



HOME OF THE FUTURE : SYSTEM OF THE FUTURE

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MIT – SDM ANNUAL CONFERENCE
“SYSTEMS THINKING”
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engineering & technology

OUTLINE:

THE PRESENTATION:

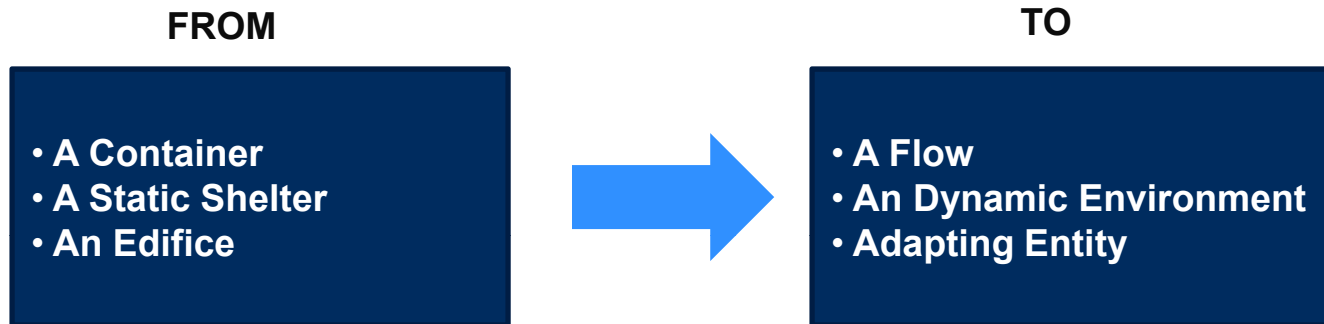
- o THE PURPOSE
- o THE PREMISE
- o THE PRIZE
- o THE PROBLEM
- o THE PROPOSAL
- o THE PITCH

THE PURPOSE

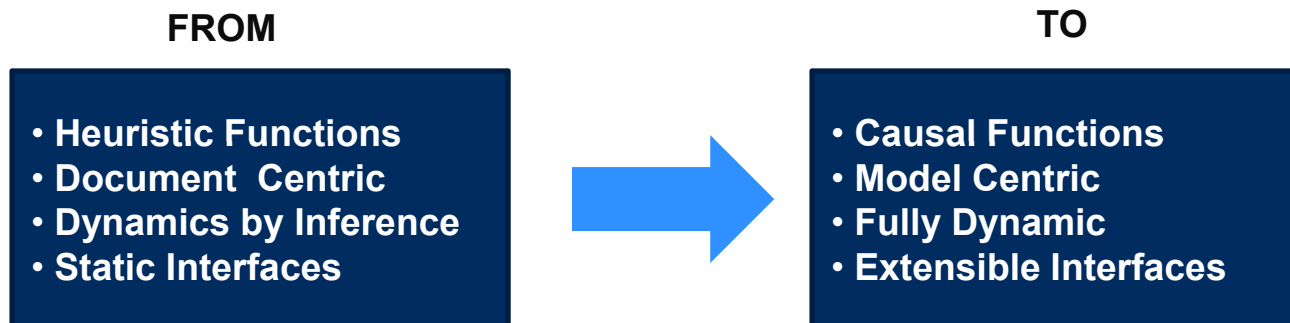
- o Make the Case for the evolution of the Home and of Systems ...
- o Explain the Convergence of the two ...
- o *Propose the Challenge and the Opportunity ...*
- o *Propose a Path Forward...*

THE PREMISE

o The Vision of the Home is Changing:



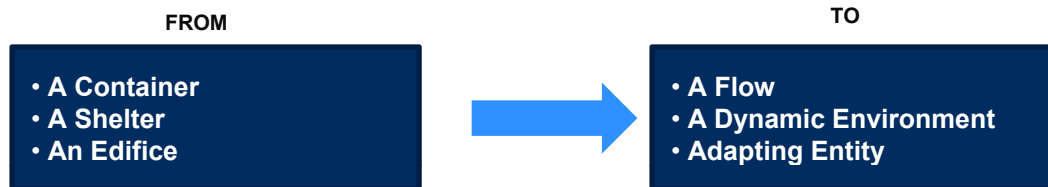
o The Vision of Systems is Changing:



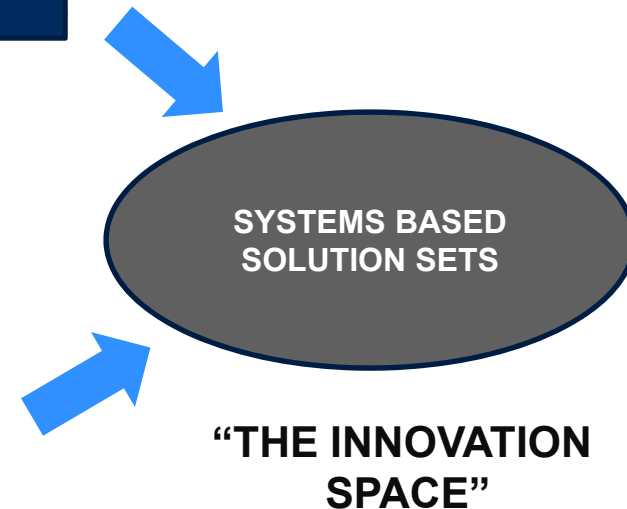
THE PREMISE

Convergence of an Opportunity Space and Solution Space

“THE EVOLVING CONCEPT OF THE HOME”



“THE EVOLVING CONCEPT OF SYSTEMS”



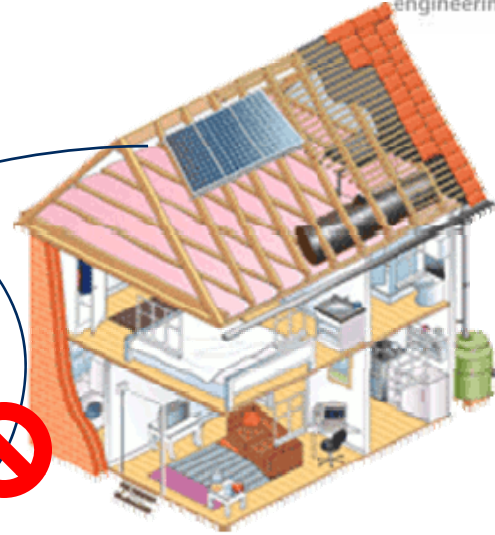
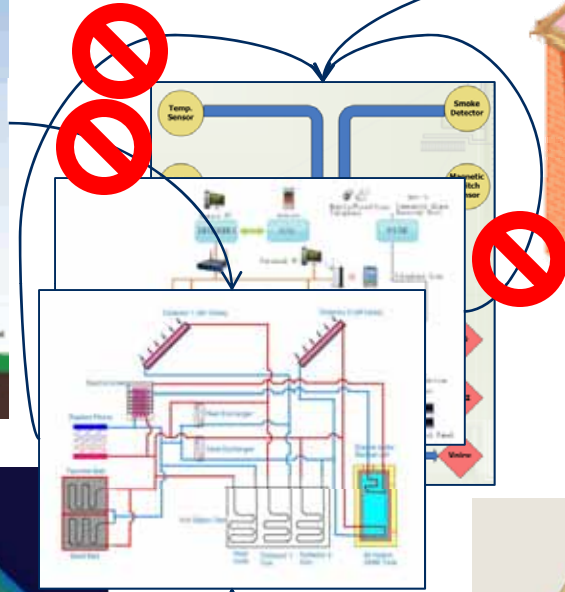
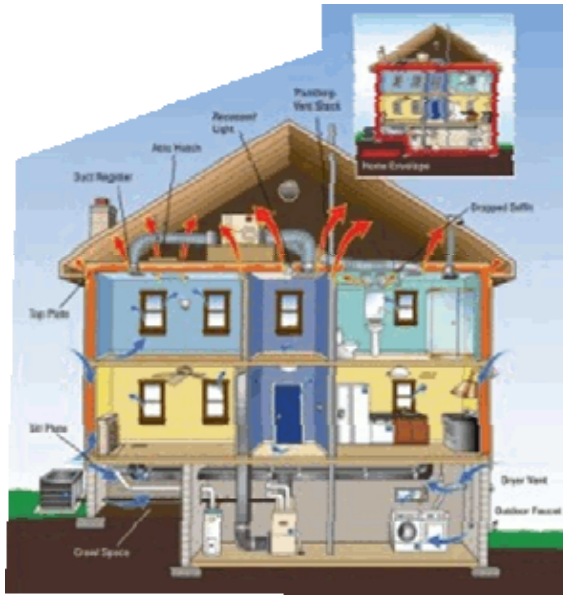
THE PREMISE

Home Systems : “Innovations Needed”

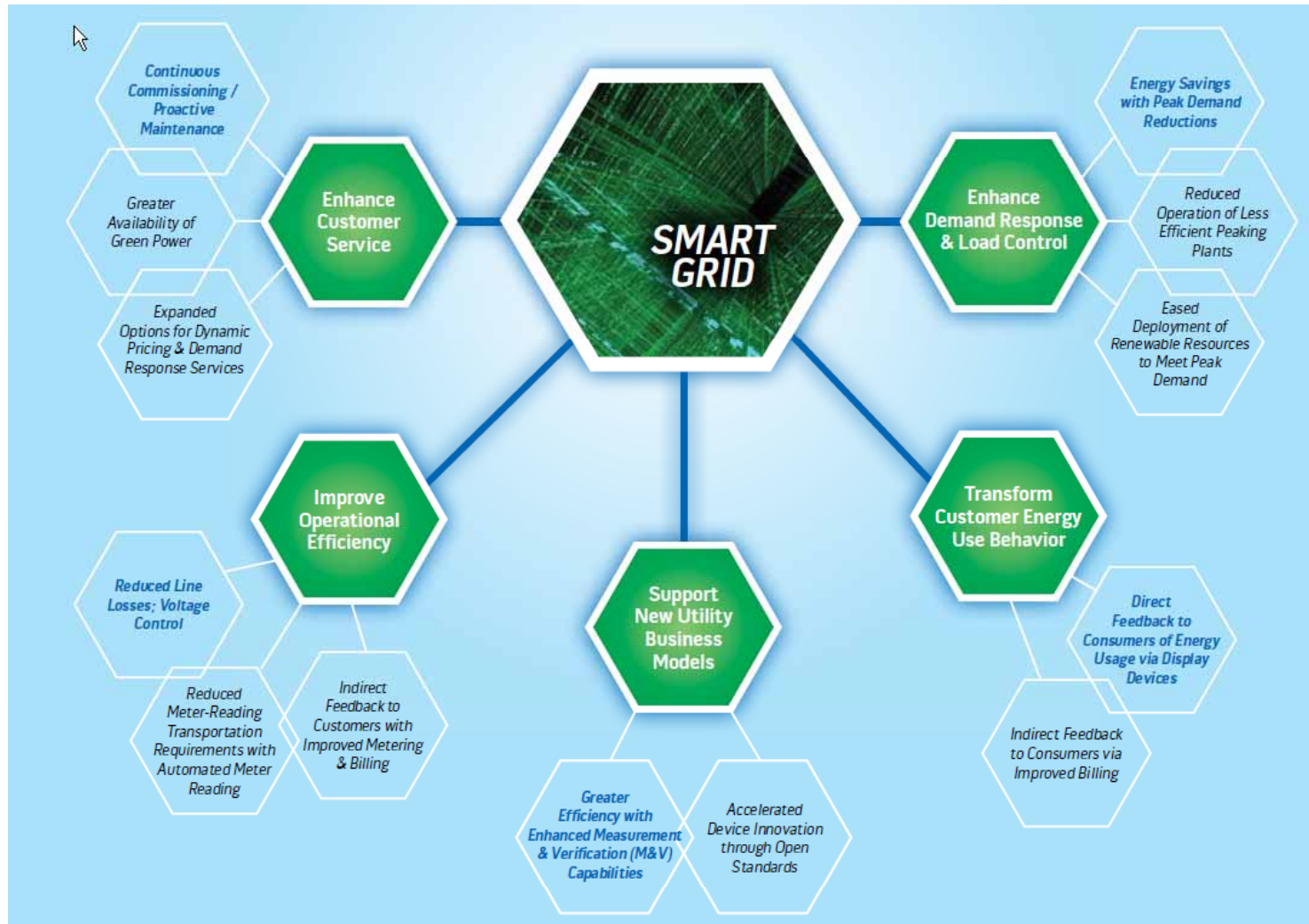
**SYSTEMS BASED
SOLUTION SETS**

- ENERGY
- ENVIRONMENT
- PERFORMANCE
 - COMFORT
 - ADAPTABILITY
 - SECURITY
- NEIGHBORHOOD
 - BUILDING
 - SECTOR
 - CITY

Models of the Home provide solutions...but are Not Well integrated...



New Forces Connecting the Home as System Stretch Models Further



New Forces.. Demand Deeper and Broader System Understanding

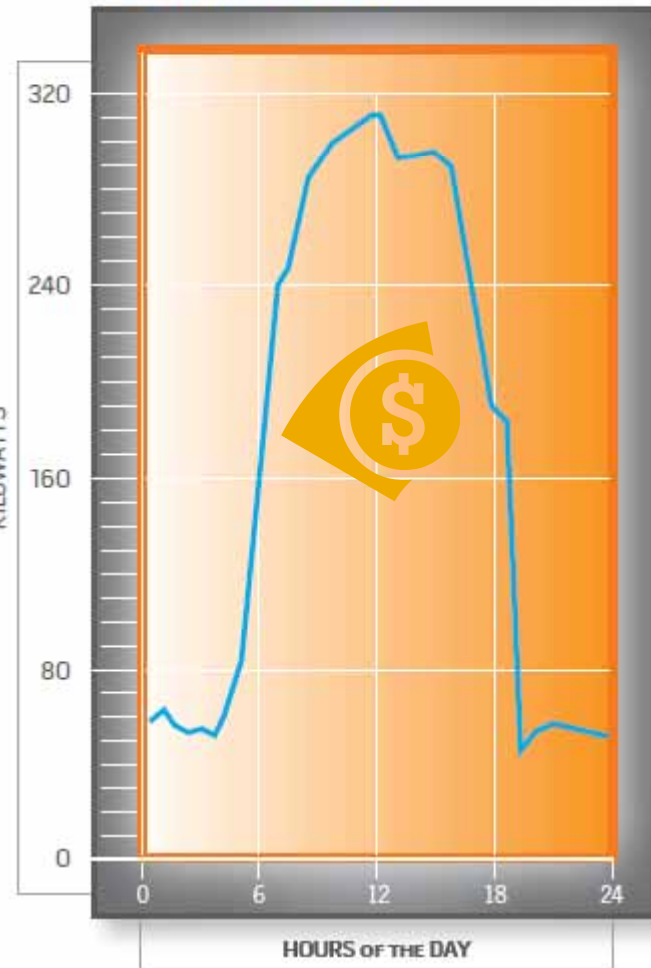
LOWERING THE FLOOR.

TODAY'S GRID. AND TOMORROW'S.

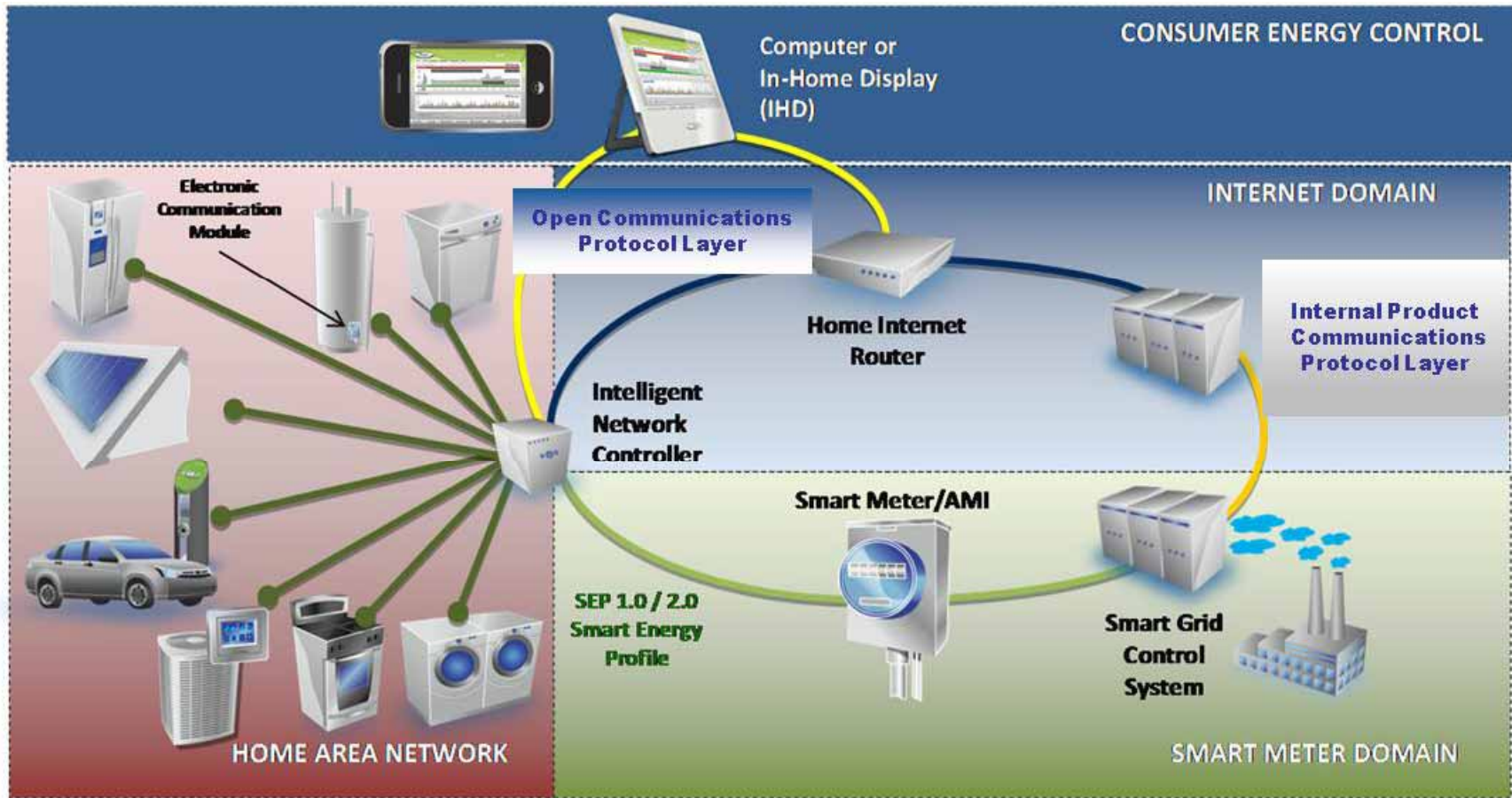
Today's Grid	Smart Grid
Consumers are uninformed and non-participative with power system	Informed, involved, and active consumers; demand response and distributed energy resources
Dominated by central generation; many obstacles exist for distributed energy resources interconnection	Many distributed energy resources with plug-and-play convenience; focus on renewables
Limited wholesale markets, not well integrated; limited opportunities for consumers	Mature, well-integrated wholesale markets, growth of new electricity markets for consumers
Focus on outages; slow response to power-quality issues	Power quality is a priority with a variety of quality/price options; rapid resolution of issues
Little integration of operational data with asset management; business-process silos	Greatly expanded data acquisition of grid parameters; focus on prevention, minimizing impact to consumers
Responds to prevent further damage; focus is on protecting assets following fault	Automatically detects and responds to problems; focus on prevention, minimizing impact to consumer
Vulnerable to malicious acts of terror and natural disasters	Resilient to attack and natural disasters with rapid restoration capabilities



Demand Profile



Enterprises are beginning the journey ...A Whirlpool Smart Grid Example...



THE PRIZE (THE WHY ...)

- o 1.5 Billion Homes
- o 15 Million New Homes per Year
- o 200 M Homes under renovation per Year
- o People, Governments, Environments are redefining the Home Space...
- o Adjacent Spaces to home redefined : new trade offs and opportunities.
- o Large Energy, Environmental, and Performance Benefits ...

THE PROBLEM

- o Systems Models of the Home and Surrounding Environment insufficient ...
- o The Depth and Breadth of Models have been non-predictive
- o Stochastic Methods and Deterministic Methods at odd's ...
- o The home and it's environment understudied compared to other systems ...

THE PROPOSAL TO SOLVE THE PROBLEM

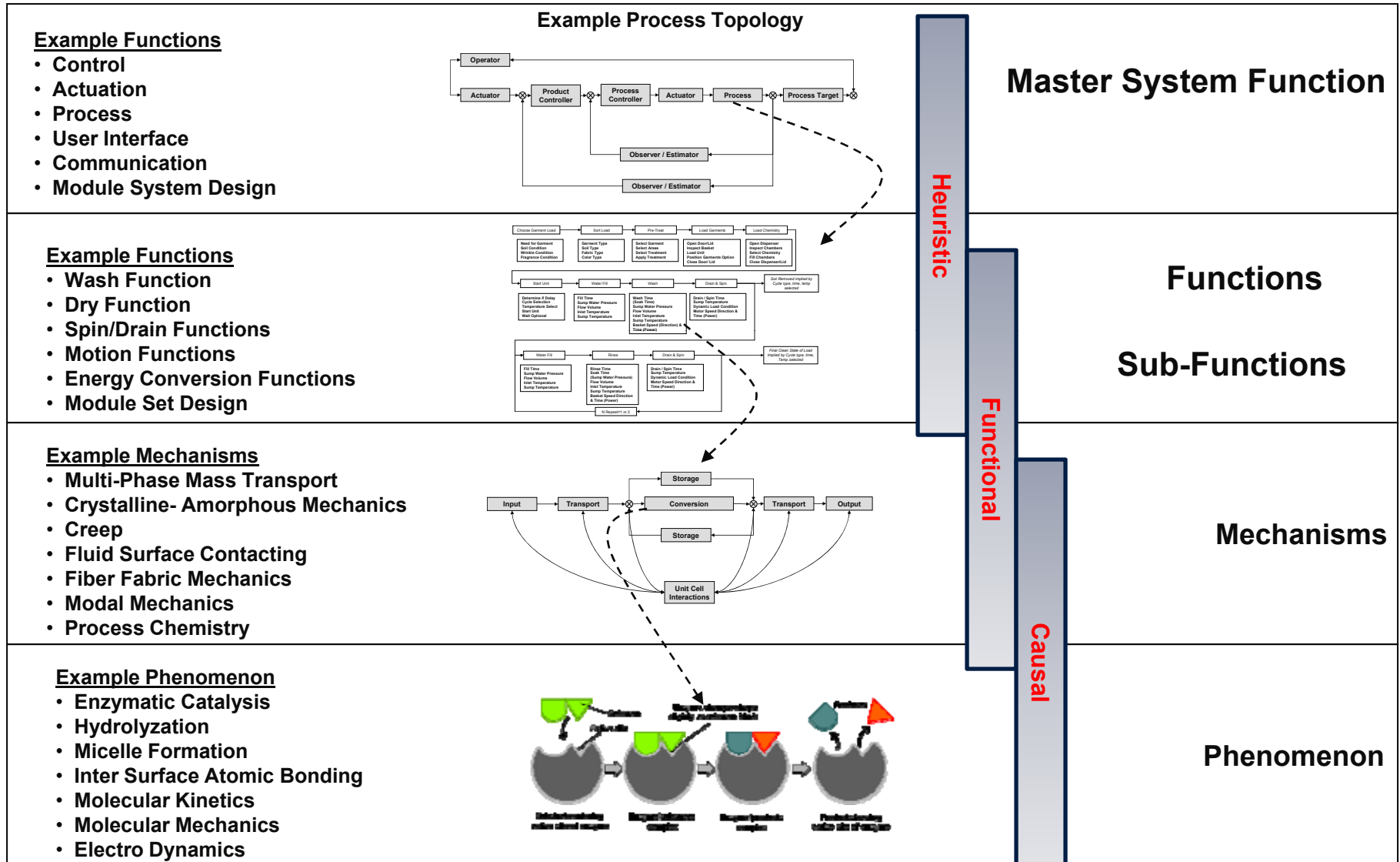
o AN EXTENDED MODELING APPROACH

- MULTI-DOMAIN
- MULTI-DIMENSIONAL
- CAUSAL

o RESEARCH AND DEVELOPMENT BASED ON THE NEW MODEL

MASTER MODEL LAYERS ... DIMENSIONS WE MUST HAVE ...

Systems Functional / Process Hierarchy Example



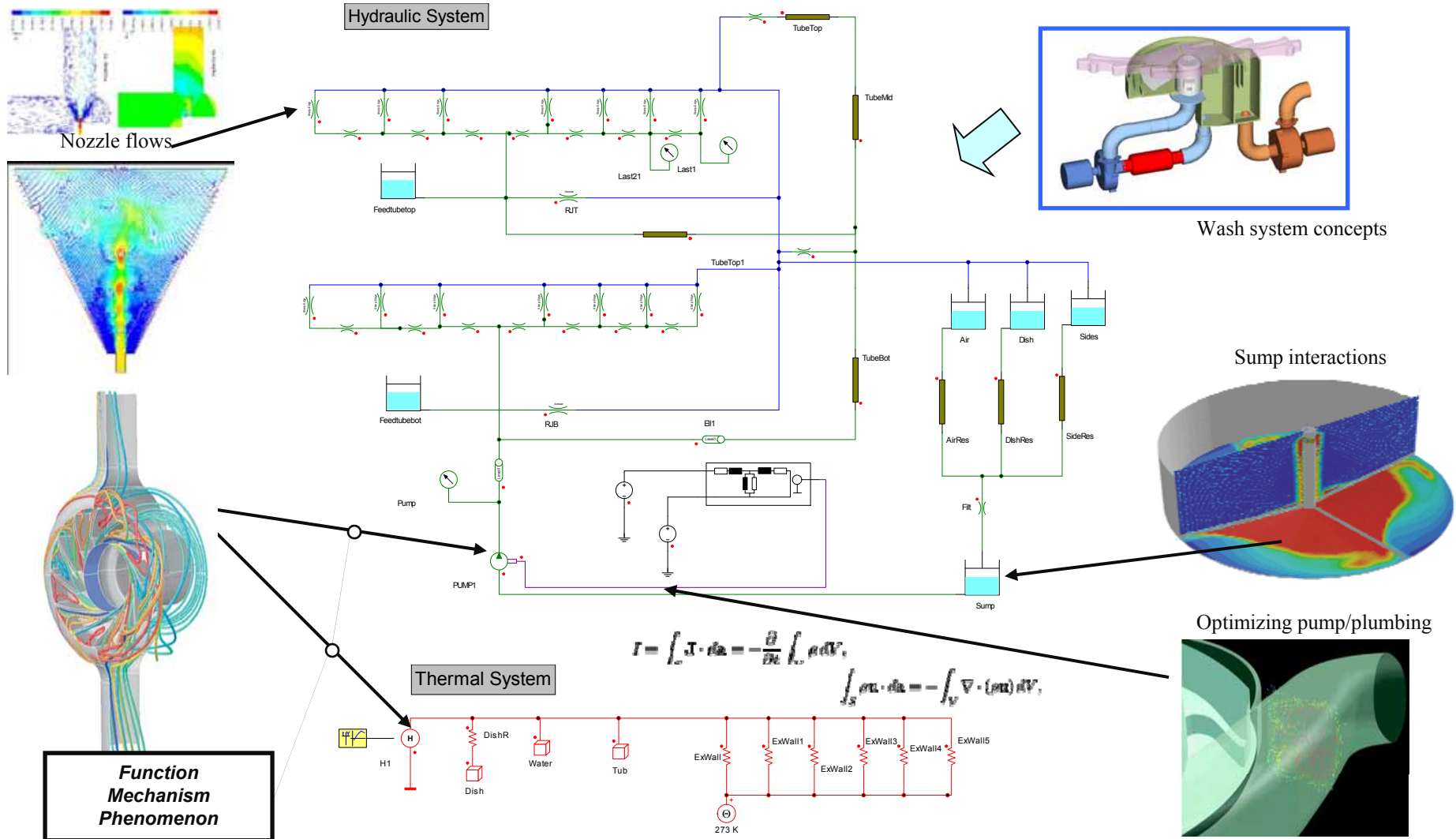
Heuristic

Functional

Causal

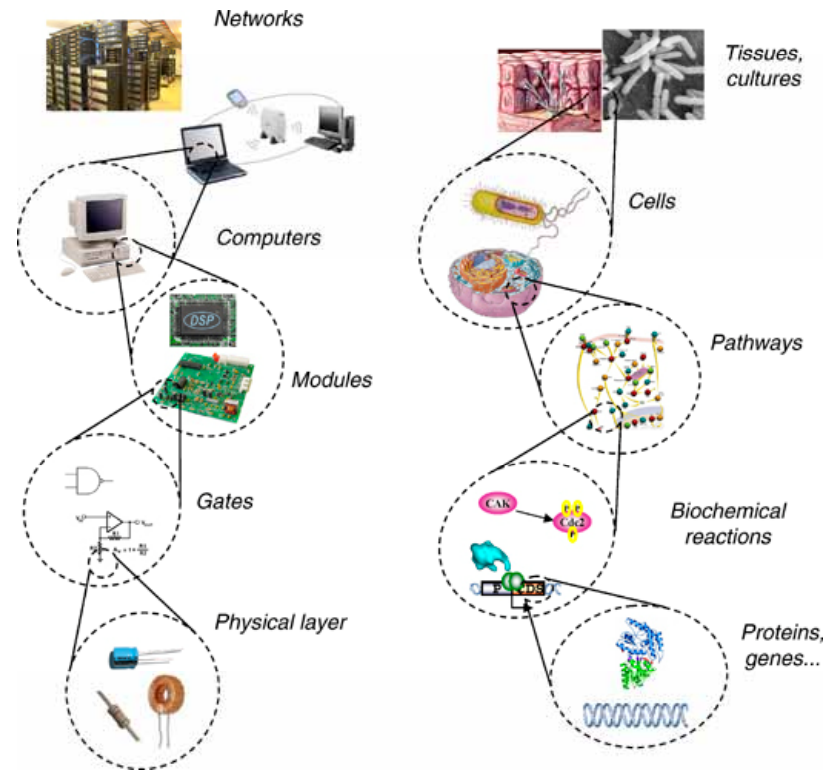
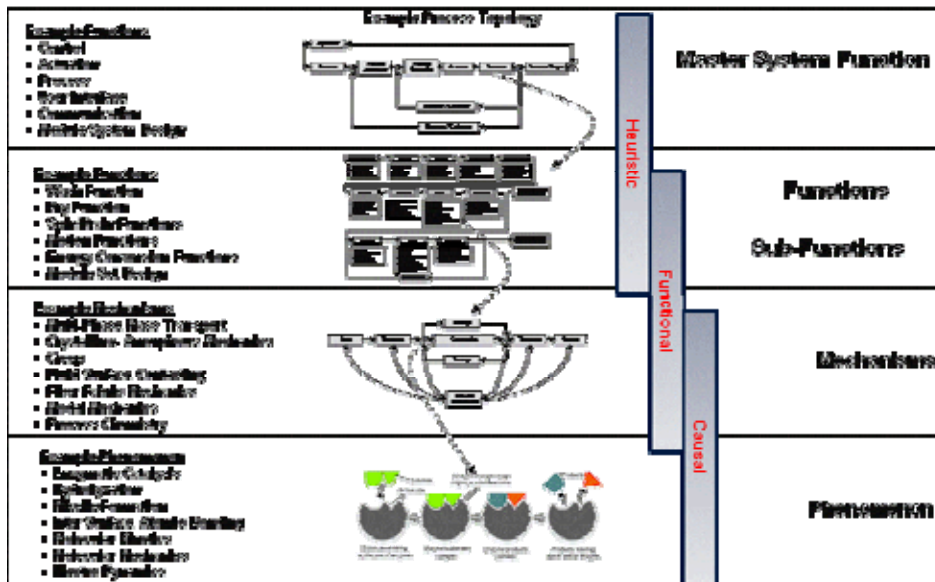
PRODUCT LEVEL MULTI-DIMENSION MODELING ARE HAPPENING ...

.....BUT THEY NEED EXTENSION ...



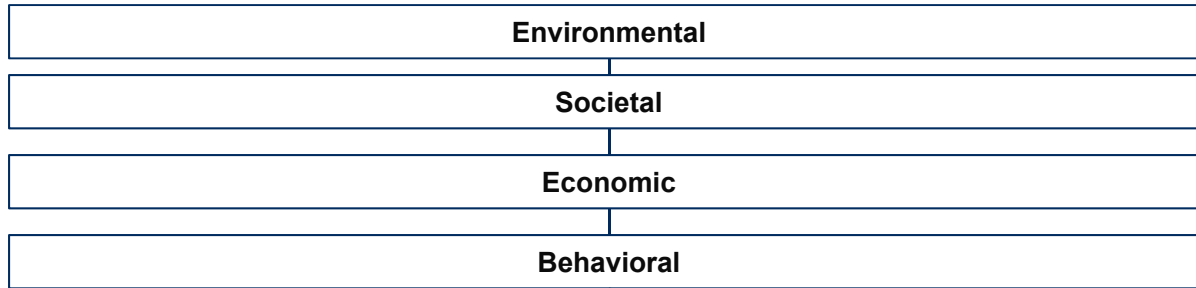
Multi Dimensional Models are Changing all of Science and Engineering (as well)

.....BUT THERE ARE LAYERS MISSING...

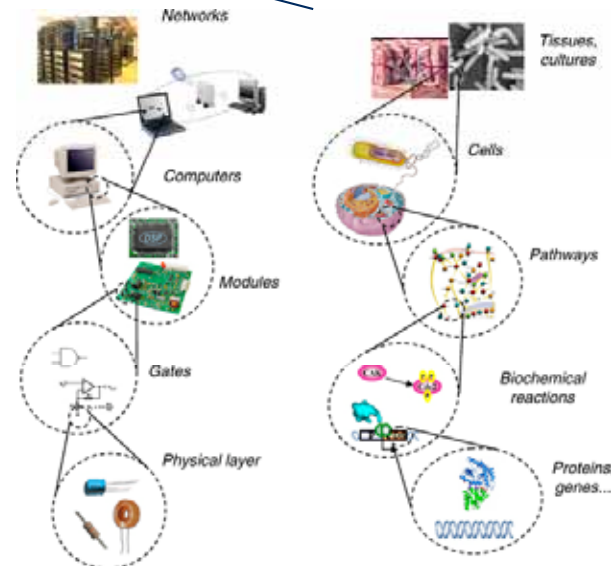
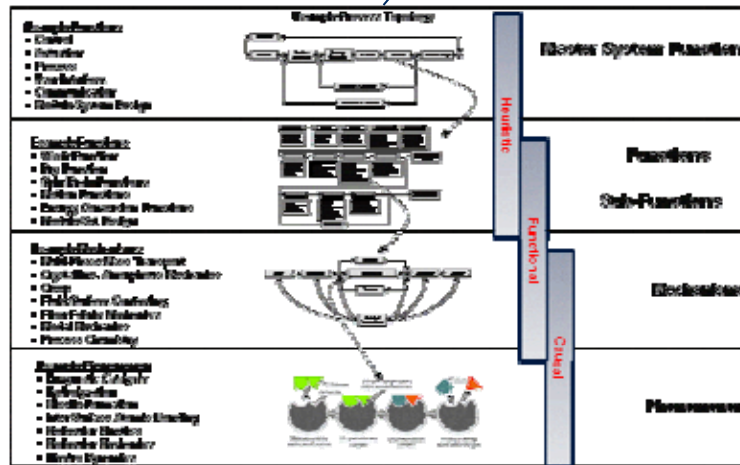


Multi Dimensional Models are Changing Science and Engineering

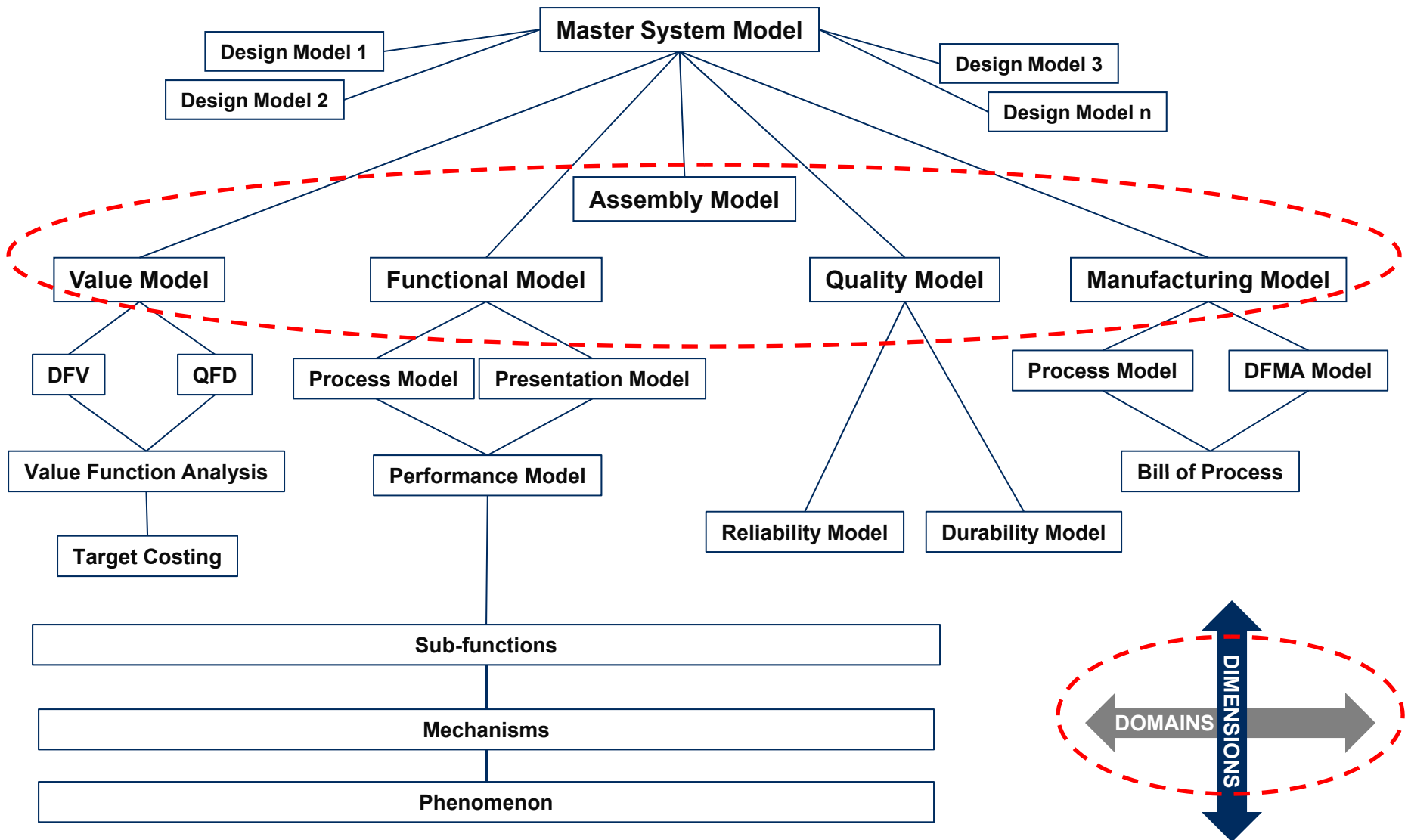
What's missing



Additional Model Layers.....



System Models also need Both Dimensions & Domains



SO WHAT AM I SELLING

THE PITCH : FUTURE DIRECTIONS FOR SDM & SEArI ...

- o MULTI-DIMENSIONAL /MULTI-DOMAIN MODELING
- o MODEL BASED ARCHITECTURES
- o OPEN STANDARDS FOR MODELS AND ARCHITECTURES
- o FUNDAMENTAL RESEARCH AND APPLIED ENGINEERING SCIENCE:
 - Alternative Architectures
 - Alternative Models
 - Alternative Innovation Sets
- o PREPARATION OF LEADERS TO MAKE IT HAPPEN ...
- o (and ..) **DON'T FORGET THE HOME AS A SYSTEMS OPPORTUNITY ...**



MANY THANKS TO THE AUDIENCE & MIT ...

WE HAVE REACHED THE END OF THIS BEGINNING ...

SOANY QUESTIONS ???



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