Addressing Model Integration Challenges in Energy Systems

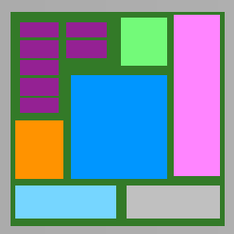
Dr. Mark Bryden
Dr. Kris Bryden

Ames Laboratory
Simulation, Modeling, & Decision Science

Increasing energy use

Increasing impact on the environment

Increasing resource scarcity



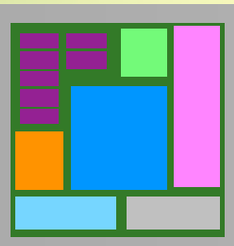
innovation

decision making

engineering

...

actionable information
that changes something

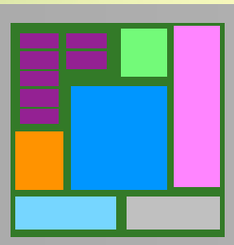


Why create models?

What's needed

Information

1. Integration
2. Mediation
3. Interaction



Actionable information

What's needed

Information

1. Integration
2. Mediation
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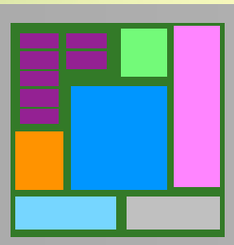
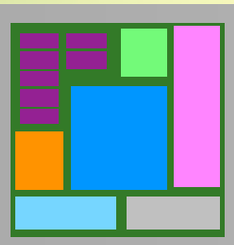


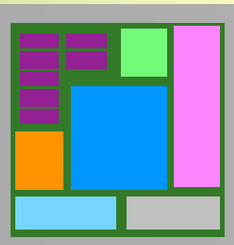
Actionable information

Computers will gather of information and format it for decision makers ...



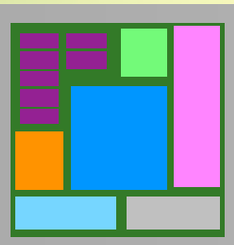
1958 - Leavitt and Whisler

design workbenches, modeling playgrounds,
problem solving environments, design sandboxes,
integrated computational environments



Unified design environments

Decision making environments that integrate all the information, models, and other artifacts related to a product or process.



“What if” environments

Analytics tools

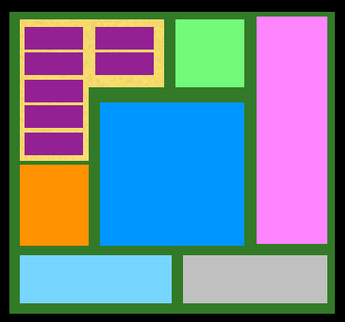
Visualization

VE-Suite

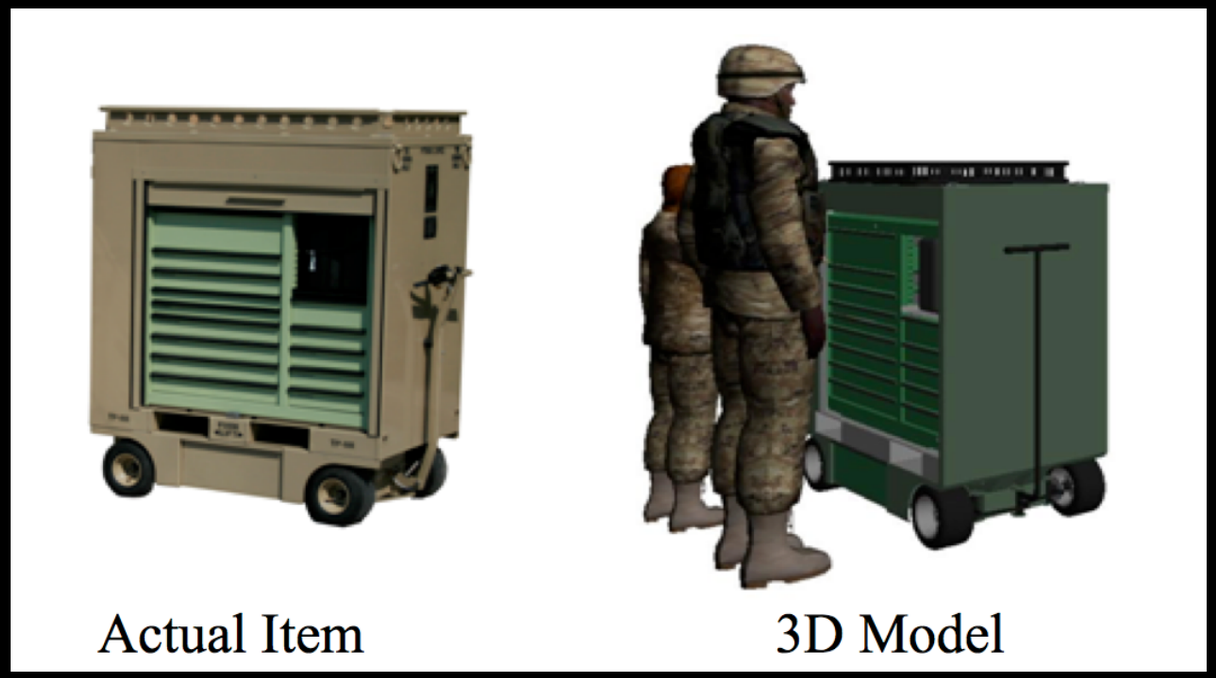
Models & Data

Design tools

- Massive data sets
- Any data source
- Any visualization platform
- Any compute platform
- osgBullet/osgWorks/latticeFX

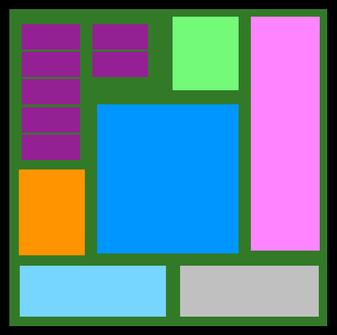


VE-Suite



Savings per project

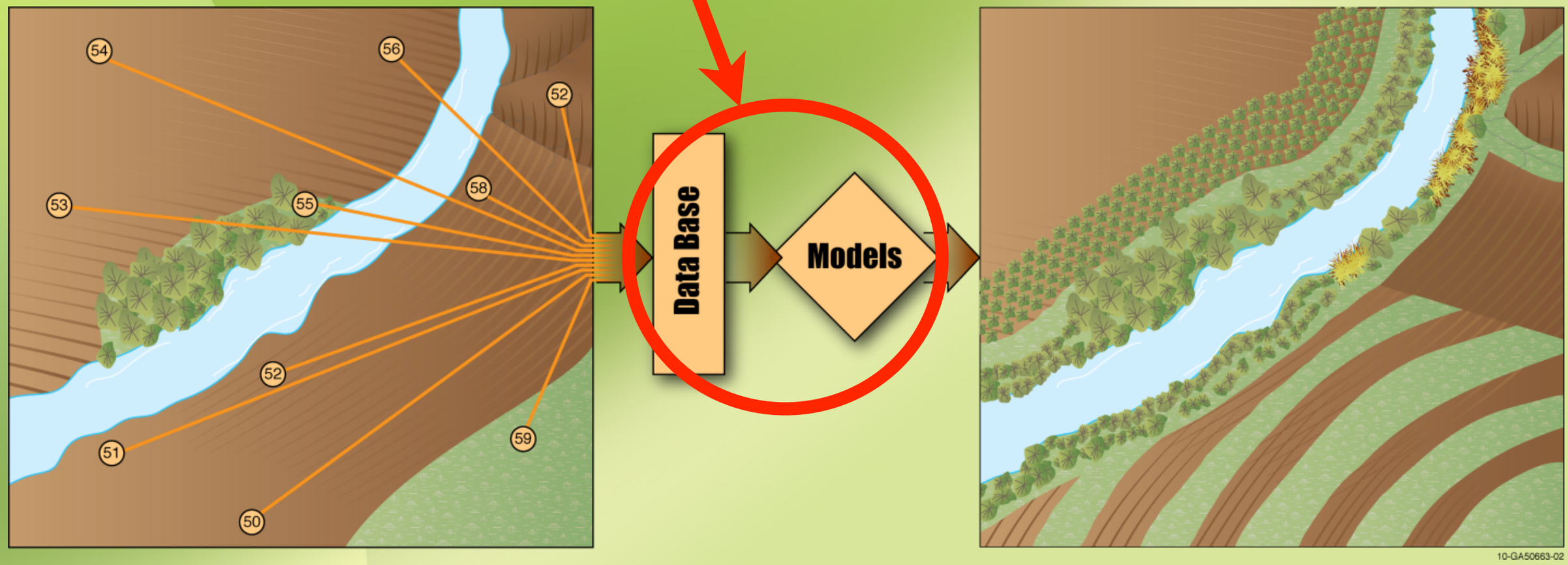
- 40% cost reduction
- development time cut in half



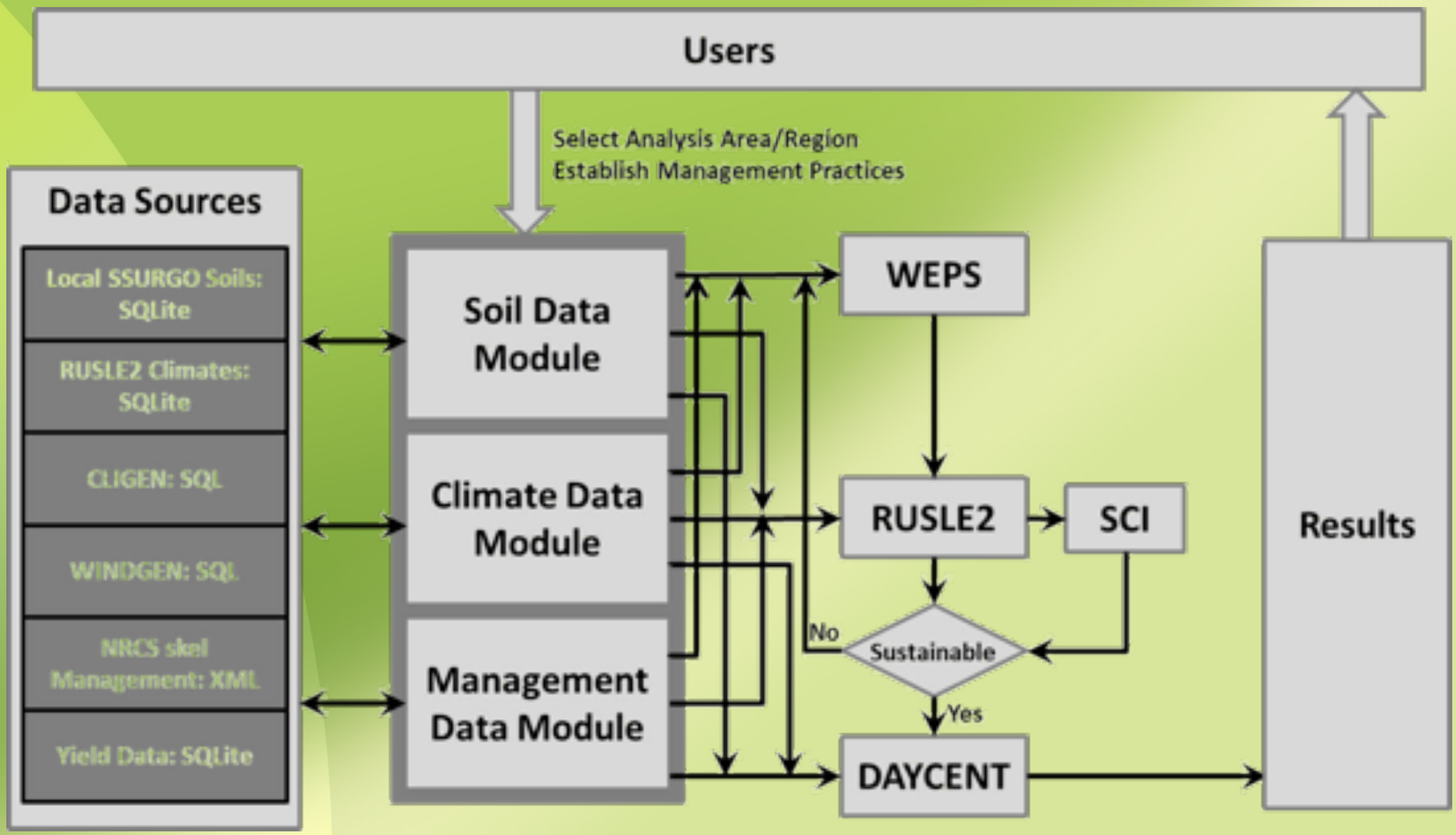
VirtualPaint™

- Paint trainer developed to reduce the cost, time, and waste associated with painting.
  - ~50% reduction in cost
  - Improved product performance
  - VE-Suite “under-the-hood”

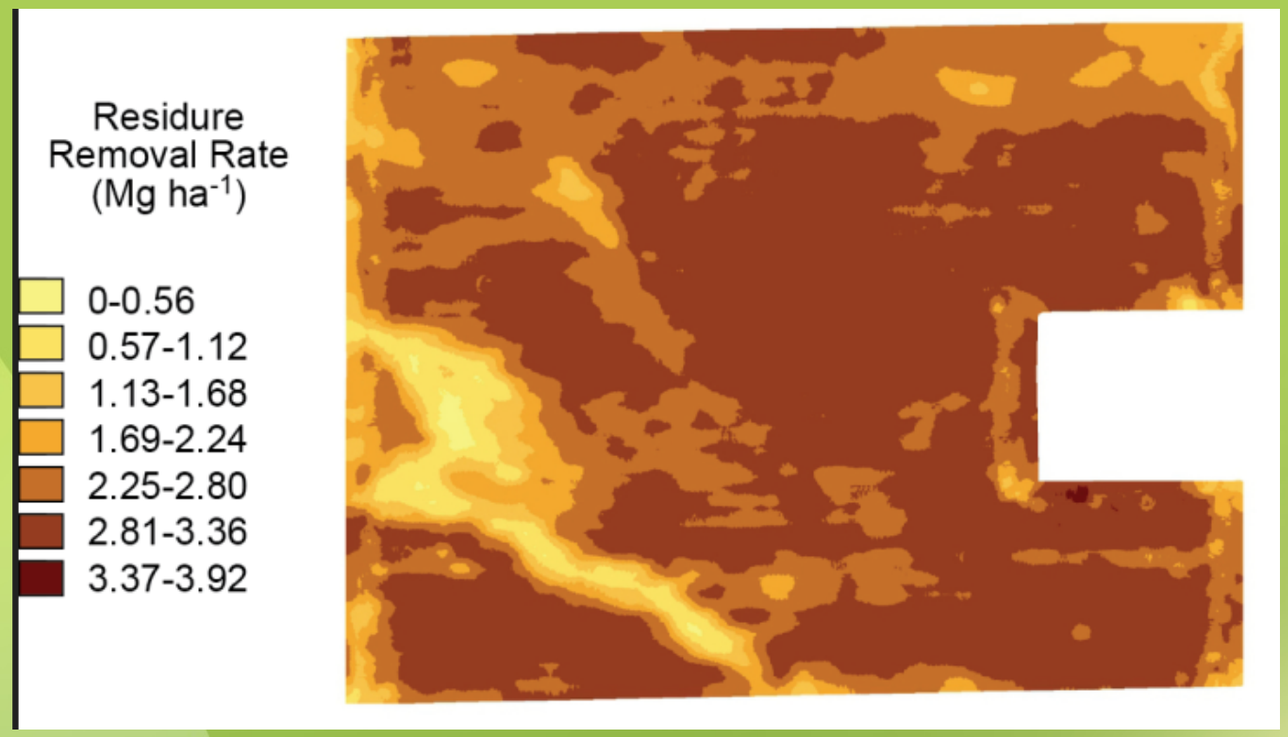
- cover crops
- variable rate residue removal
- Integrated cropping systems
- Landscape management



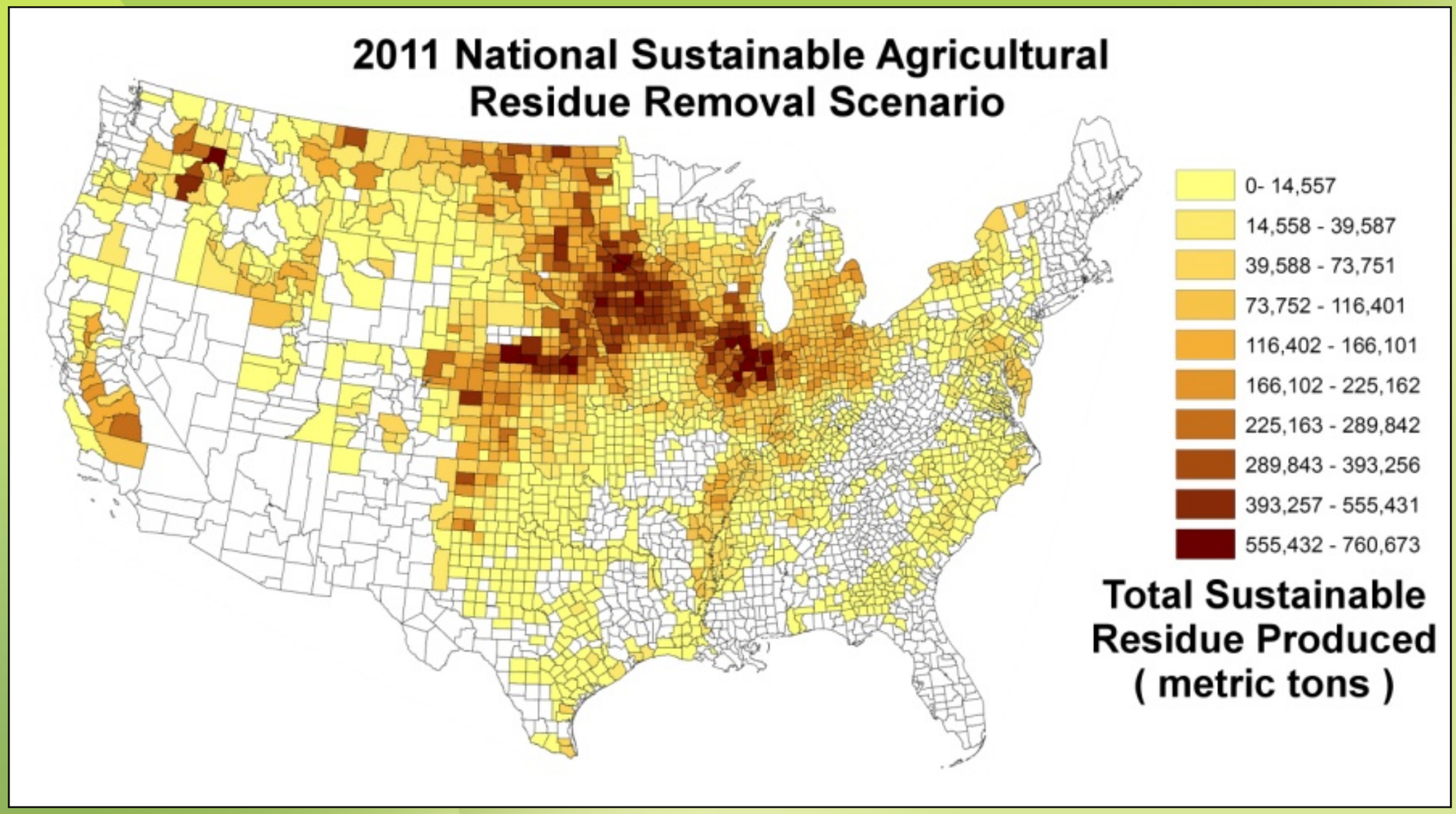
Agronomic strategies

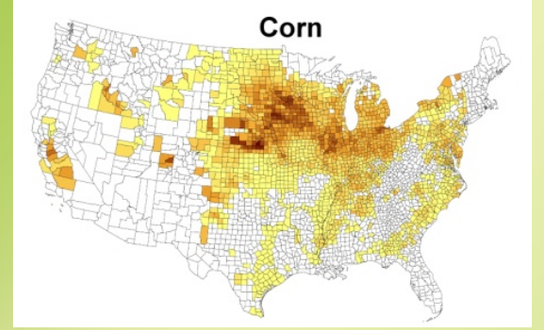


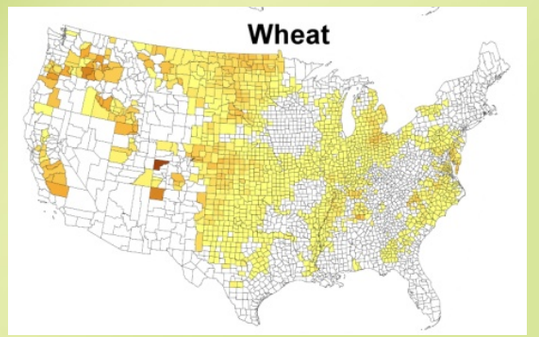
Integrated model

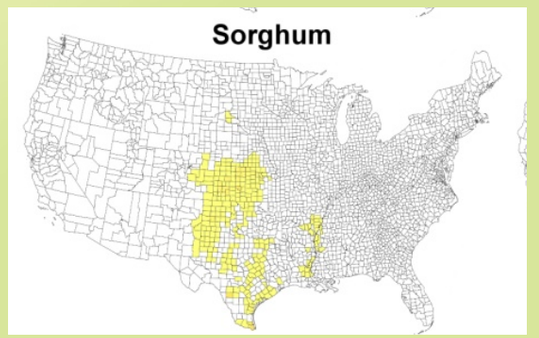


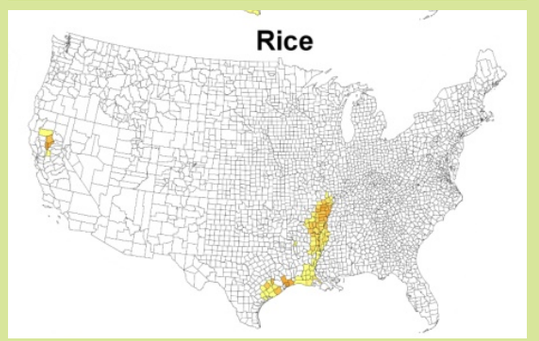
Sustainable residue on a subfield scale

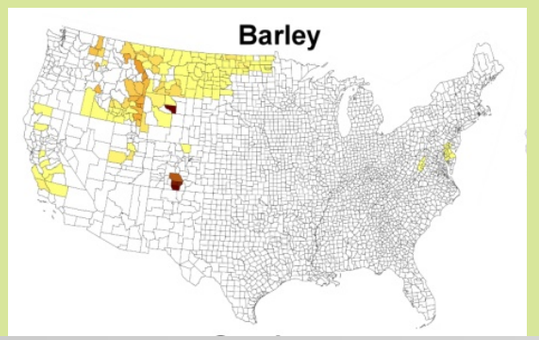






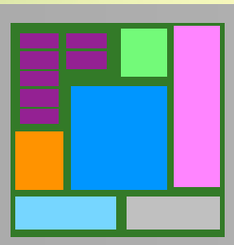






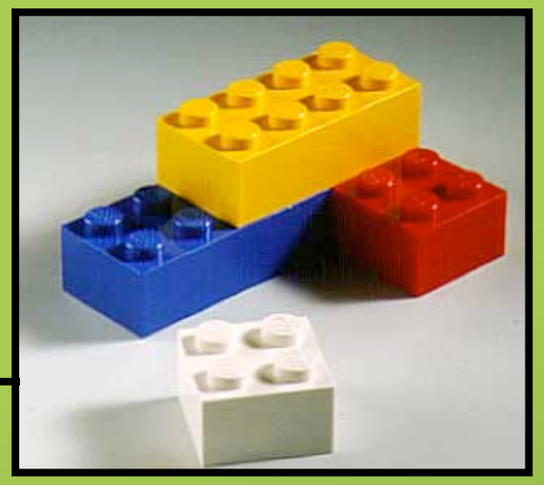
Sustainable residue on a national scale

Computers will gather of information and format it for decision makers …

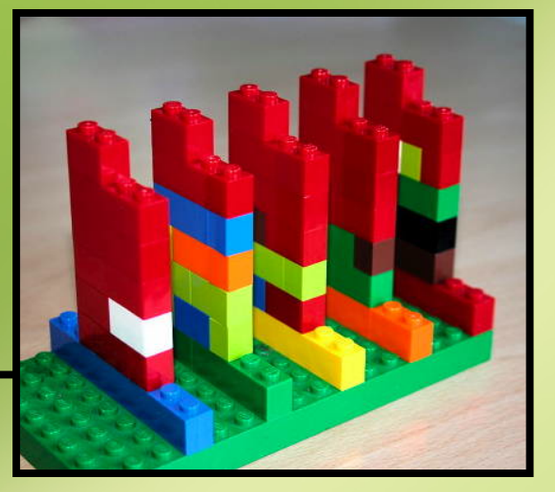


Old decision making paradigm

Snap



Build

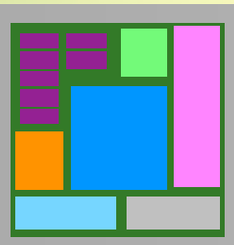


Do

New decision making paradigm

"… a centralized model encompassing a set of other models"

- integration framework
- global ontology and semantics

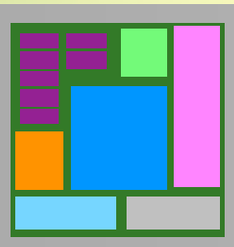


Integrated modeling

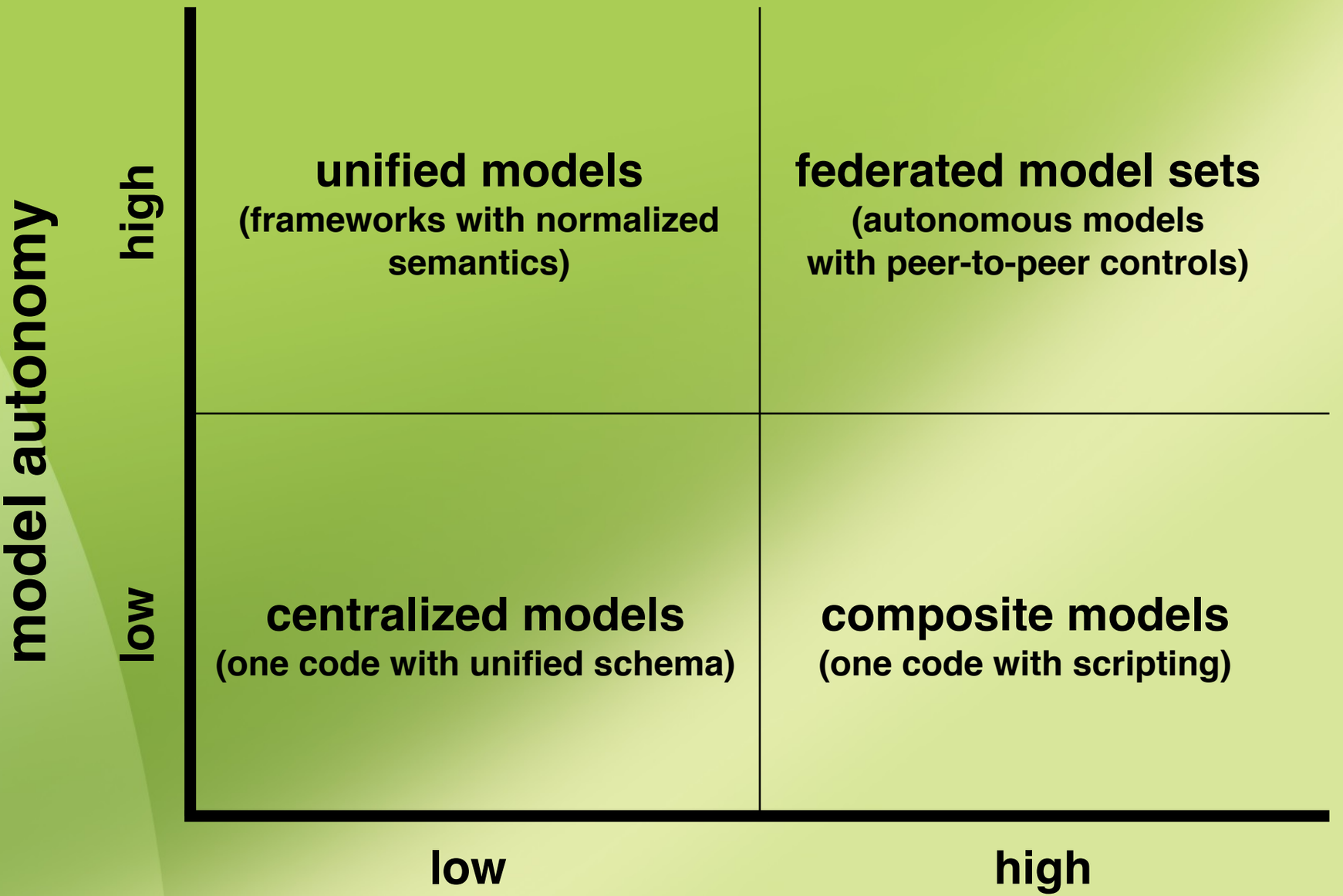
"… a centralized model encompassing a set of other models"

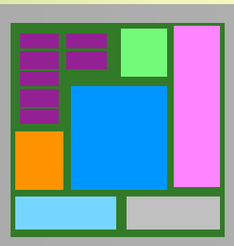
- integration framework
- global ontology and semantics

Pre-determined meta model



Integrated modeling

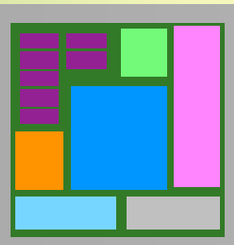




Model portability

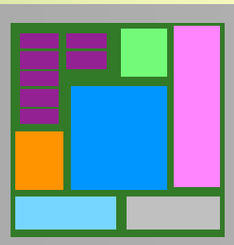
To provide

- high degree of independence for component models;
- a common, light-weight mechanism for model linkage; and
- a basis for deploying the federated model set.



Goal of developing a new architecture

- **Constituency**
  the capability of models to come together in groups that have coherence and substitutability
- **Articulation**
  a simple and precise mechanism for describing how the models are chosen, linked, executed, and results reported
- **Convergence**
  a knowledge of the topological mapping of the federation and the capability to route and converge information through the federation to complete the assigned tasks



Federated model set requirements

Cloud

Model A

Model B

Model C

Model D

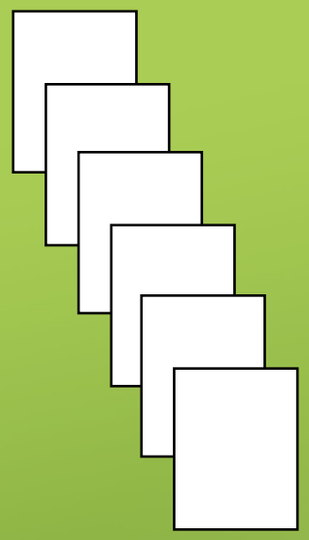
Model E

Model F

…

…

Library



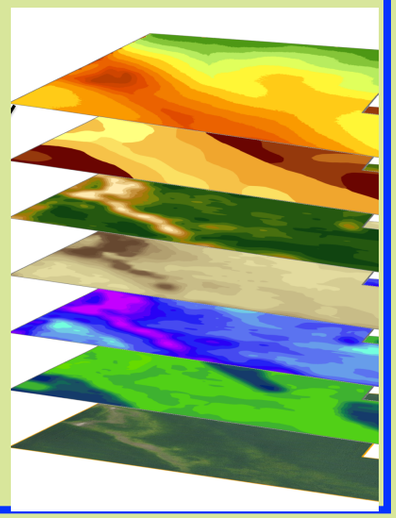
Federation schema

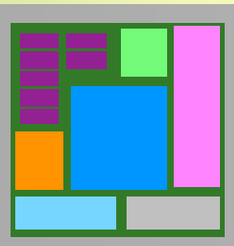
inputs
outputs

Model A …
Model C …
Model E …
Duplicate
    Model F …
    Model G …
End duplicate

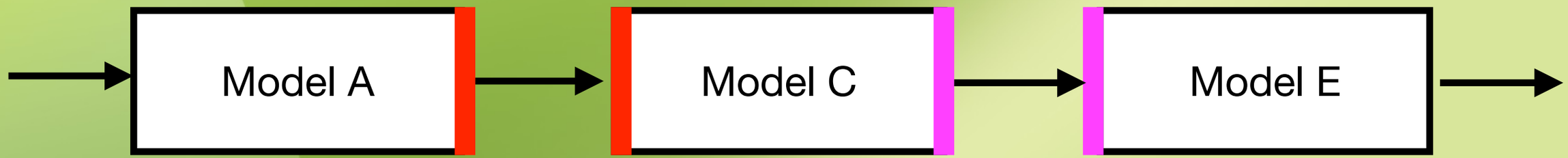
Federation management system

User interface

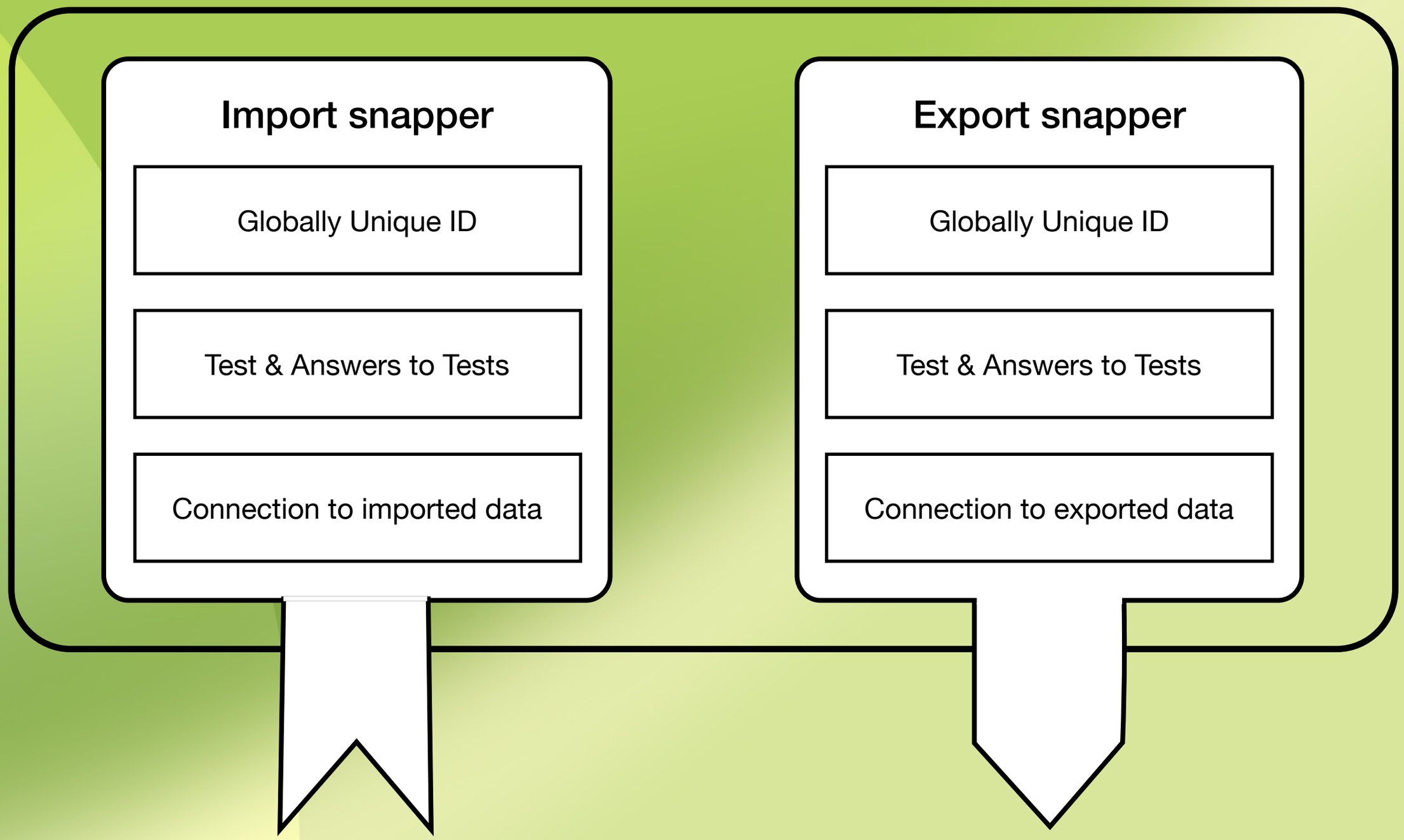




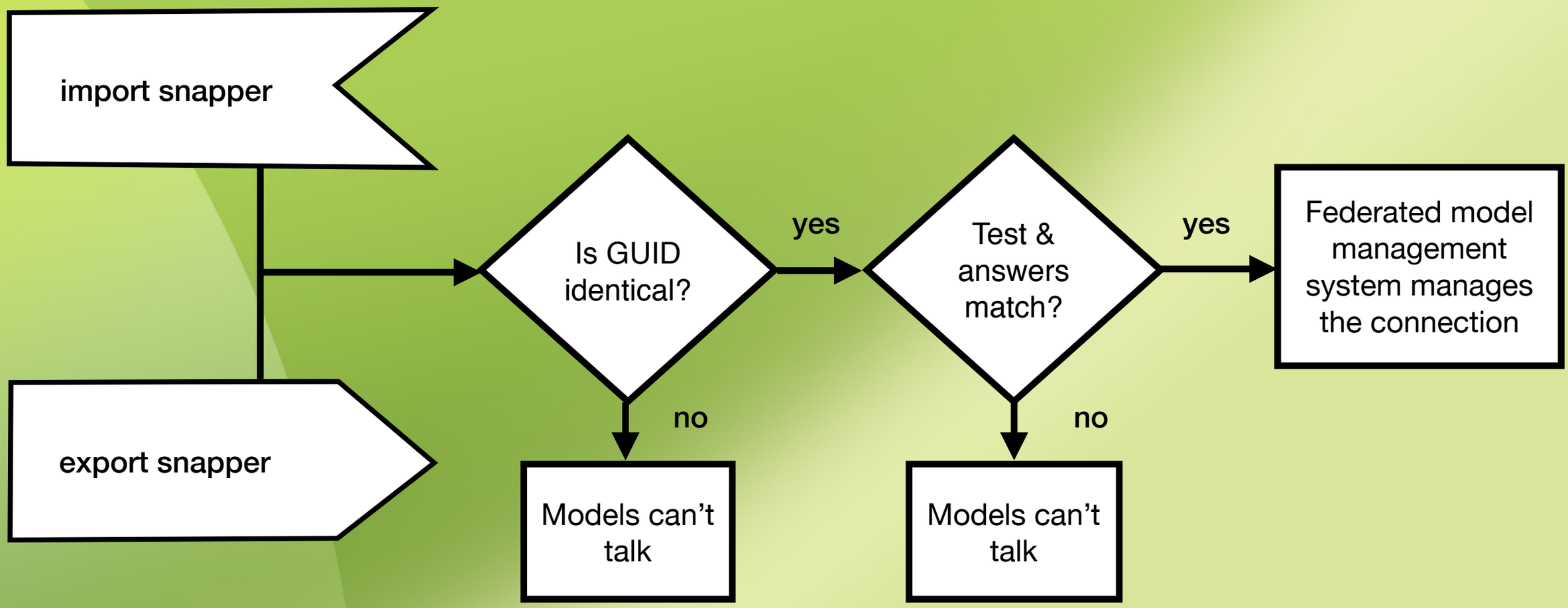
Components and information flow



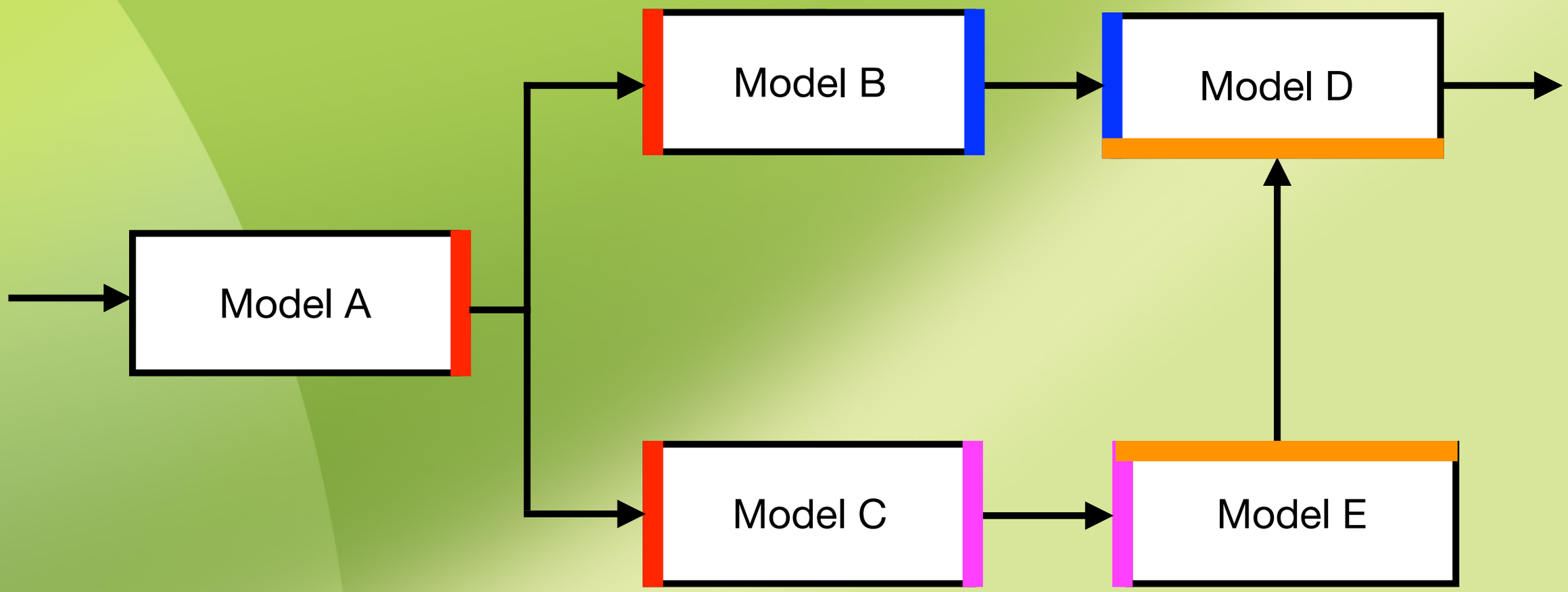
Peer-to-peer ontology



Structure of a component model

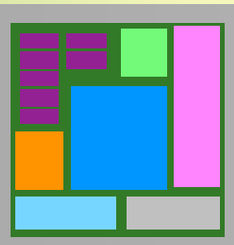


Connection process



Connection process

- “Accurately” simulate/model the virtual world
- Interactive decision tools
- Realtime player communication and decision making
- Easily understood graphical interface



Mark Bryden

515-294-3891

kmbryden@iastate.edu