# Moving Down the stack

Notes from the ASKE May Phase 2 PI Meeting Breakout Session on Moving Down the Stack

## Framing the issues:

* Grand Challenges: Coming up with an architecture where domain knowledge for science can be abstracted away. Mechanism for abstraction and concretization. Must have the representational range. Closed mathematical field. Process can’t be lossy or ambiguous. Defining the restrictions of knowledge for each layer.
  + Classes of model artifacts and interpretation: Execution errors and their consequences. Result interpretations and their consequences. Constraints of model. Constraints on solution. Constraints of results.
  + How do we generalize the removal and addition of semantic knowledge at each layer.
* Technical Gaps: There is an ideal, and there is the current. How do we bridge from current practice to ideal practice. How do we translate between, and encode artifacts of side knowledge that need to be used. Things like domain knowledge, or error resulting from implementation.
  + Semantic interpretation on knowledge generalization and specificity between machine and domain layers.
* Overarching categories and themes: Restrict domain knowledge to the top layer. Restrict implementation to the bottom layer. Layers define knowledge boundaries, not atomicity of implementation.

## Solutions and plans:

* Practical/Compelling Applications:
  + Reusable model stack. Forms the basis for a reusable modeling stack. Specifications for encoding a domain, “knobs” to turn to fit the stack to a domain.
  + Model refinement and assumption checking - how to fix models on the basis of model/human assumption errors.
  + Knowledge extraction and domain casting.
* Human Integration.
  + Moving down the stack moves from domain science to quantitative scientist to machine engineer.
  + Casting current layer results into appropriate context for new layers assumptions.
* Community Components
  + Moving down the stack allows sharing of extracted knowledge between domains.
  + Moving between may illuminate and identify domain constraints and assumptions, and equivalences that were not previously realized.
  + Community standards on how to interpret layer results, and required context for layer translation.
  + Community interaction happens at the middle layer. Readers work primarily on the middle layer.
* Powerful ways to connect tools and ecosystems
  + Standards for middle layer expressivity: Needs to cover all scientific models.
  + Middle layer representations must be isomorphic, and computing the isomorphisms needs to be performable.
  + Isomorphisms allow collaboration between focused ecosystems which solve sub-problems efficiently.
* Mechanisms for collaborative progress:
  + Between milestones, pairwise, or ring partnering to check middle layer compatibility and whether they are isomorphic.
  + Working groups to share tools in one ecosystem through isomorphic transforms.

## Questions

* Abstract layer vs. middle layer: different domains
* Organizing community resources
  + Libraries in R, etc.