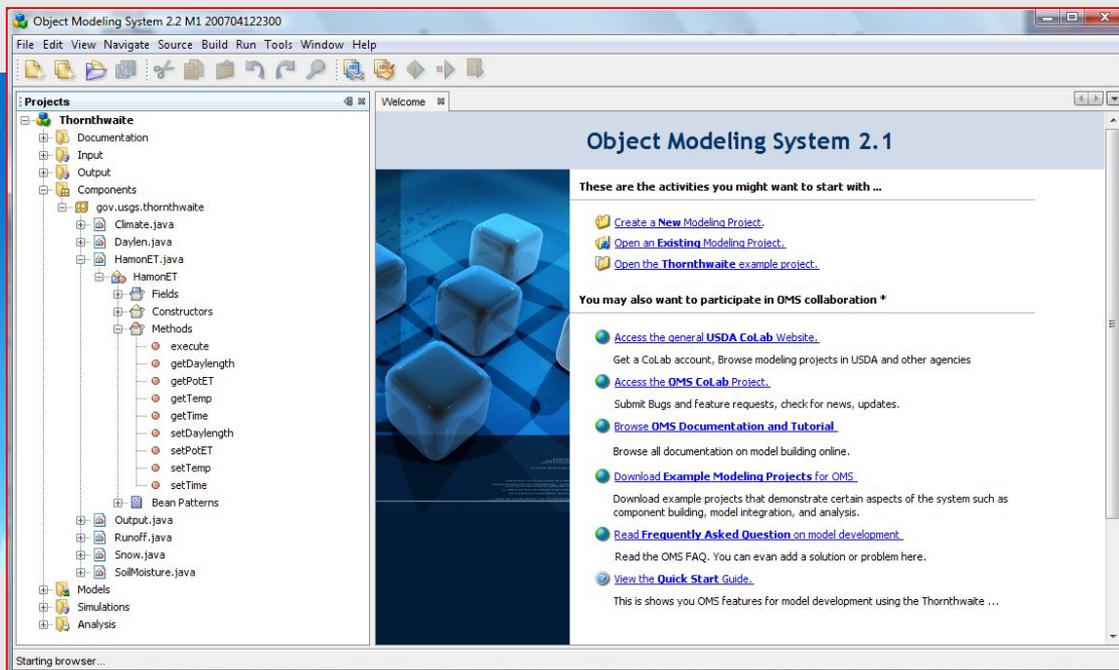


Delivery of Science Components to NRCS Business Applications



USDA - ARS - Agricultural Systems Research Unit

USDA - NRCS - Information Technology Center

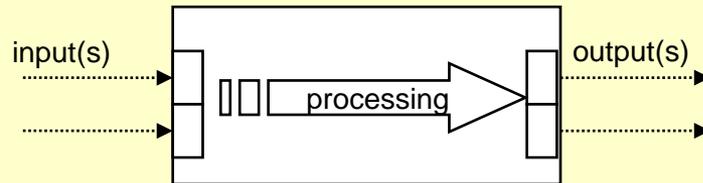
Colorado State University - Civil Engineering and Computer Science

Key Concepts

- **Science Component**
- **Model**
- **Model Base**
- **Model Service**
- **Modeling Framework**
- **Utility/Cloud Computing**
- **Ontology / Knowledge Base**

Key Concepts

• Science Component



- Self contained software unit representing a (bio-) physical process (e.g. interception, evapotranspiration, ...)
- A component can consist of two or more components, in which case it is a compound component (e.g. erosion, ...)
- A component can be tested, validated, certified, deployed, archived, and documented

Key Concepts

- Science Component

- Model

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- A model aggregates components.
- A model contains science components ((bio-)physical processes) plus system components (e.g. temporal or spatial operations, input/output).
- A model can be considered a compound component.
- A model is validated and certified.

Key Concepts

- Science Component

- Model

- **Model Base**

- Model

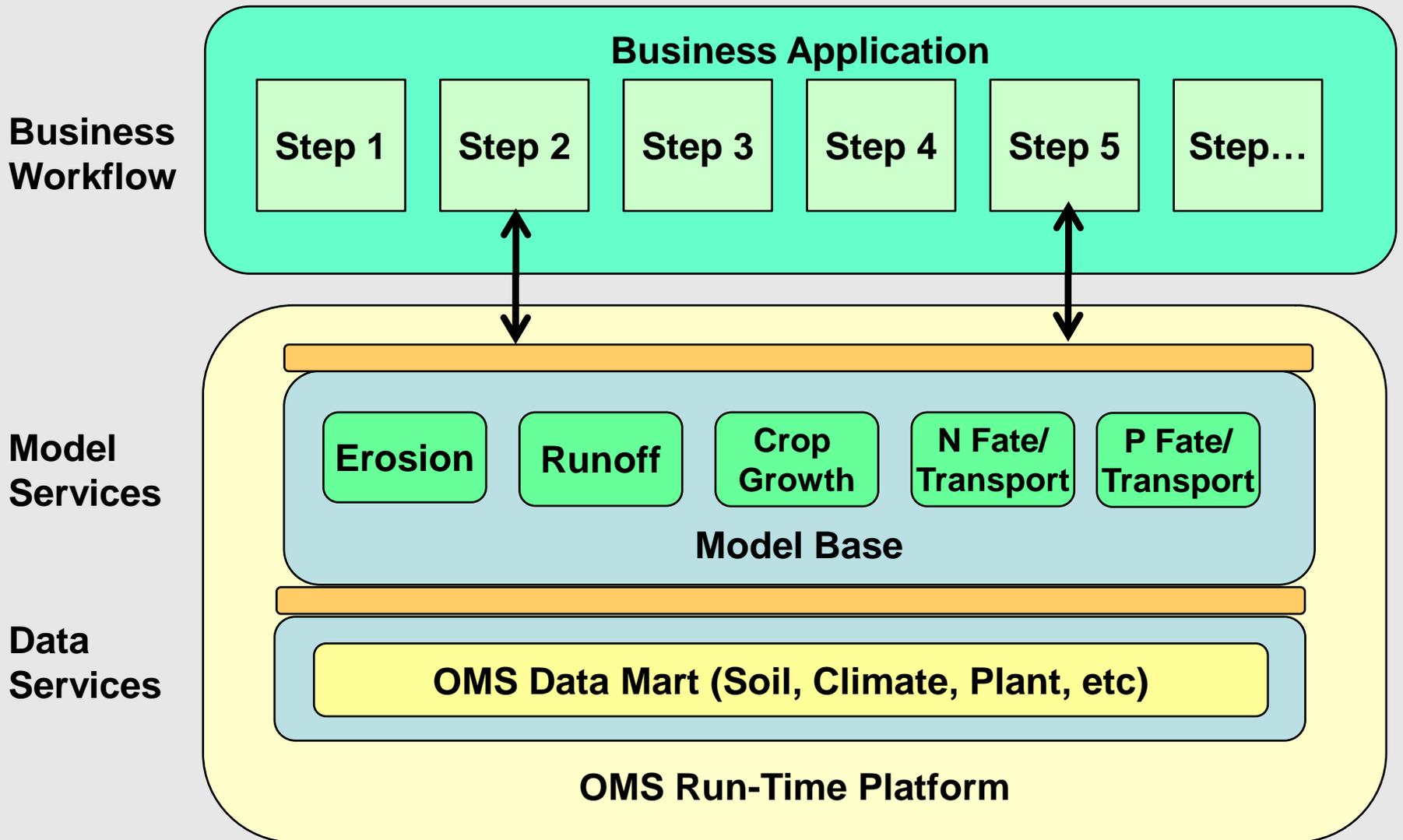
- A model base contains one or more model instances to satisfy the requirements of a primary business need.
- Model instances are created as necessary for regions within the area of intended use.
- The model base is calibrated for regions within the area of intended use.
- Data is provisioned to the model base for regions within the area of intended use.

Key Concepts

- Science Component
- Model
- Model Base
- **Model Service**
- Modeling Framework
- Utility/Cloud Computing
- Ontology / Knowledge

- A calibrated model base is packaged and deployed as one or more model services to a run-time platform.
- Model services contain the data required to run the model instances within the model base.
- Model services are deployed to a Service Oriented Architecture (SOA) as web services.
- Agency/organization business applications call and run model services in a business workflow.

Model Services for Business Applications



Key Concepts (continued)

- A modeling framework supplies the system components, tools, and platforms necessary to build, validate, deploy, and support a model base.
- Without a modeling framework, the modeling team must fill this void from scratch on an ad hoc basis.

• **Modeling Framework**

- The Object Modeling System (OMS) is the USDA approved framework, currently the de facto standard.

Key Concepts

- S
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- Model services are deployed to a utility computing platform that scales to user load.
 - Model services can be multi-threaded to increase performance under heavy user load.
 - Access to model services is mediated through interconnectivity agreements.

• **Utility/Cloud Computing**

• **Ontology / Knowledge Base**

Key Concepts

• Science Component

- Science components and models are stored in the modeling framework repository.
- Science components and models contain metadata that facilitate their proper use and integration.
- To reduce confusion, metadata are best managed using an ontology and knowledge base

• Ontology / Knowledge Base

- Knowledge often is conceptual and non-computational.
- A model can contain both computational components and those that run against a knowledge base.

The Object Modeling System (OMS)

- **OMS is a modeling framework, currently the only framework used within USDA; modeling frameworks are used by EPA, USGS, and agencies in Europe and Australia.**
- **Modeling projects use OMS to build, validate, and deploy science components for agency business applications.**
- **Through OMS, science components are aggregated into models, deployed as services, provisioned with data, and made available to agency business applications.**
- **Users run agency applications containing a business workflow with processes that call OMS model services, such as erosion estimation, computing a forage balance, calculating runoff, etc.**

OMS Contains...

**Model / Component
Development and
Validation Platform**

**Model
Run-Time Platform**

**Data Provisioning
Platform**

**Knowledge Base
Platform**

- System Components
 - Data Input/Output
 - Time
 - Statistics
 - Geospatial Interface
- Modeling Project Management
- Component Development Standard
- Model Builder
- Test Harness
- Calibration Tools
- Analysis Tools
- Geospatial Tools
- Visualization Tools
- Science Component Library

OMS Contains...

**Model / Component
Development and
Validation Platform**

**Model
Run-Time Platform**

**Data Provisioning
Platform**

**Knowledge Base
Platform**

- Amazon Elastic Computing Cloud (EC2)
 - Virtual service instances
 - Virtual data storage
 - Capacity adjusted to user load
- Enterprise Service Bus (ESB) – Glassfish Enterprise Server
- Multi-threading – Terracotta
- Registered and advertized SOA-compliant web services
- OMS operations team
- Models also can be run within the OMS application on a desktop or notebook computer

OMS Contains...

**Model / Component
Development and
Validation Platform**

**Model
Run-Time Platform**

**Data Provisioning
Platform**

**Knowledge Base
Platform**

- Data provisioning standard
- Data mart for each model base
- Operational data marts deployed to the run-time platform
- Data access web services available to model bases
- Data stewards for each model base
- Data stewards are organized into data provisioning teams serving the respective areas of use.
- Data marts fed by agency data warehouses through ETL process

OMS Contains...

**Model / Component
Development and
Validation Platform**

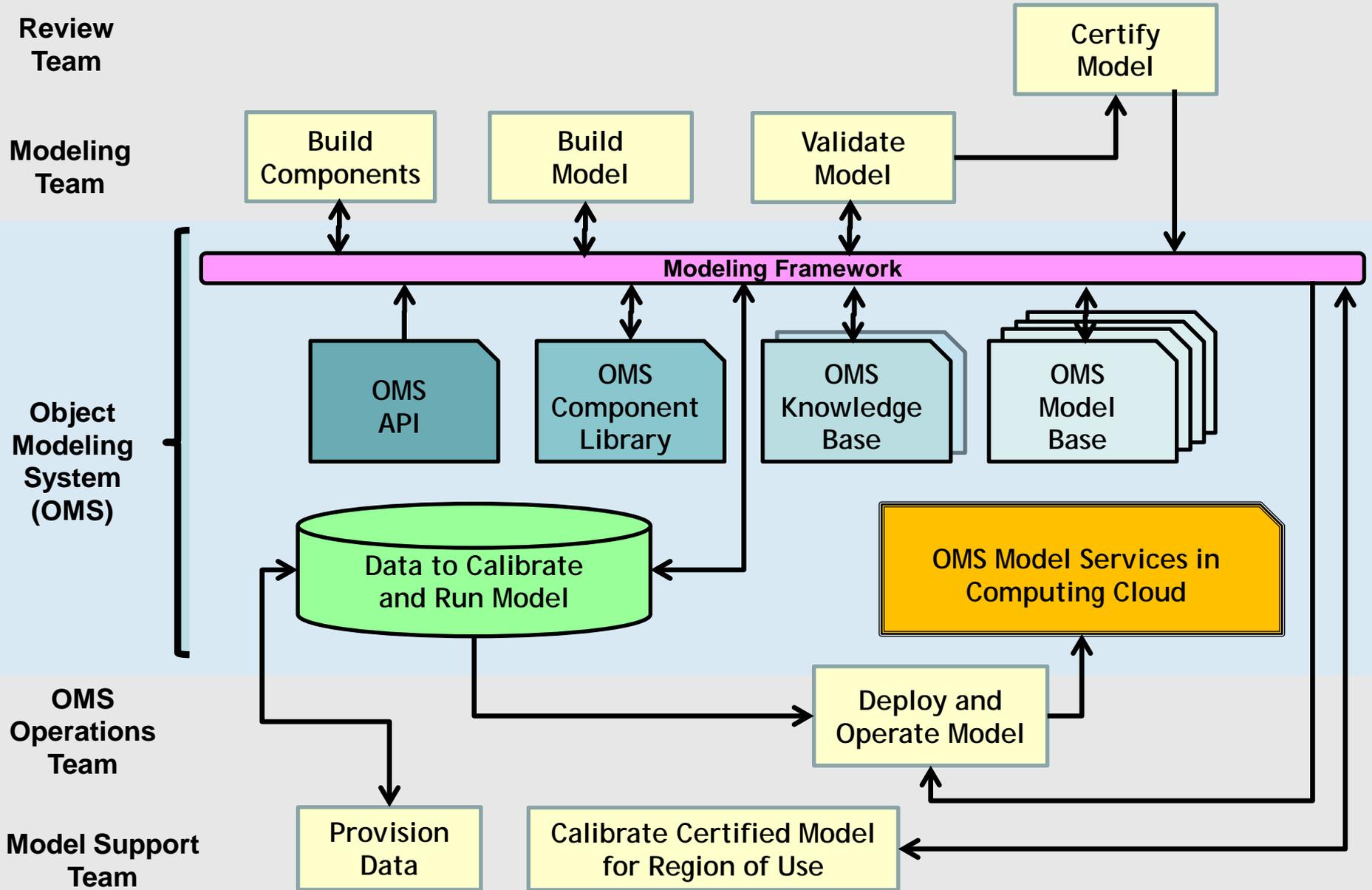
**Model
Run-Time Platform**

**Data Provisioning
Platform**

**Knowledge Base
Platform**

- **Ontology and knowledge base accounting for (among other entities):**
 - Science component/model
 - Land unit
 - Management system
 - Conservation practice
 - Resource concern
 - Soil mapunit
 - Ecological site
 - Climate station
 - Common resource area
 - Plant/crop
 - NRI sample unit

Model Development and Delivery Workflow



Proposed Conservation Model Bases

Conservation Effects Assessment

CEAP
Rapid Watershed Assessments

Conservation Planning

Next Generation
Customer Service Toolkit

Conservation Practice Design

Engineering, Vegetative Practices

Ecosystem Services

Carbon, Nitrogen
Ecosystem Health Indicators

Natural Resource Forecasting

Water Supply Forecasting
Forage Production

Conservation Program Delivery Workflow

