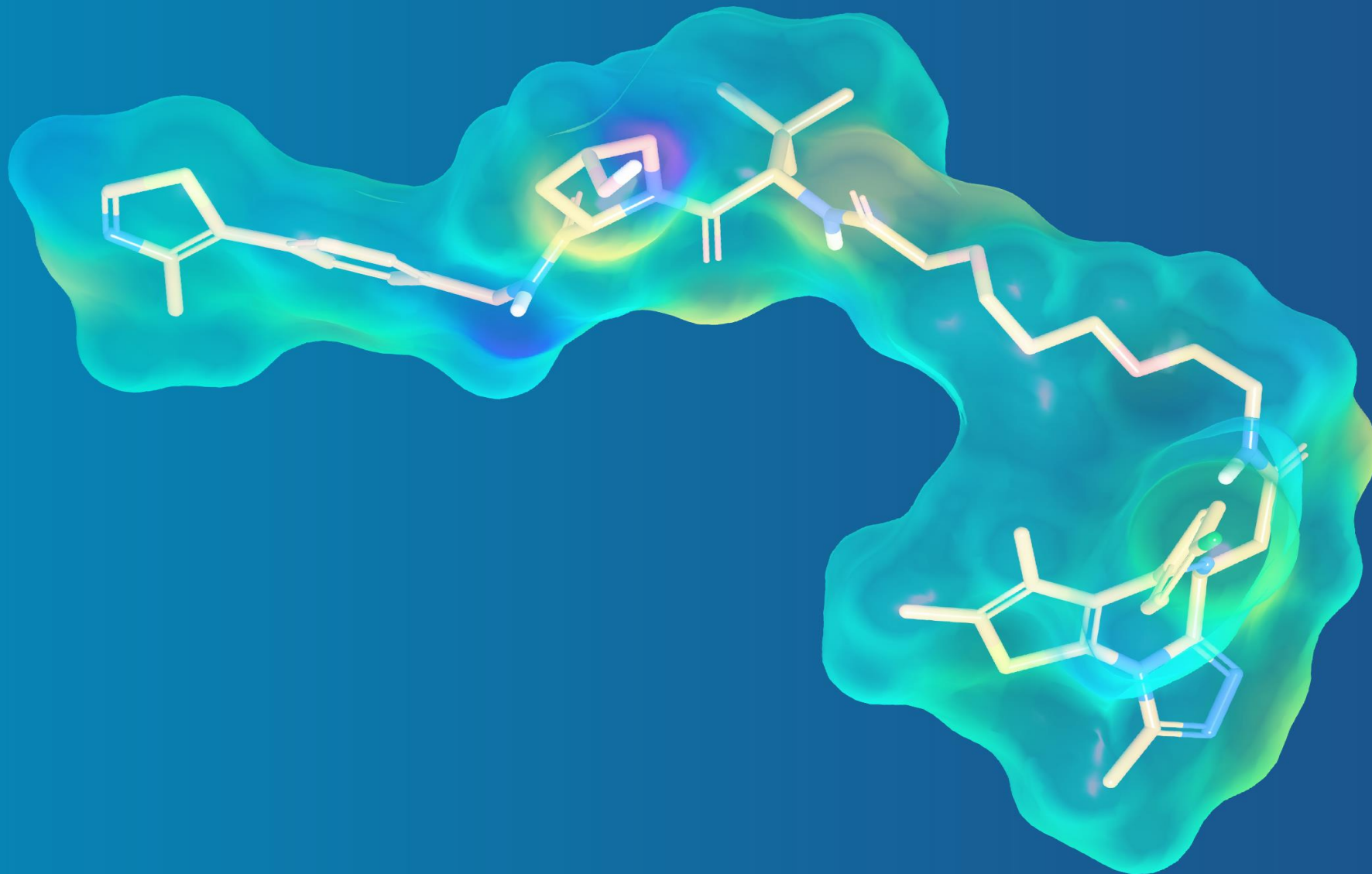▪ Lack of support on Bingo cartridge

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Summary

- There are many benefits of SaaS, but understand the limitations

  - Balance of flexibility vs. operability

- Understand the limitations of RDS installations

- If on-prem vs. hosted is an option, consider long-term needs

- Dive deeply into what the vendor says they can provide "out of the box" or just a "configuration"

- Make sure the appropriate SME's are at the table

This is an opportunity for the vendors to partner on delivering a high-value, robust solution

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Thank You's

- The Arvinas Core Team of Jim Belcastro, Rob Bertekap, Dean DiNicola, Keith Hornberger, and Kimberly Wehger

- John McNeil and Brian Bolt

- Jason Burbank (Certara)

- The Thermo-Fisher team

- ChemAxon

- Oracle

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Questions?