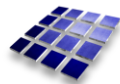


**Case Study:**  
**Leveraging Industry Standards  
& Model-Driven Development  
for Enterprise Information Management  
& Semantic Integration  
at Long Island Power Authority (LIPA)**

Predrag Vujovic, Phillip Jones , Fran Clark, Stipe Fustar



**XTENSIBLE SOLUTIONS**  
An ESCO Technologies Company

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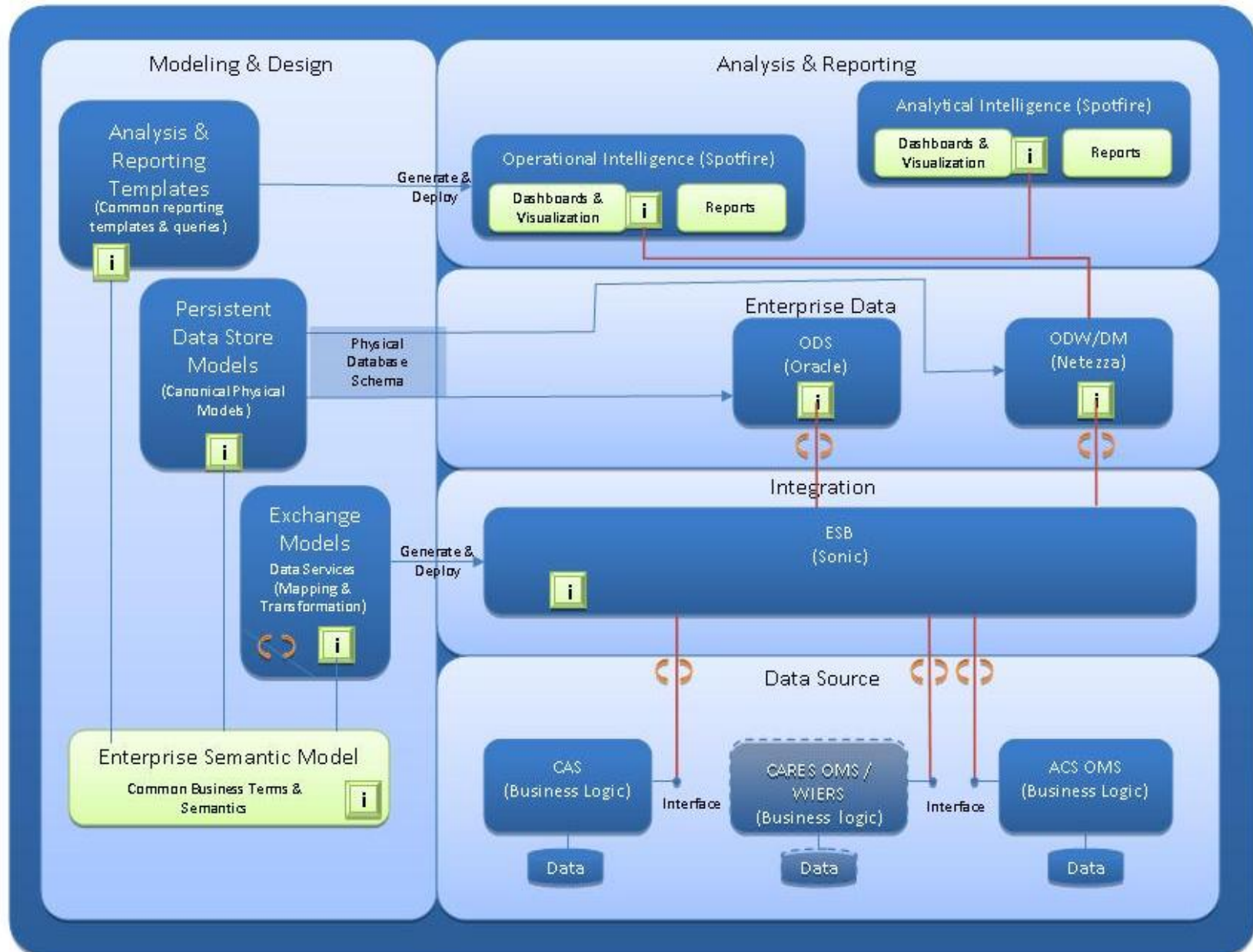


- Real-world Case Study of how LIPA are using a Model-Driven approach, leveraging an Enterprise Semantic Model (ESM) to:
  - Implement Semantic Integration
  - Implement Persistent Data Stores (e.g. for Analytics, Data Warehouses)
- Our Story:
  - LIPA Smart Grid Business Drivers (Why?)
  - Target Architecture and Enablers (What?)
  - Semantic Integration Approach (How?)
  - Persistent Data Stores (How?)

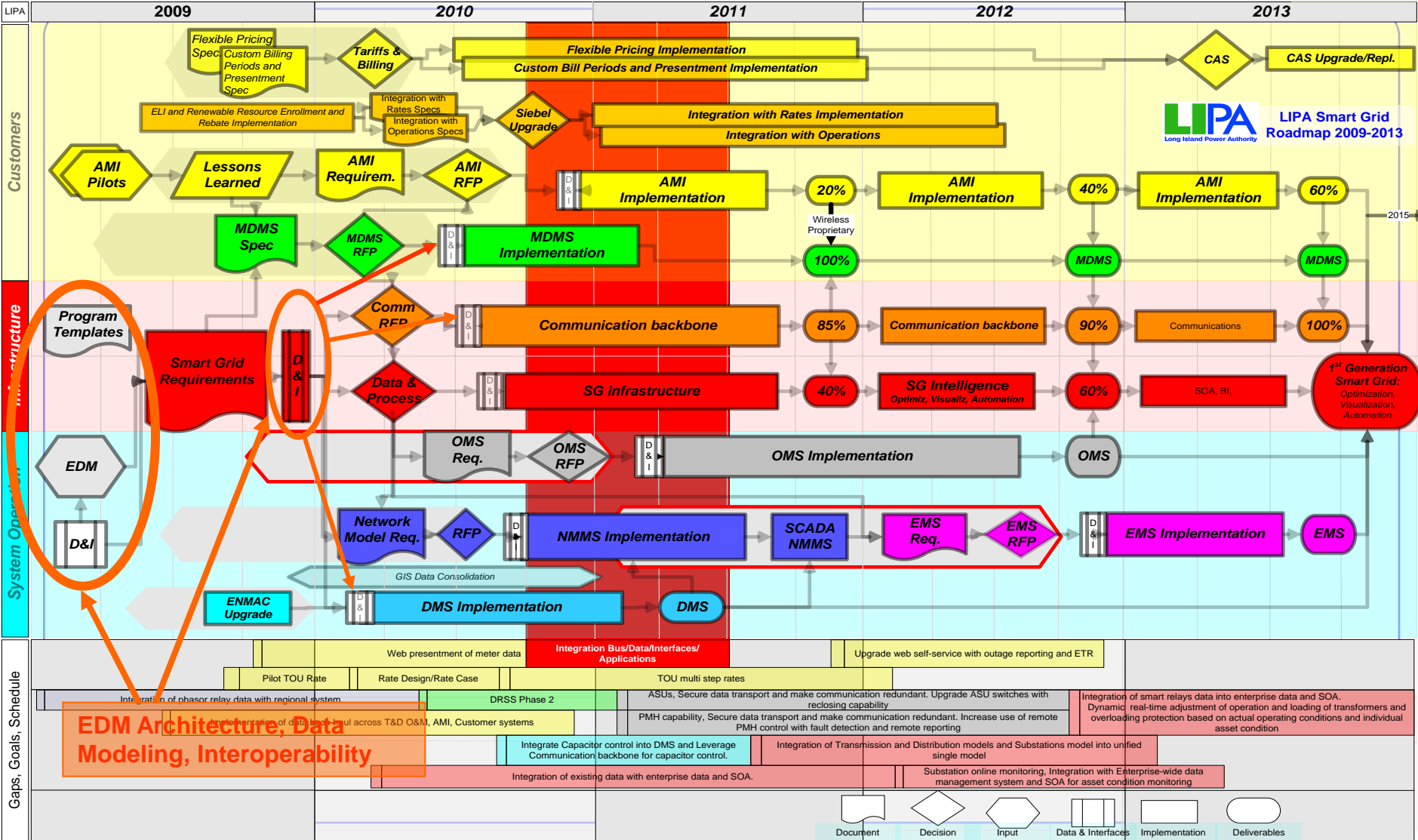
# Foundation – Model-driven process

- LIPA has adopted a model-driven process for defining, designing, developing and deploying:
  - Services on the Enterprise Service Bus
  - Persistent data stores for analytics (ODS, Data Warehouse, Datamart)
- The Model-driven approach leverages industry standards (e.g. CIM) wherever possible to:
  - Promote reusability
  - Accelerate development cycles
  - Facilitate visibility, governance and change management
- Four key models
  - Enterprise Semantic Model
  - Service Model
  - Exchange Model
  - Data Model
- Process & Governance

# ODW Conceptual Technical Architecture



# LIPA Smart Grid Road Map



# LIPA Model-driven Architecture Business Drivers



- Reduce cost of implementations and integrations
  - including maintenance / change management
- Reduce risk to implementations and integrations
- Increase speed of implementations and integrations
- Improve ability to solve business problems by choosing best of breed applications and services
- Avoid vendor- and technology lock-in's
- Support Multiple Service Providers
- Architecture:
  - “Near Plug and Play”, Flexibility, Agility & Portability
  - Consistent semantics for data in-flight and persisted for analytics
  - Flexibility of Business Intelligence Options
  - Open to new technology, solutions, applications
    - the key to leveraging investment in Smart Grid infrastructure and many new players, functionality, data consumers & -producers

- Accomplish this by:
  - Establishing a loosely-coupled SOA architecture through :
    - Leveraging an Exchange Model (EXM) for model-driven “development”, that ...
    - mediates all interfaces through a LIPA Enterprise Semantic Model (ESM), ...
    - which is based on available industry standards (e.g. CIM)
  - Using a model-driven design and development process to:
    - Speed development process
    - Improve reusability
    - Improve governance and change management
  - Require that any new vendor applications:
    - Where possible, conform to LIPA canonical interfaces
    - When not possible, conform to some industry standard interface
    - Publish interfaces / APIs so that knowledge of underlying database structures is not required for integration (transactional or analytical)

# LIPA Model-Driven approach

- End-to-End Model-Driven approach
- Paradigm Shift compared with the conventional approach
- Bridges the gap (chasm?) between design, development and run-time
- Increased Agility, Responsiveness, Speed
- Decreased Time, Cost, Risk
- Enabler for implementation of new functionality, processes and analytics solutions



# LIPA Integration & Standards History

- LIPA started pilot projects in utilizing industry standards for interoperability of systems in 2000
- LIPA Recognized the need for an innovative model-driven approach in 2007
- LIPA's New Model-Driven Approach :
  - Enables semantic integration through the use of a common semantic model
  - Supports “automated” maintenance, testing, and updates of enterprise data model across company systems

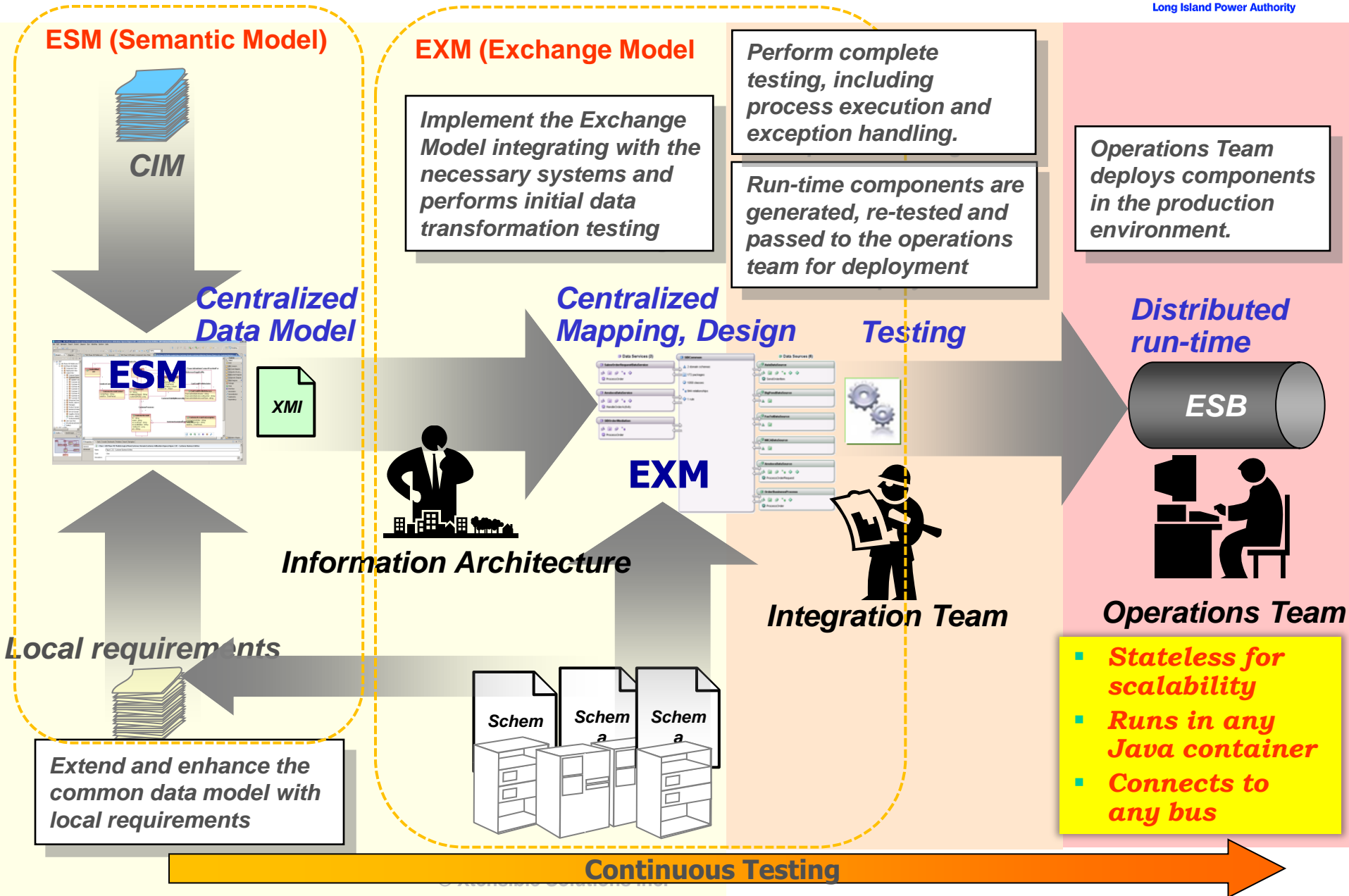
## Projects Track Record

- Projects comprised integration solutions and persistent data stores (ODS's and Data Warehouses)
- The LIPA Model-Driven Semantic Integration approach has consistently performed under budget and on time under complex and challenging conditions.
- Trend of reduced cost and improved delivery speed is based on:
  - Model-driven approach + governance + processes + tools for
    - “automated/integrated” development, testing, implementation, and maintenance of the model
  - Reuse of data and interfaces across company systems and SOA

# Projects Track Record

- Projects completed & in-flight include:
  - Energy Trading Solution
  - Customer Outage Communication (Web Outage Map)
  - Customer Outage Communication (Text Messaging)
  - Meter Data Management
  - Outage Management (OMS – in progress)
  - Customer Consumption Data integration

# Model-driven Workflow : "Lossless" Metadata



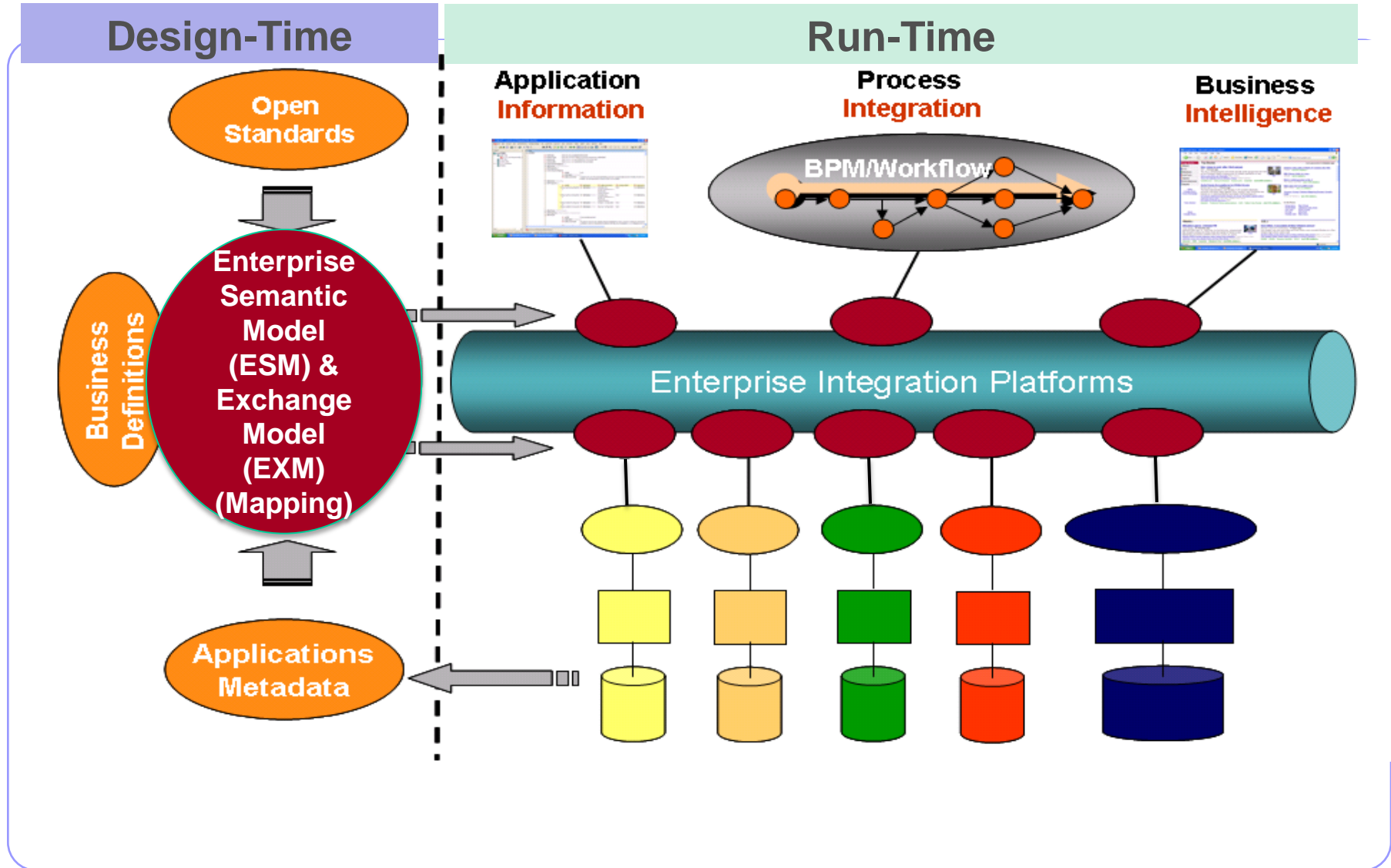
# Key Elements of LIPA Semantic Integration

- Centrally Managed Semantic (Data) Model (ESM)
  - Heterogeneous interfaces mediated through common model
  - Based on industry standards (IEC CIM)
- Centrally Managed Exchange Model (EXM)
  - Semantic Mapping and Business Rules
  - Integrate & Reuse Business Rules, transformations, mappings
  - Automate gap analysis, documentation
  - Centrally Managed Mapping and Run-Time Deployment
  - Generate ready-to-go SOA services (Deploy the Model, No code written)
  - Continuous testing
  - Deploy into any Java runtime environment
  - Automate impact analysis on change

# Semantic Integration Value Proposition

- Make all run-time interoperability decisions at semantic layer
  - Configuration rather than coding
    - Automate implementation
  - Simplified testing
    - Test mappings, transformation and business rules using design-time tool (DXSI)
  - Effective change management, maintenance and updates!!!

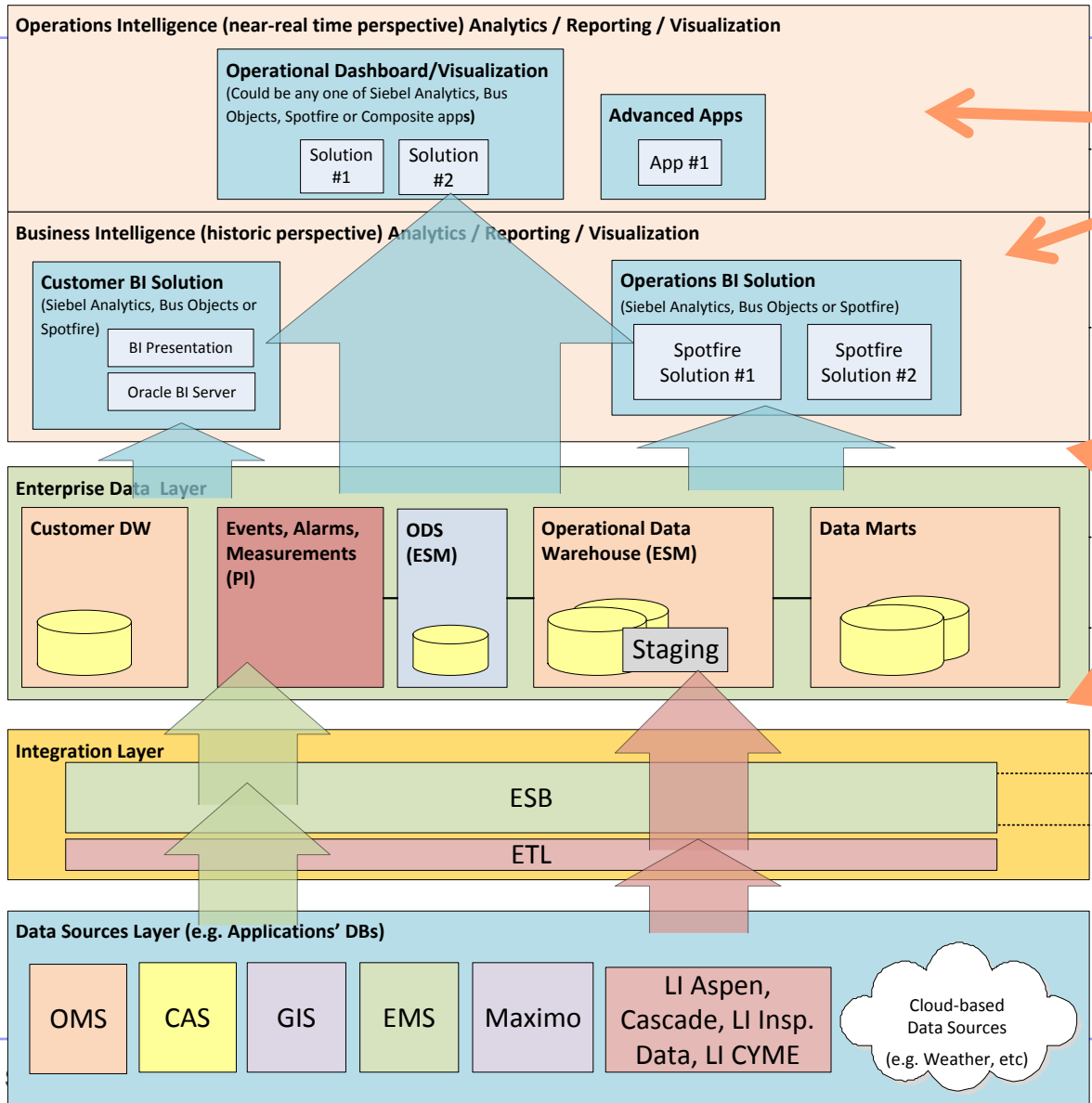
# LIPA ESM and Integration Concept



- LIPA Data Warehouse Key Requirements and Drivers
  - Provide business users with rapid, reliable and consistent access to information for making business decisions
    - Business Intelligence (Historic perspective) uses ESM-based data warehouse
      - Provide data mining features at ODW or DM level for various analyses (e.g. statistical, time series)
    - Operational Intelligence (near-real-time perspective, which includes Visualization tools) utilize ESM-based near-real time data store, ESM-based data warehouse and Canonical data services .
  - Gain efficiencies by eliminating need for business users to reconcile semantic interpretation of data
  - Show value in near-term but build to support future
    - Support both event-driven and batch-oriented data and process integration, as required.
    - Leverage existing and future data services for ensuring minimal latency between data in applications and the data warehouse / datamart / ODSs'



# Logical View of LIPA Analytics Vision



Freedom to use any BI or DV Tool on the dataset(s)

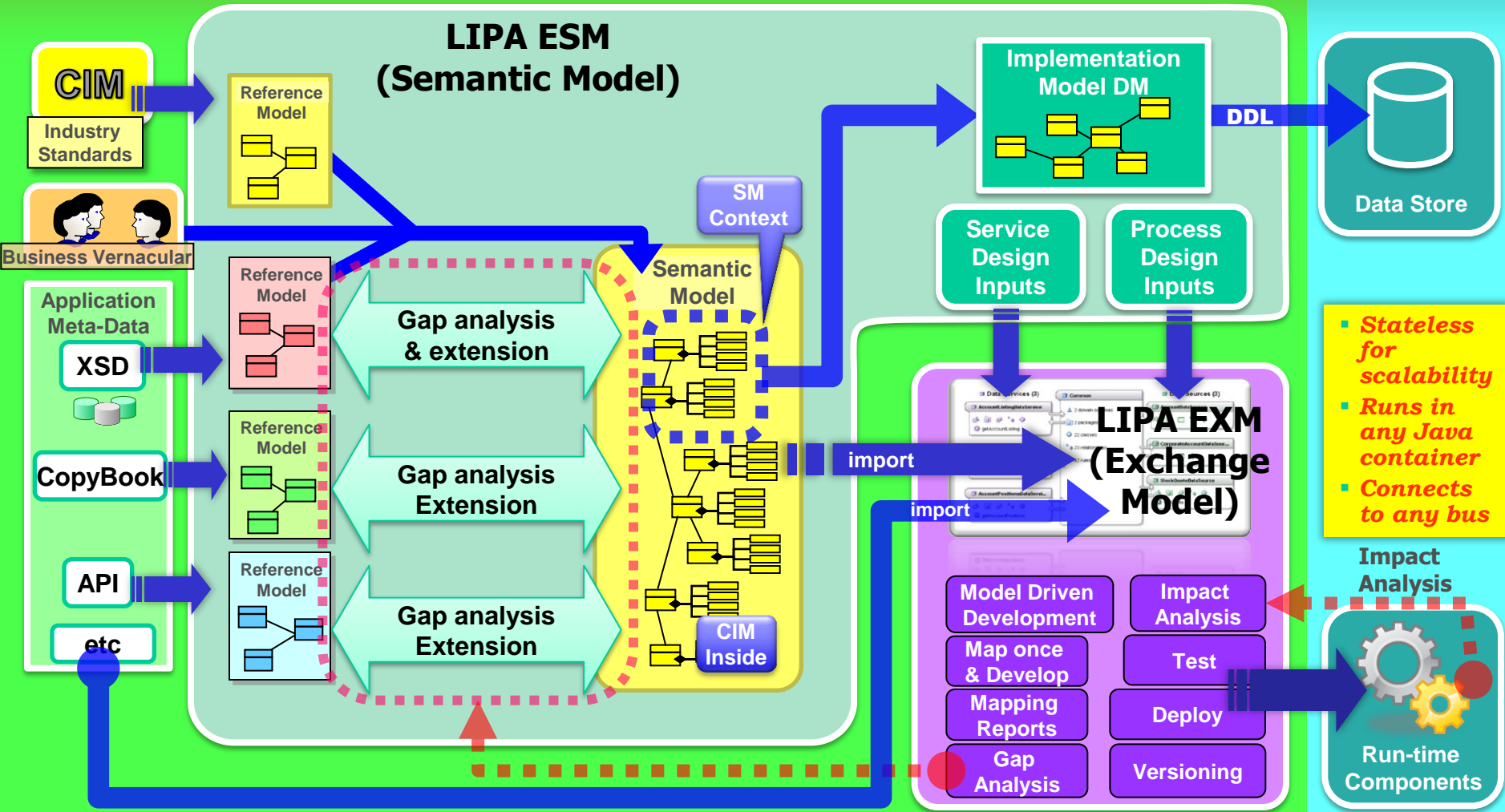
De-coupled Layers; Common Analytic Models & Services

Applications can be upgraded or replaced without impacting the Analysis & Reporting functions

# Model Driven Approach Integration Services & Persistent Datastore (Database) Design – Develop – Deploy Cycle (information perspective)

## Design- & Development

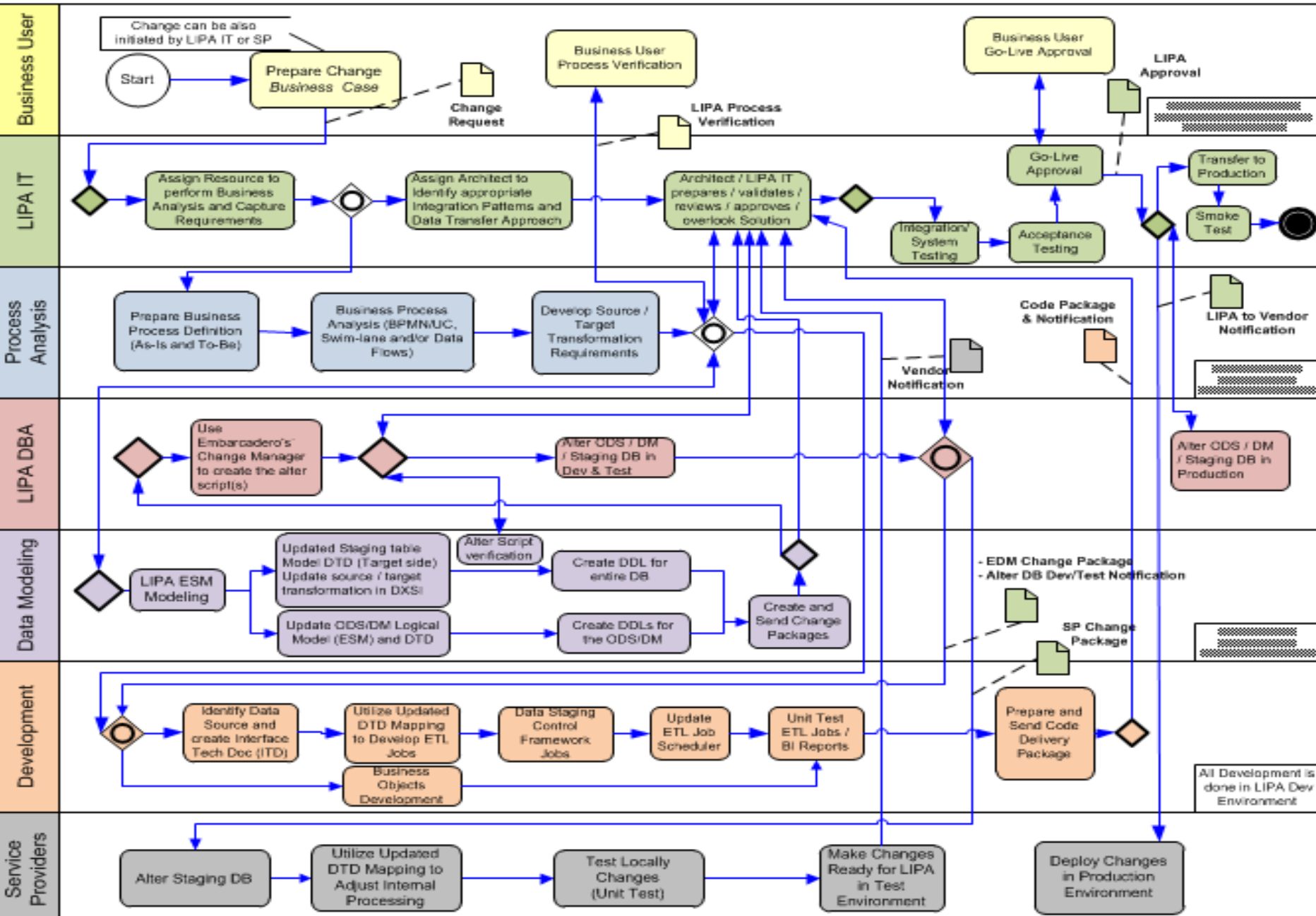
## Run-Time



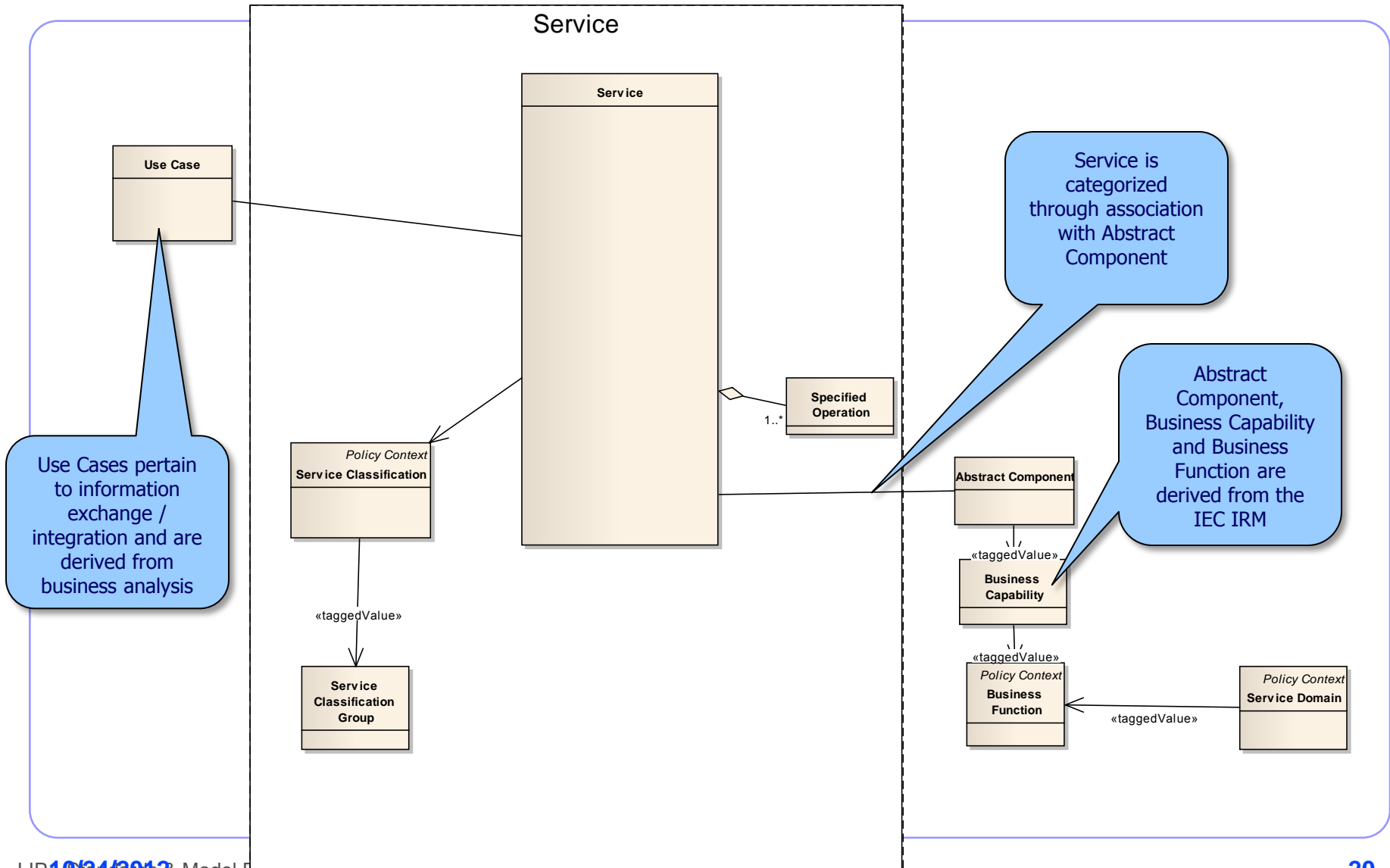
# Governance and Change Management

- Guiding Principles
  - Models are central to all governance and change management activity
  - Automated processes will be used to reduce effort and errors
- Change Management
  - Version and Source Control – Process for managing and packaging changes to services
  - Defect Fixing
  - Enhancements
- Governance – Process for managing all of the above and insuring highest quality and reusability
  - Design Time – checks and controls to insure best possible design prior to implementation
  - Runtime – enforcement of defined policies

# LIPA Enterprise Data Management – Change and Release Management Process



# Meta Model for Service Model Realized in the LIPA Service Taxonomy



## Key Take-Away Points

- Innovative Integration approach with benefits of
  - “Near Plug and Play” for systems and Analysis Solutions
  - Model Driven Development, End-to-End
  - Benefits of automation for integration, testing, maintenance, updates
  - Significantly Lower Life Cycle Cost and more effective system deployments
- Model-driven approach that leverages Industry Standards (CIM) for interoperability
- Scalable (Structured, planned, model-driven approach)
- Semantic understanding is guaranteed (explicit, not implicit) ;
  - availability of strongly typed syntactical interfaces is not a requirement for success any more
- Easier updating and tracking of standards development

# Thank You

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