

# **Modelling Power as a Utility**

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# Outline

- Review of current practice
- Model based services
- Paradigms of applications
  - Critical components
  - Critical application areas
- Shaping up the utility functions
  - Market and business conditions
  - Technological innovations

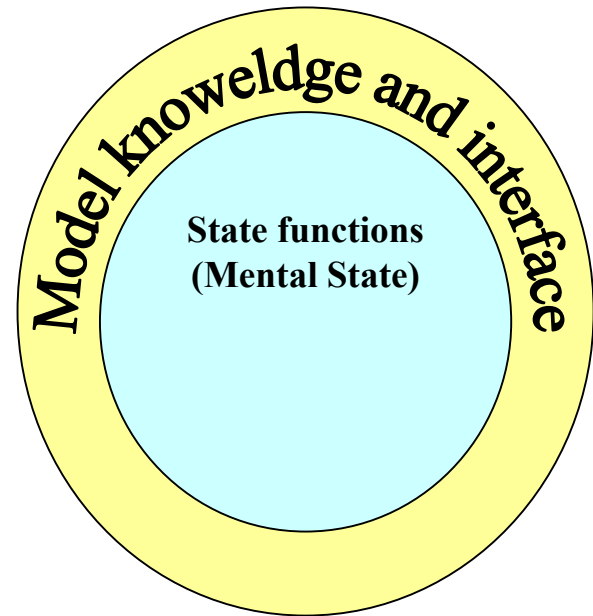
# Models, models, everywhere

Established software and services

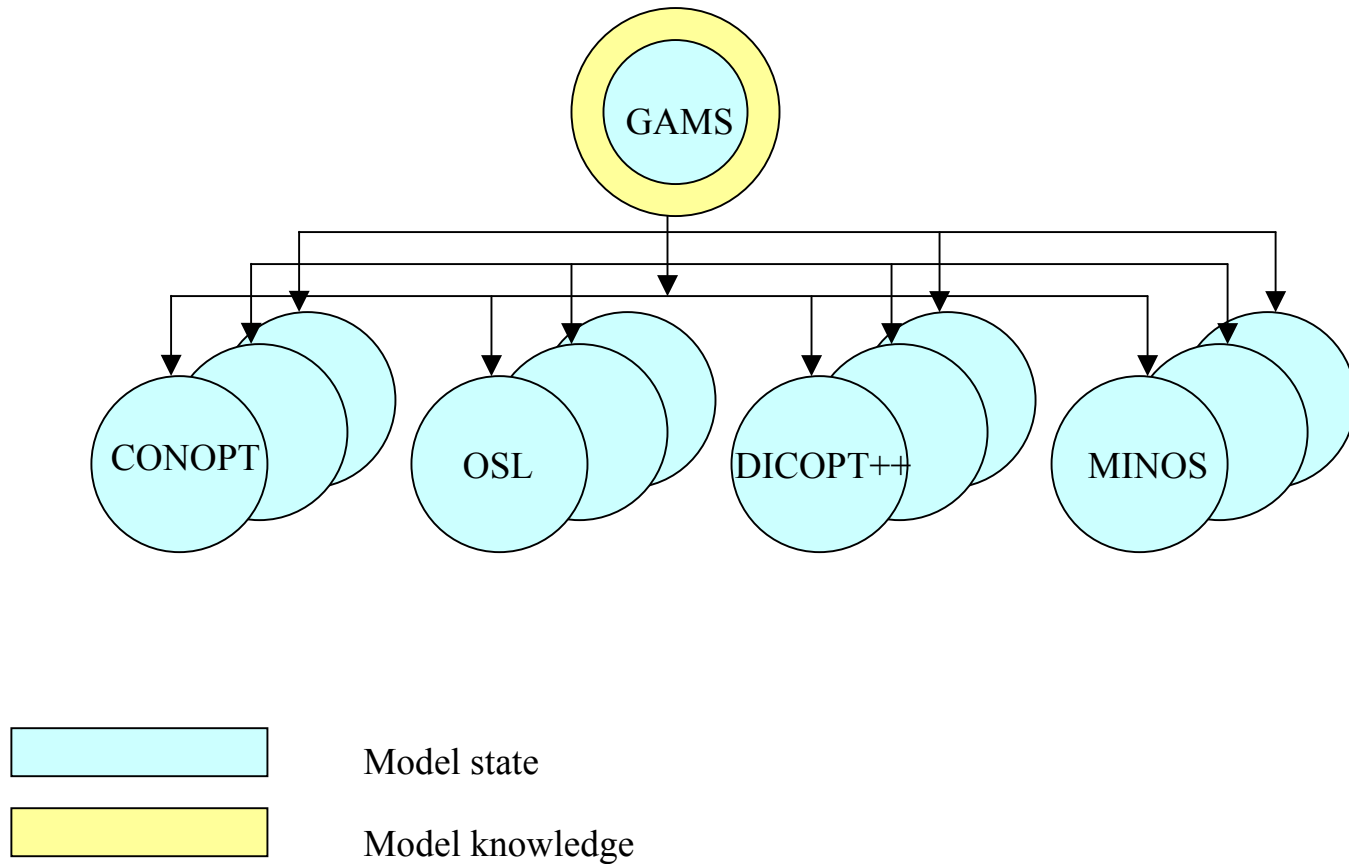
- Various purposes: simulation, optimisation, enterprise management and control
- Various sectors: automobile, chemicals, transportation, utilities
- Dramatic improvements in quality:
  - Internal: modularity, readability
  - External: robustness, extendibility, portability

# Conceptual model of a “model”

- State functions
  - Accuracy and validation
  - Better/faster performance
  - Major effort consumed here
- Knowledge interface
  - Unsettled developments
  - Progress much slower and more wavering
  - Internet imposes an even stronger priority



# Modelling environment: typical case



# Bring us the knowledge!

- Potential boost: distributed computing, agent-enabled applications
- Basic forms:
  - Set of rules, tags
  - Taxonomies and hierarchies
- Semantic knowledge
  - Ontologies
  - Semantic Web and Grid applications

# Model based services: drawing analogies

Energy services: 70's

- Emphasis: improve efficiency in generating power
- Production regulated and distributed by large suppliers

Over last 10-20 years

- challenge in power generation replaced by challenge to distribute the power
- Power grids

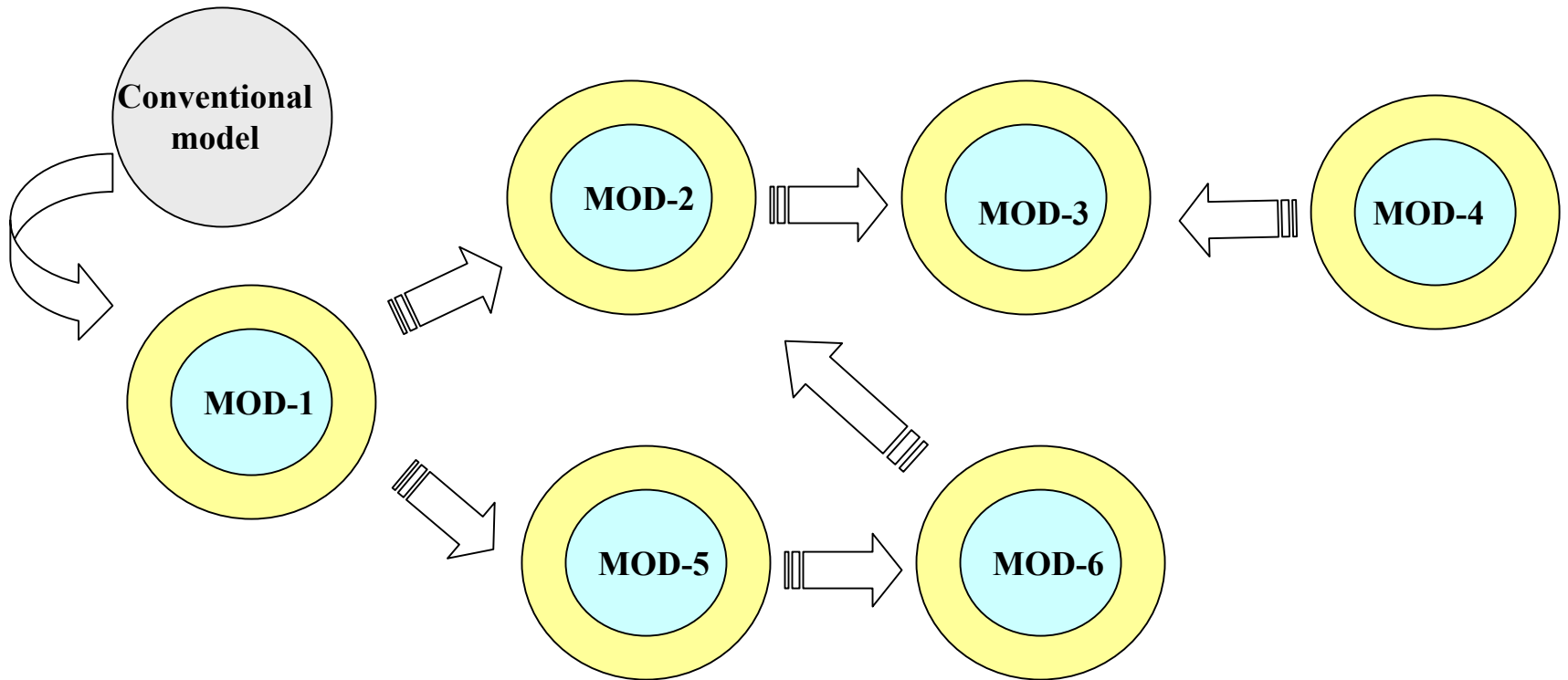
Modelling services: 90's

- Emphasis: improve efficiency in actual engine (state functions)
- Production regulated and distributed by large software houses

Next 5-15 years

- Challenge is modelling efficiency replaced by distribution of service
- Service management
- Computer grids

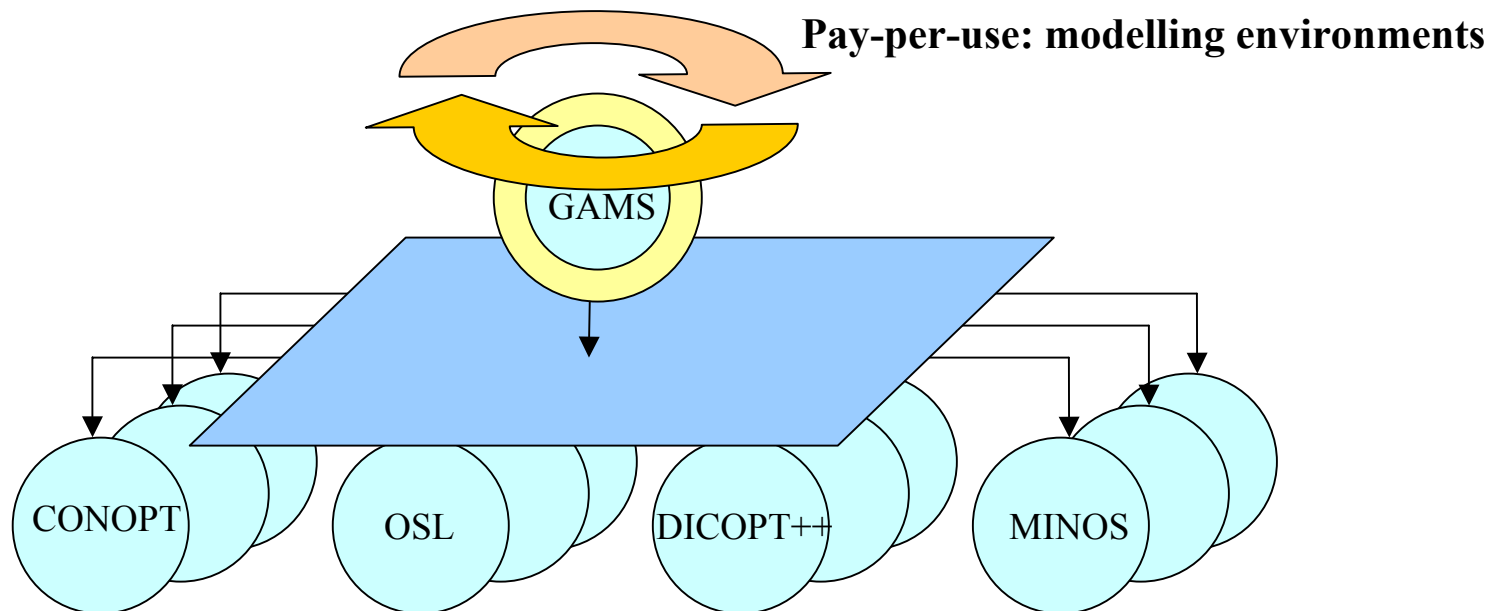
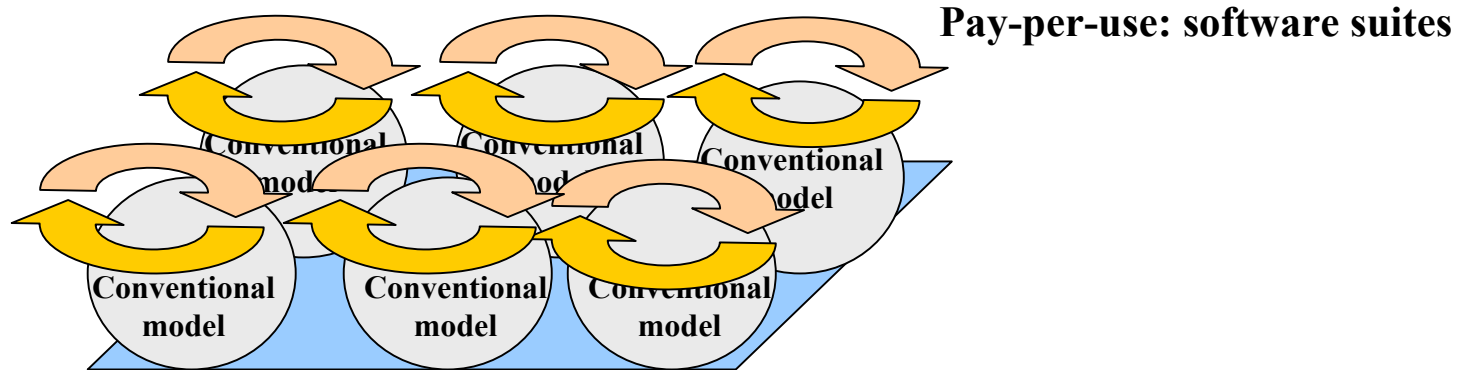
# Conventional and Semantically enabled models



# Heralds of change

- Portal services
  - Client-server arrangements
  - Single-language servers
- Pay-per-use cost models
- Increased use of distributed computer power
- Enhanced services to support and maintain models

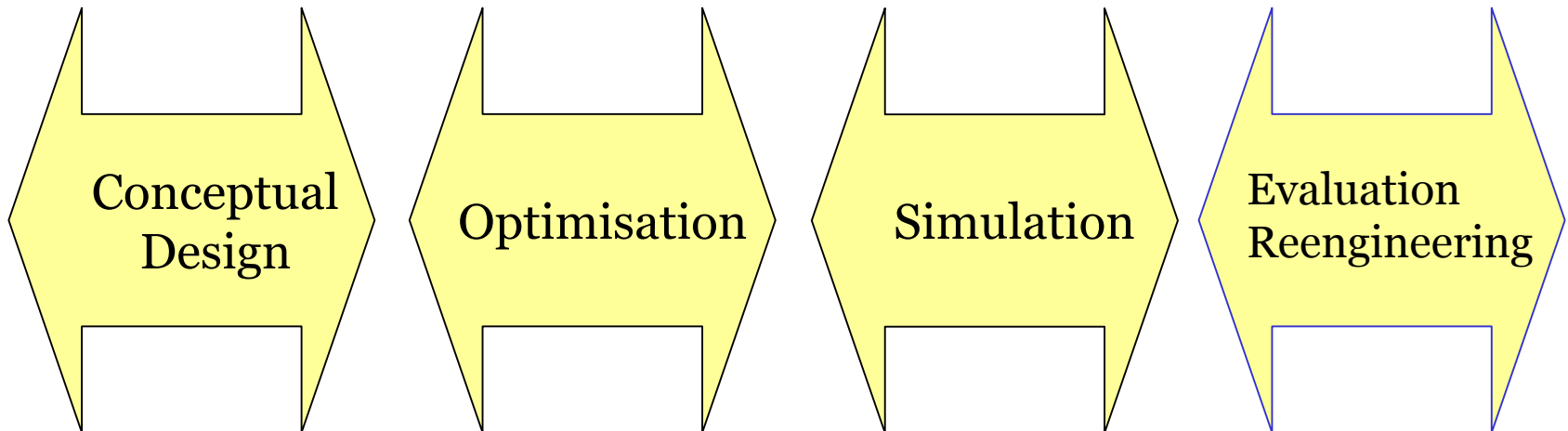
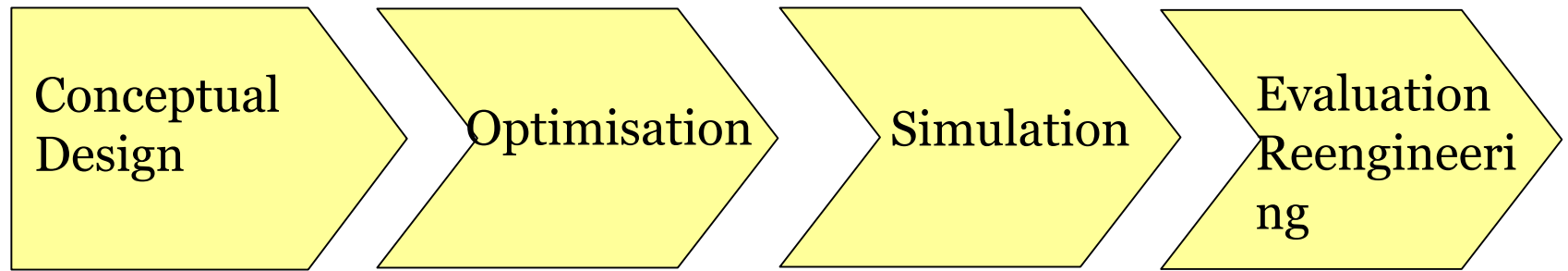
# Pay-per-use: available models



# From modelling services to utilities

- Large volume of services
  - models are employed routinely, in large numbers, and with considerable financial implications.
- Engineering models :
  - simulation and optimization;
  - models are typically linked vertically and horizontally
- Application areas
  - On-line decision support and optimization in manufacturing systems
  - Advanced control systems in product supply chains
  - Product and process design

# Example: project and product development



# Assumptions

- Models with advanced capabilities and semantic layers
- Model “awareness” limited with respect to
  - overall context of the application,
  - existence of other models, resources available
  - interoperability issues.
- Development of semantic layers



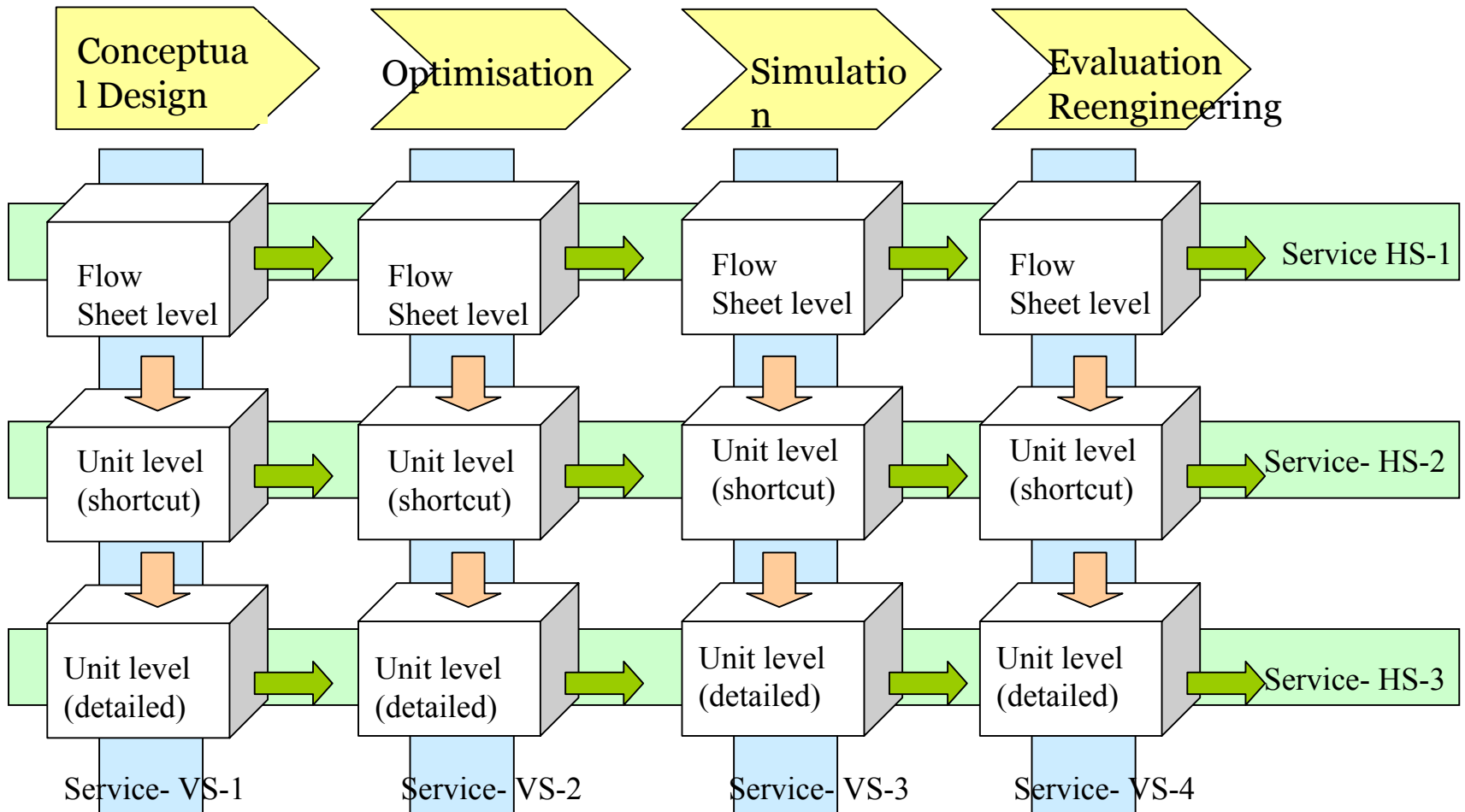
# Multi-level modelling services

- Opportunities for vertical integration
  - relate lump parameter models with Monte Carlo and QMC applications,
  - regression models with CFD's and experimental databases with parallel-computing simulation.
- Conceptual level
  - models may relate to the entire process flowsheet or a particular unit
    - reactor, separator, heat exchanger
  - models could differ with respect to details in the level of granularity and application context.

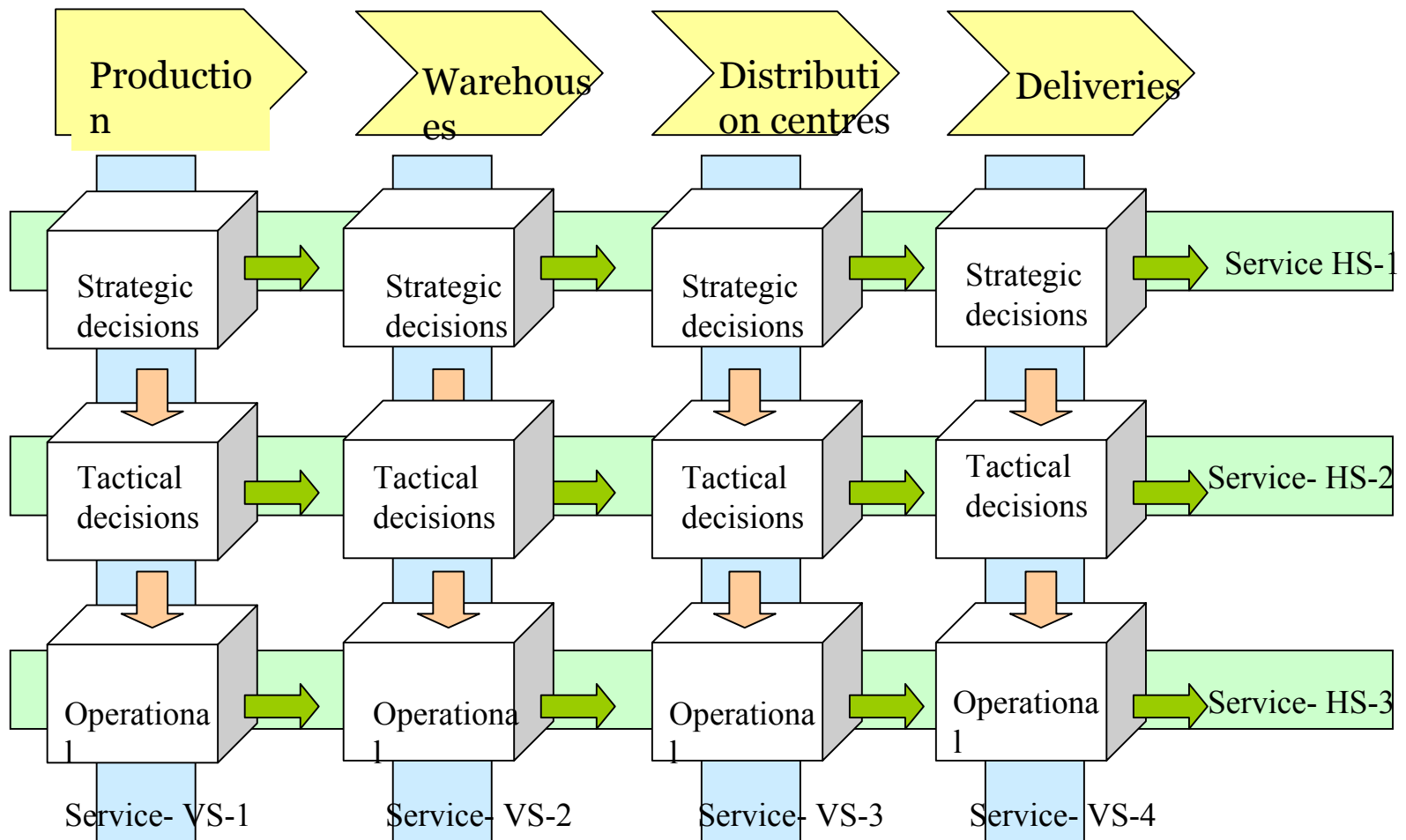
# Multi-stage modelling services

- Opportunities for horizontal integration
- Across sectors:
  - refinery, petrochemicals, bulk products, specialty product
- Across departments
  - marketing, R&D, sales
  - production and distribution
- Between production and distribution.

# Paradigm services: process design



# Paradigm services: process operations



# From services to utilities

Business and technological innovations

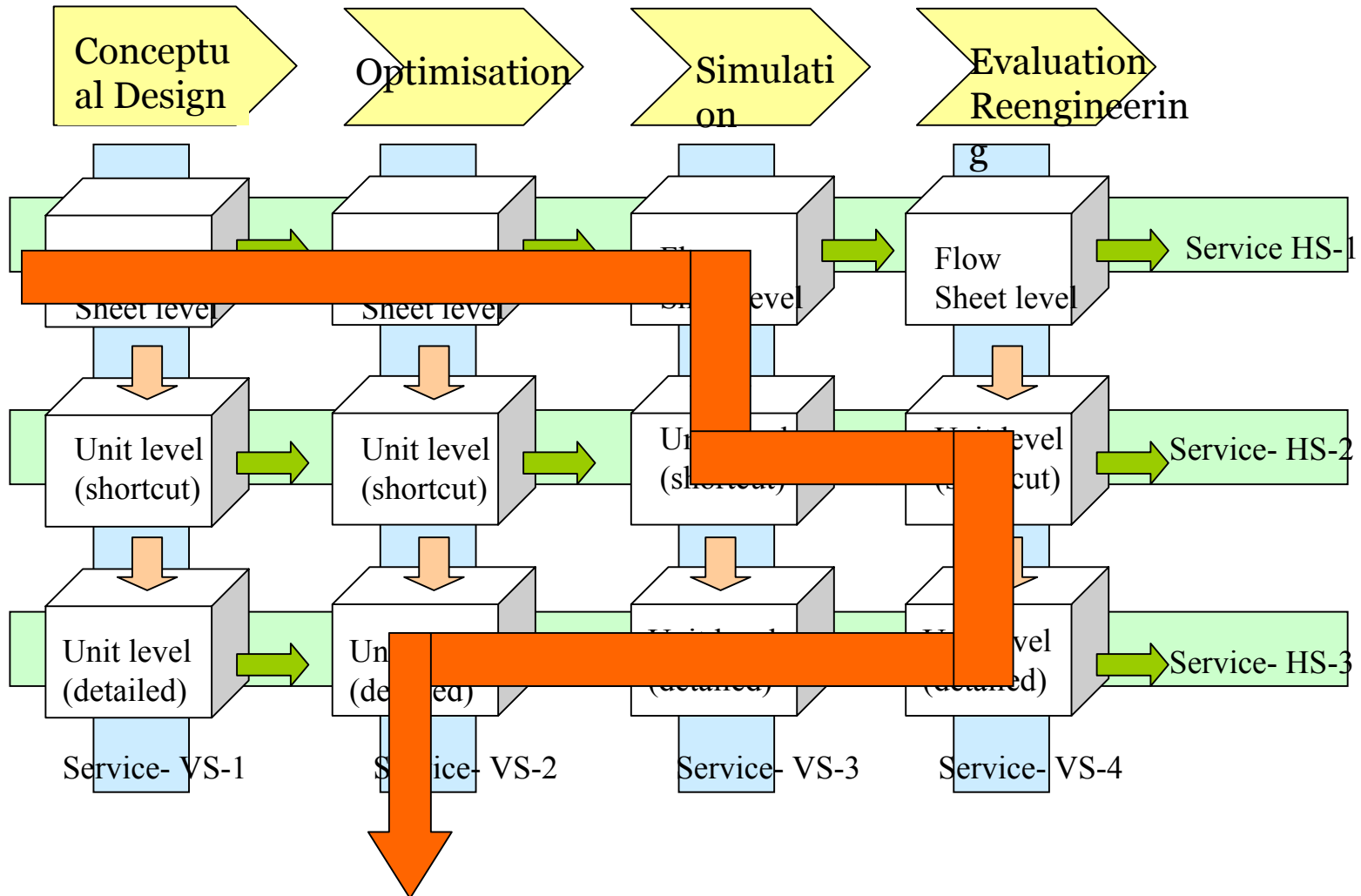
- Paradigms to host integrated applications
- Service layers with application context pointed to specific markets and industries.
- Better quality of service
- Cultural changes in attitudes of suppliers and users.

Much larger volume of suppliers and users.

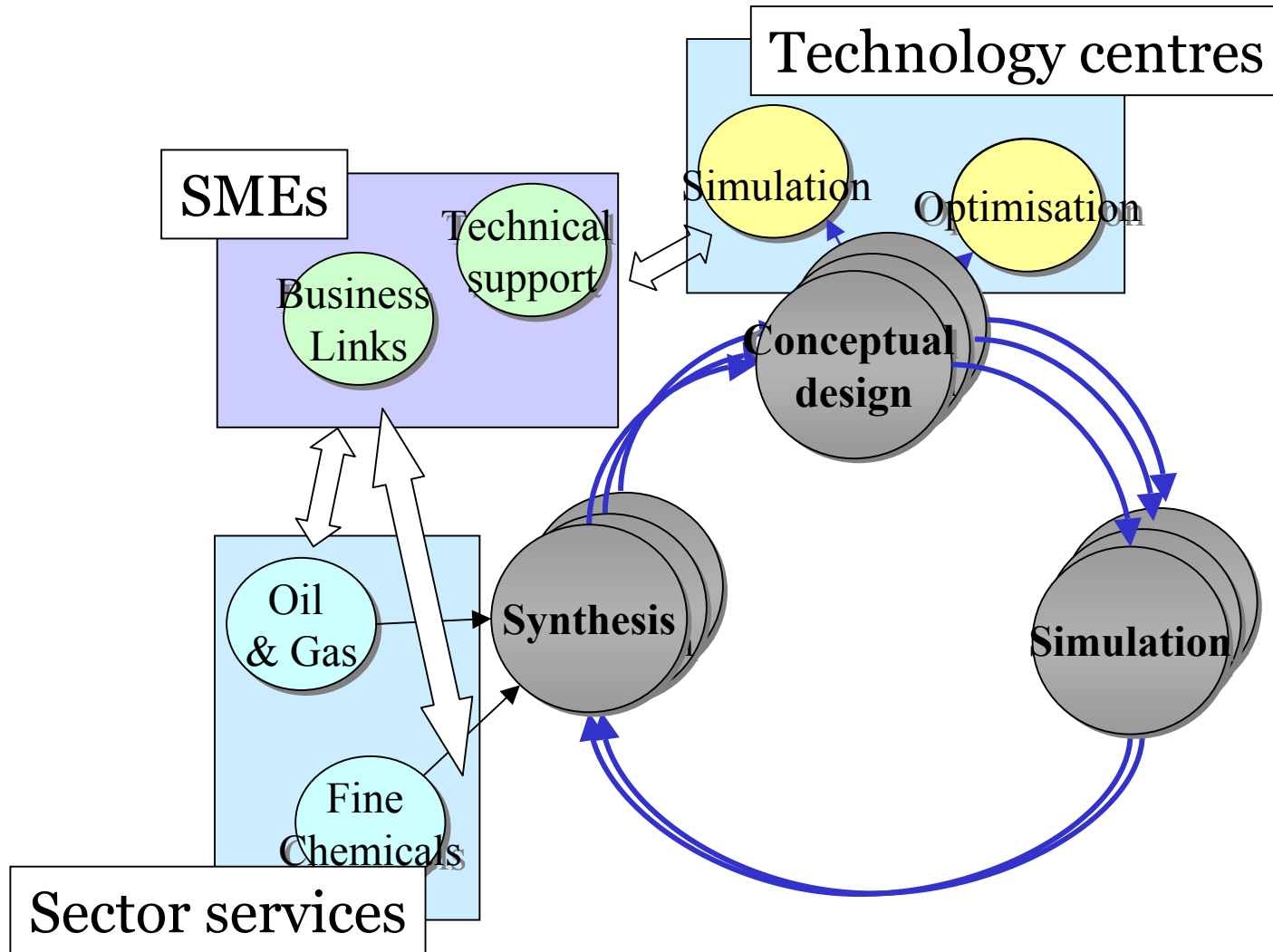
# Future technology drives

- **Semantics and open standards.**
  - application layers for services that describe modeling tasks, product specifications, cost models, and management services.
  - Agents would share such semantics to support advanced search and enforce control access
- **Open standards**
  - enable interoperability and business interaction
- **Computer Grid technology**
  - support peer-to-peer calculations and task management
  - sophisticated sharing modalities alongside global and local directories of registered resources and service agents.

# Agent-enabled integrated services



# Grid-enabled integrated services



# Conclusions

- Modelling services continue to grow
- Dramatic shift from state functions to knowledge semantics
- Services to shape up into utility structures
- Model based utilities
  - Dramatic innovations in engineering design and operations
  - Promote novel solutions and patents