

# **Creative Architecture and Design Concept for Smart Grid Applications**

Design and Run-time use of Common  
Semantic Models

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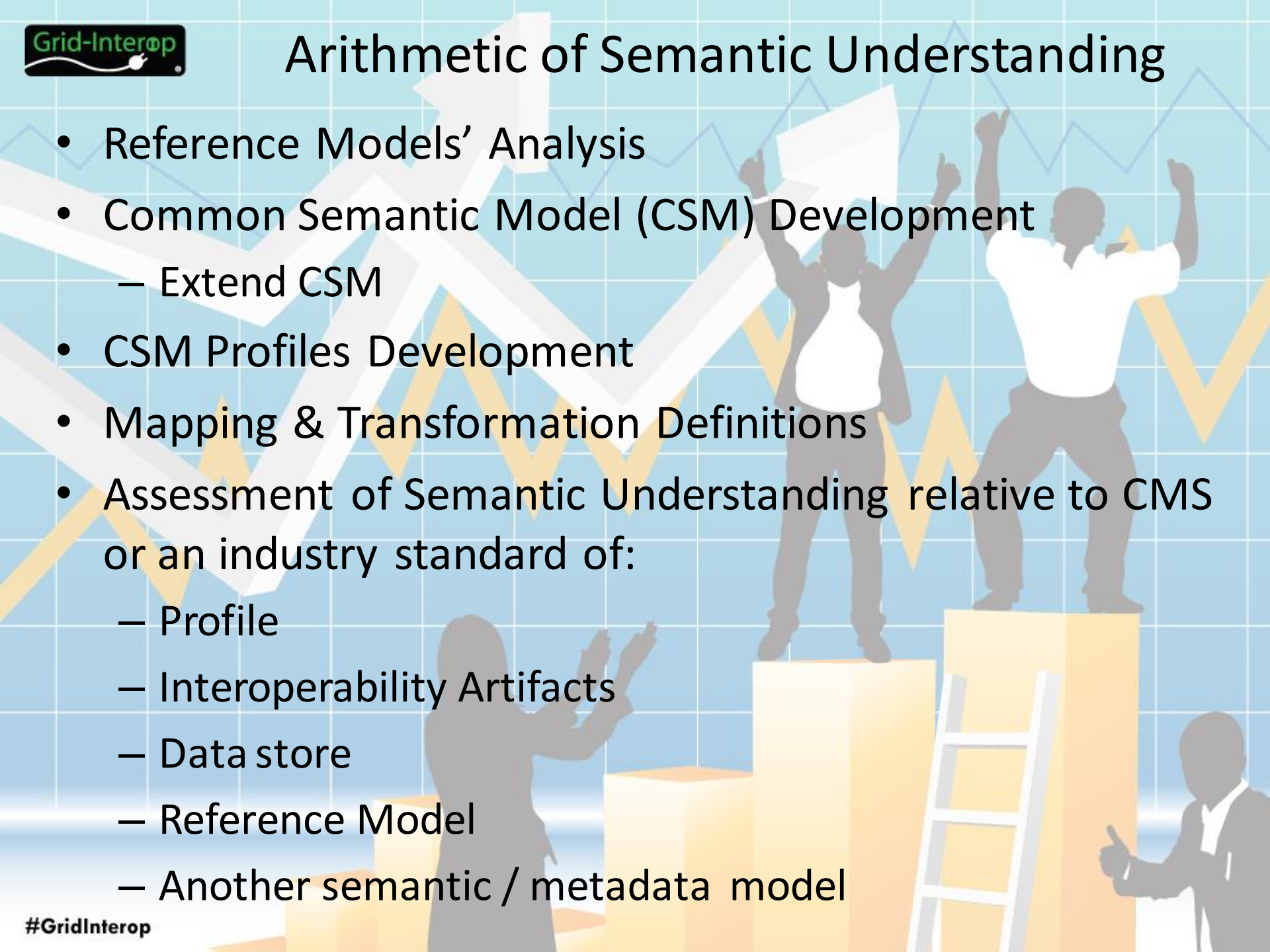
# Presentation Outline

- Architecture Challenges
- Arithmetic of Semantic Understanding
- Interoperability Meaning Diagram
- Role of Common Semantic Modeling
- Model-Driven Approaches
- Semantic Integration Perspective
- Creative Smart Grid Architecture Concept
- Multi-tier Architecture: Addition of Interoperability tier with Semantic Integrator
- Conclusion

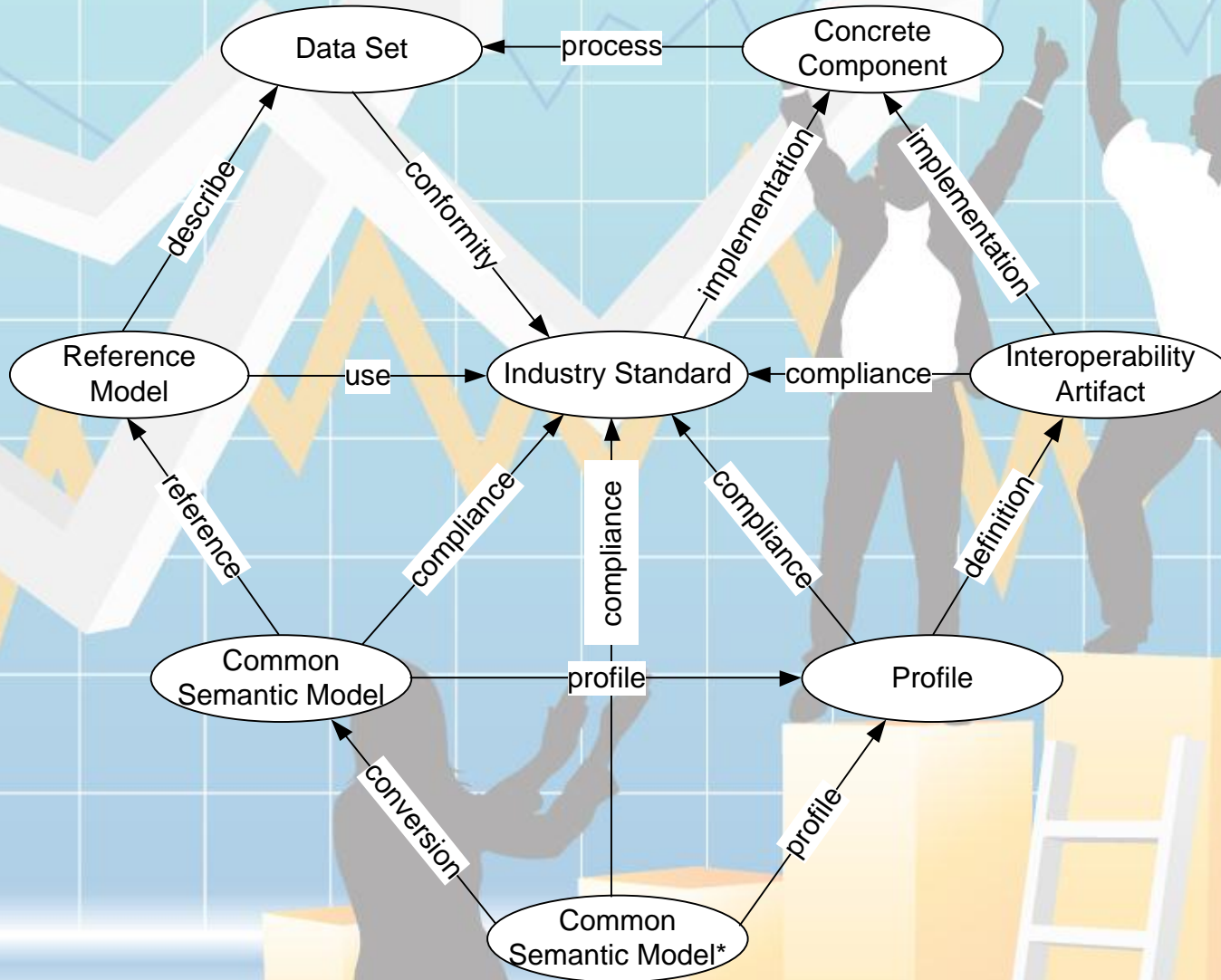
# Architecture / Design Challenges

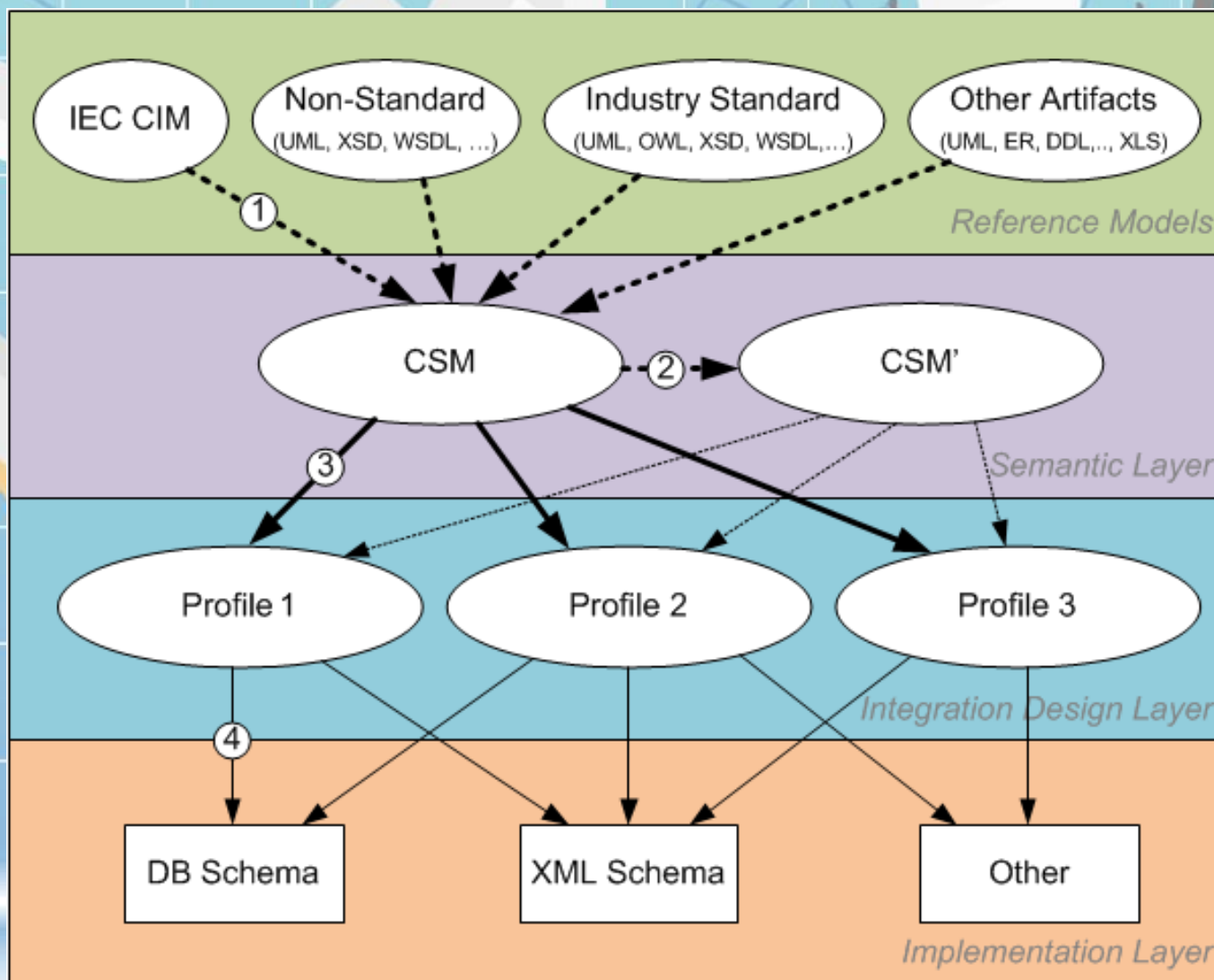
- Lack of consistent and clear role of semantic model from practical point of view
- Industry Standards and semantic model driven approach are not consistently leveraged on large scale integration projects
- Misperception of Standards' Usage and ambiguities around semantic understanding make implementations more difficult
- A lot of ambiguities at the different levels
- A need to promote more aggressively use of Industry Standards and semantic integrator at design and run-time
- Smart Grid Applications and systems are built-to-integrate
- Practical Rules and Definitions for Assessment of Semantic Understanding in terms of various levels, presented in Grid-Interop 2008 and 2009, can be leveraged

# Arithmetic of Semantic Understanding

- Reference Models' Analysis
  - Common Semantic Model (CSM) Development
    - Extend CSM
  - CSM Profiles Development
  - Mapping & Transformation Definitions
  - Assessment of Semantic Understanding relative to CMS or an industry standard of:
    - Profile
    - Interoperability Artifacts
    - Data store
    - Reference Model
    - Another semantic / metadata model
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- The background features a light blue grid with several large, stylized arrows in white and yellow. In the foreground, there are silhouettes of business professionals: two men standing on a tall yellow pedestal with their arms raised in celebration, a woman on the left clapping, and a man on the right pointing upwards. A white ladder is positioned against the pedestal.

# Interoperability Meaning Diagram





Semantic Integrator

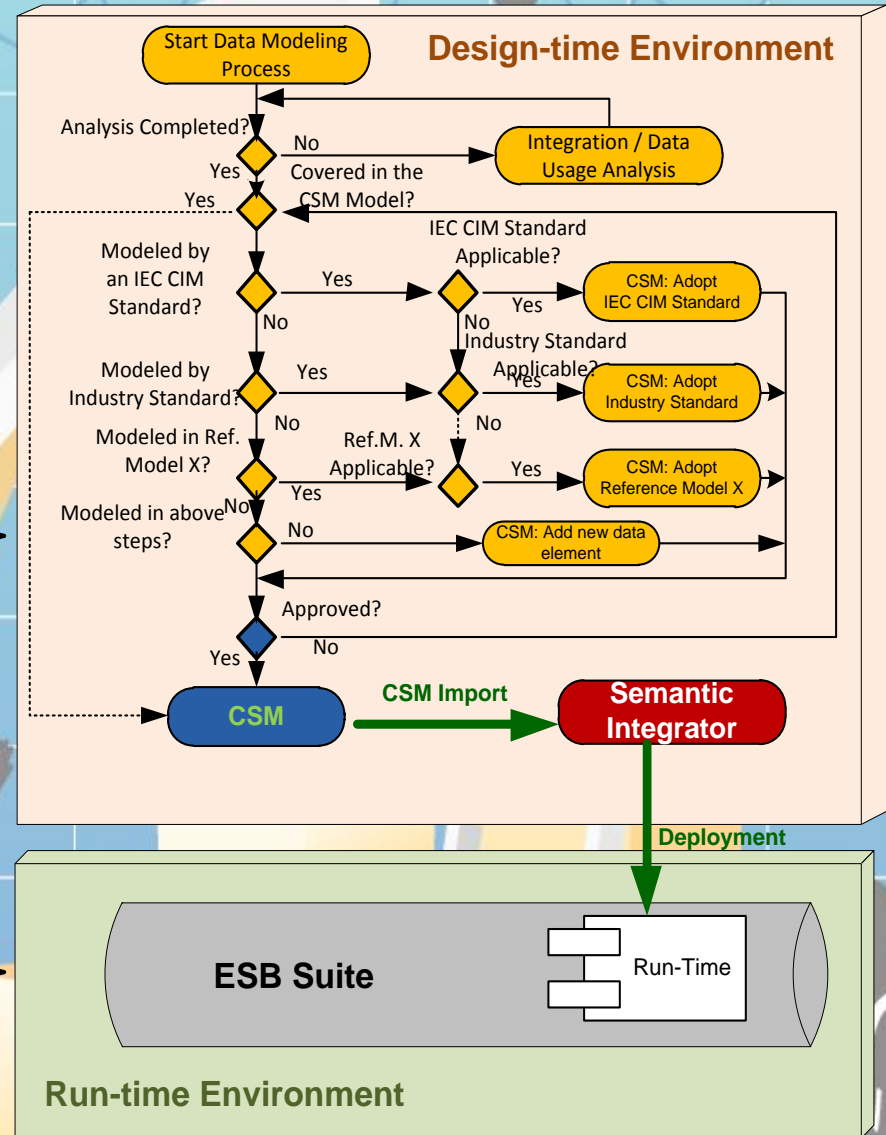
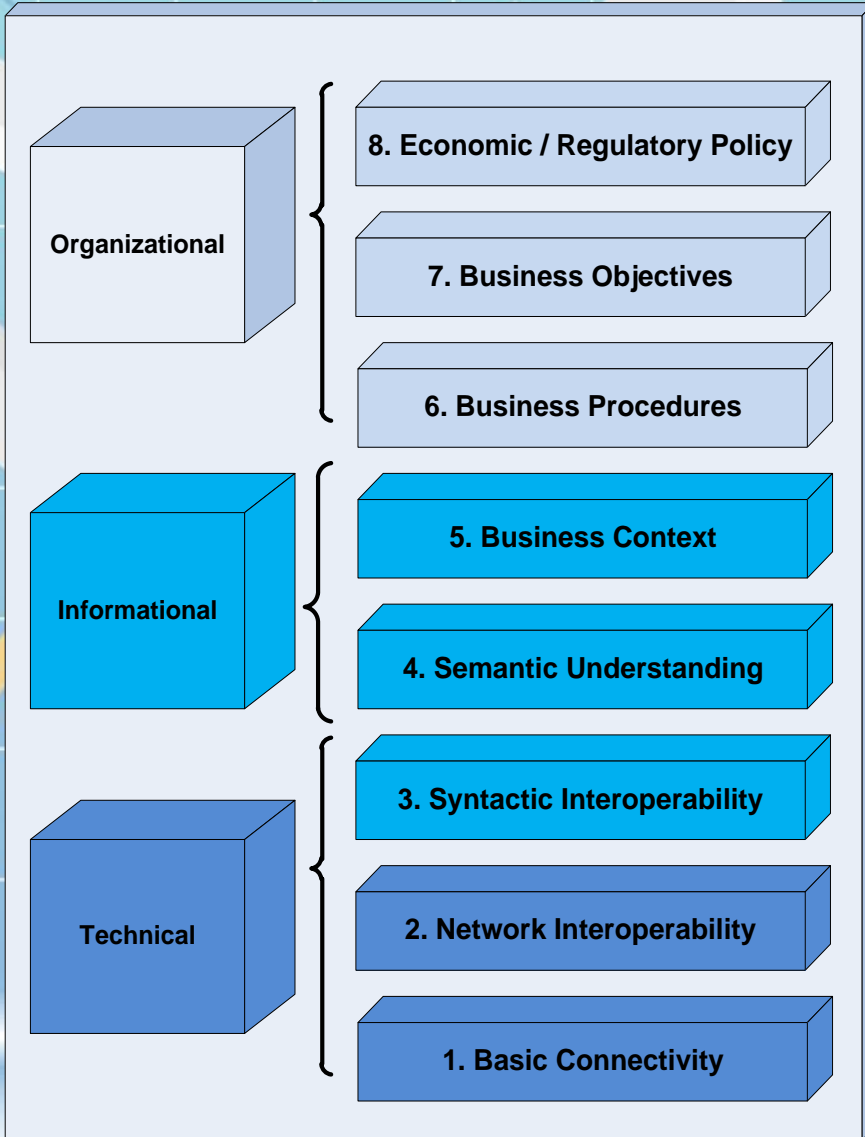
# Model-Driven Approaches

## Traditional Model-driven Approach

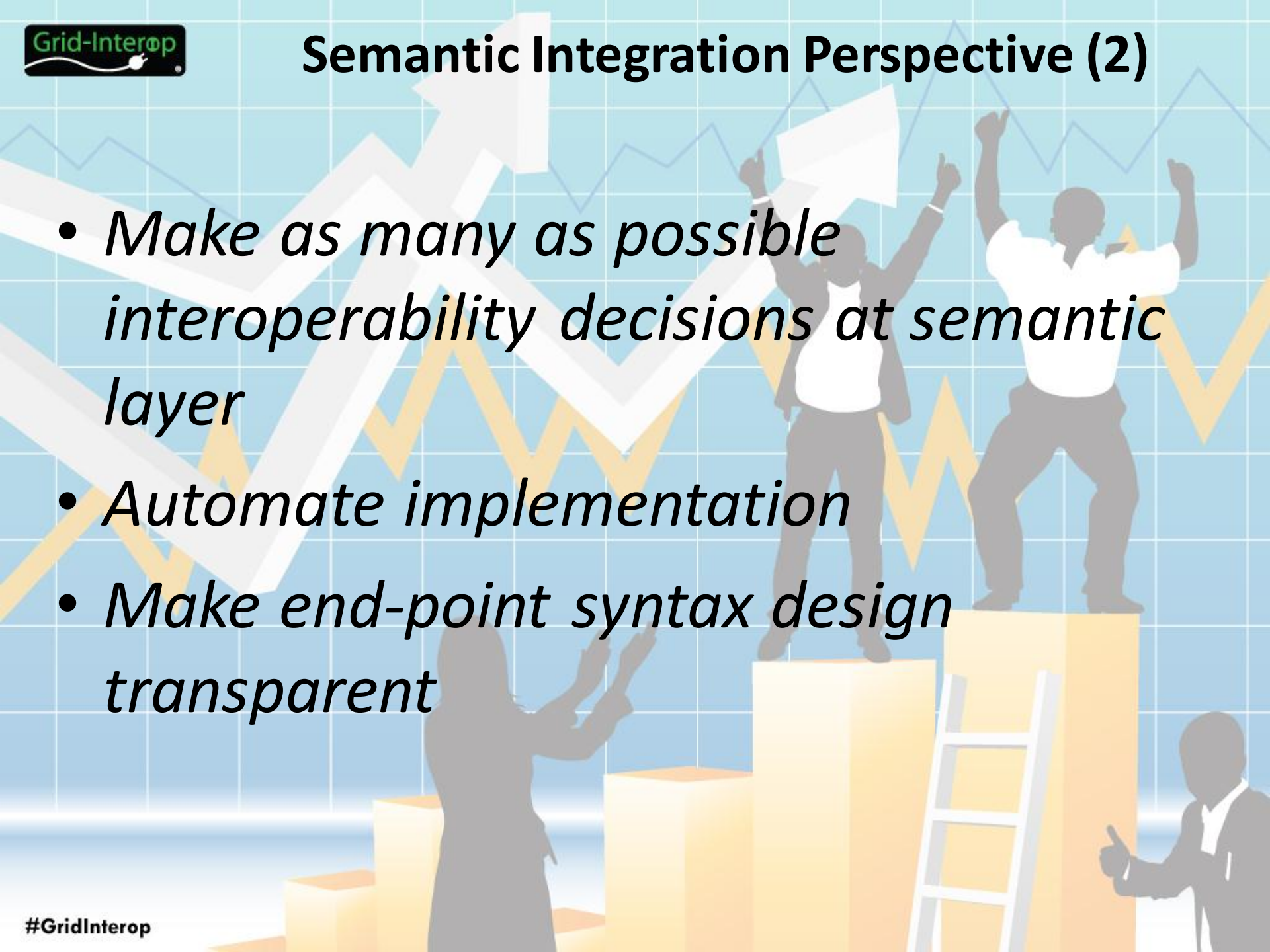
- Process and Data Usage analysis
- Design Time Semantic Layer Modeling
  - Common Enterprise or Interoperability Models
  - Modeling of specific end points, as profiles, such as message payloads, staging areas, Web Services
  - Define / generate syntax of end points
- End point Implementation / Coding
- Integration layer development (connecting dots) and testing

## Advanced Model-driven Approach

- Process and Data Usage analysis
- Design Time Semantic Layer Modeling
  - Common Enterprise or Interoperability Models
  - Modeling of specific end points, as profiles, such as message payloads, staging areas, Web Services
- **Generate end points' run-time components**
- **Run tome Semantic Integrator**
  - **Import semantic model**
  - **End point mapping and data transformation**
    - **Configuration exercise( connecting dots)**



## Semantic Integration Perspective (2)

- *Make as many as possible interoperability decisions at semantic layer*
  - *Automate implementation*
  - *Make end-point syntax design transparent*
- 
- The background features a light blue grid with several large, stylized arrows in white and yellow pointing upwards. In the foreground, there are silhouettes of business professionals: one person stands on a tall yellow bar chart, another stands on a shorter bar, and a third person is positioned near a ladder leaning against a bar. The overall theme is one of growth and achievement.

# A Smart Grid Creative Architecture Concept

“A Smart Grid Creative Architecture is seen as a high-performance, highly distributed operational data management infrastructure that encompasses hierarchically clustered gateways / agents with distributed memory resident data sources to provide very low-latency, predictable, high-throughput data sharing and event distribution while emphasizing quality of service and cyber security requirements . The platform is envisioned as dynamic massive server networks (dynamic grid), **semantic design and run-time components**, massive distributed and replicated memory spaces, use of event-based internal architecture for intra-systems communications (Event Driven Architecture EDA, SOA and Complex Event Processing CEP inside) and use of an extensible modularity of platform and cloud services.



# A Smart Grid Architecture

## Smart Grid System Assemblies

**Technology Components**

Portal / Rich Client / Ajax  
Application / Web Servers  
Data Mgmt

**Semantic Integrator**

ESB / EAI  
ETL / EII  
Security  
Calculation Engine  
SOA, EDA, CEP  
XTP

**Service**

- *Presentation services*
- *Business/Application services*
- *Data Modeling services*
- *Data Management services*
- *Enterprise services*
- *QoS services*
- *Business-to-Business*

ISO / RTO

Transmission

Distribution

Market Participant

Generation

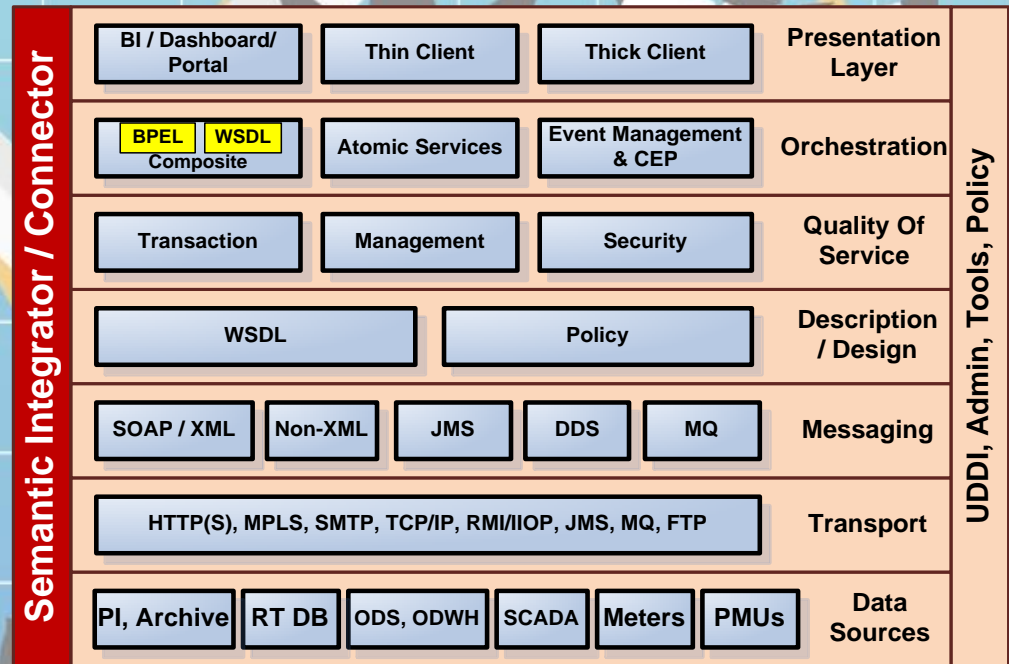
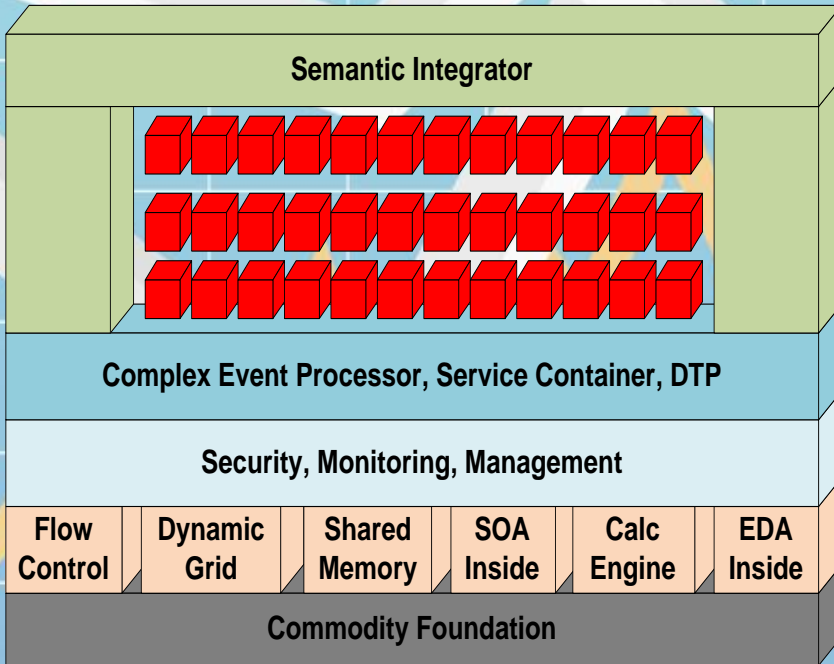
Consumers

**Customers**



# Smart Grid Technology Stack

Multi-tier Architecture: Addition of Interoperability tier with Semantic Integrator



# Conclusion

- An Idea / Approach for making interoperability decision at Semantic layer is introduced.
- The approach key benefits are
  - Reduce the need for defining standard strongly typed end-points related to syntactic interoperability
  - Buy time required to develop standard strongly-typed end-points
  - Make all interoperability decisions at semantic layer
  - Automate implementation
  - Make end-point syntax design and run-time implementation automated
- A Vision of Smart Grid Platform is presented
- Role of Common Semantic Model is addressed. The underlying idea is also
  - To standardize interoperability using a Semantic Model as a logical and physical intermediary at Design and Run-time
  - To provide platform-independent centrally-managed logical model for all end-points and applicable data stores