Getting serious about Enterprise Architecture

[22nd EAPC - London]

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Session - Objectives

- **A clear understanding of the meaning of :**
  - Enterprise architecture in terms of components and inter-relationships
  - Best practices around modelling methods and practices
- **An appreciation of:**
  - Formal methods of enterprise modelling
  - Testable architectures as an extension to Enterprise architecture methods to help clearly articulate formal descriptions for component inter-relationships
  - Real life implementation and benefits of testable architectures

Agenda

- Setting the scene
- Enterprise Architecture Definition and Modelling Methods
  - TOGAF ADM
  - Archimate
- Introduction of Testable Architecture Methodology
  - Testable Architecture as an extension to Enterprise Architecture
- Customer Case Study
  - Processes, Methods and Tools used
  - Benefits achieved
- Q & A

Setting The Scene - EA Definitions

IEEE Std 1471-2000 :

The "architecture" of a system is the system's fundamental organization, embodied in its components, their relationships to each other and to the environment, and the principles guiding its design and evolution.

The Open Group Architecture Framework (TOGAF version 9):

- ❑ *A formal description of a system, or a detailed plan of the system at component level, to guide its implementation (source : ISO / IEC 42010: 2007)*
- ❑ *The structure of components, their inter-relationships, and the principles and guidelines governing their design and evolution over time*

Other definitions submitted to The Open Group - EA Definition Project:

❑ *Enterprise Architecture is a set of principles, practices and processes, that defines the structure as well as operations of the enterprise and its systems for effective realization of enterprise goals to enable an enterprise performance to be predictable, measurable and manageable*

❑ *Enterprise architecture is a management discipline concerned with describing the components of an enterprise and the inter-relationships between those components necessary to achieve the enterprise's purpose*

❑*Enterprise Architecture is a practice discipline characterised by a complete collection of tools, methods, and models to be employed by any enterprise to optimize the business and information assets*

❑ *The EA discipline defines and maintains the architecture models, governance and transition initiatives necessary to co-ordinate an organization towards common business and/or IT goals to ensure the enterprise is fit for purpose to achieve it's mission*

❑ *By being inclusive with all other management frameworks, EA is the discipline that helps the Enterprise define, develop and exploit boundary-less information flow capabilities in order to achieve the Enterprise's Strategic intent*

Setting The Scene
- What are we going to focus on ?

System's fundamental organization

Effective Integration with Business Partners

Practical
Measurable
Flexible

Component inter-relationships

Embodied in components

Formal grounding

Enterprise Architecture

Relationship to internal & external environment

Standardization

Model Driven

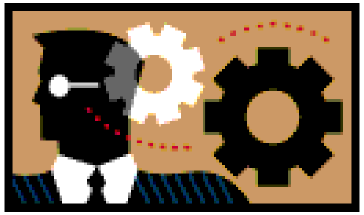
Incremental Development

Operational Improvement

Tools & methods

Problem Domain
– Architecture and Ambiguity

- **Ambiguity**
  - in requirements (capture, analysis or engineering)
  - between architecture and requirements
  - between implementation and architecture



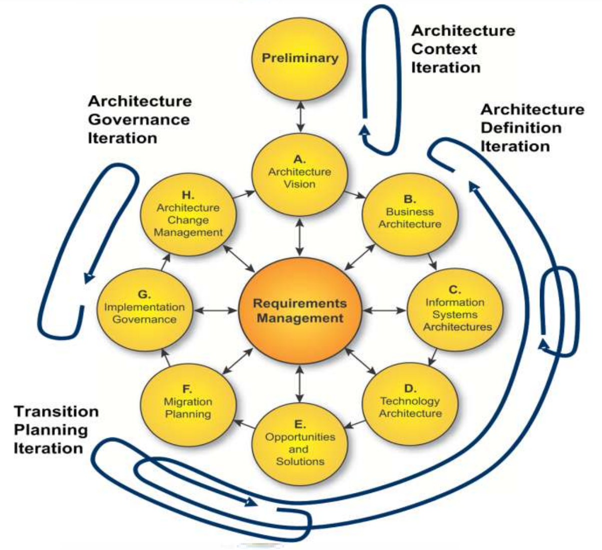
- Ambiguity exists because requirements are divorced from architecture and architecture from implementation, as a result we end up with:
  - *Poor alignment of IT to business*
  - *High cost in managing complexity*
  - *High cost of testing*
  - *Lack of transparency and control in delivery and change management*
  - *Poor reuse of IT assets*
  - *Lack of business agility hindered by IT*

Removing ambiguity, joining things up, moves us from "art" to engineering

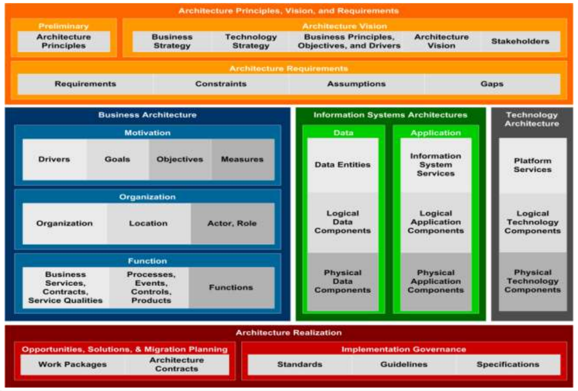
Leading to industrialisation of IT

EA Definition Methods - TOGAF 9

Source: www.opengroup.org


Preliminary
Architecture Context Iteration
Architecture Governance Iteration
Architecture Definition Iteration
A. Architecture Vision
B. Business Architecture
C. Information Systems Architectures
D. Technology Architecture
E. Opportunities and Solutions
F. Migration Planning
G. Implementation Governance
H. Architecture Change Management
Requirements Management
Transition Planning Iteration

Architecture Content Framework


Architecture Principles, Vision, and Requirements

Preliminary: Architecture Principles

Architecture Vision: Business Strategy | Technology Strategy | Business Principles, Objectives, and Drivers | Architecture Vision | Stakeholders

Architecture Requirements: Requirements | Constraints | Assumptions | Gaps

Business Architecture

Motivation: Drivers | Goals | Objectives | Measures

Organization: Organization | Location | Actor, Role

Function: Business Services, Contracts, Service Qualities | Processes, Events, Controls, Products | Functions

Information Systems Architectures

Data: Data Entities | Logical Data Components | Physical Data Components

Application: Information System Services | Logical Application Components | Physical Application Components

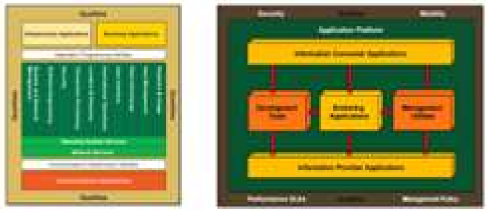
Technology Architecture: Platform Services | Logical Technology Components | Physical Technology Components

Architecture Realization

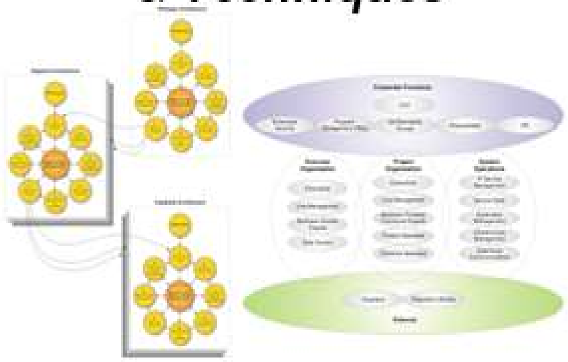
Opportunities, Solutions, & Migration Planning: Work Packages | Architecture Contracts

Implementation Governance: Standards | Guidelines | Specifications

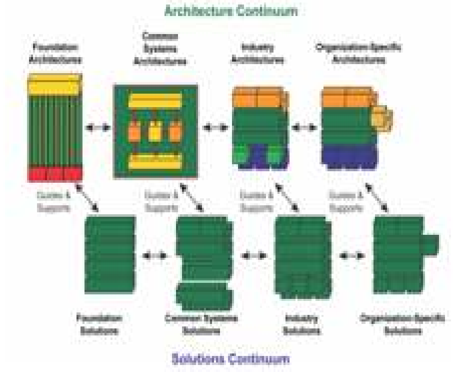
Reference Models



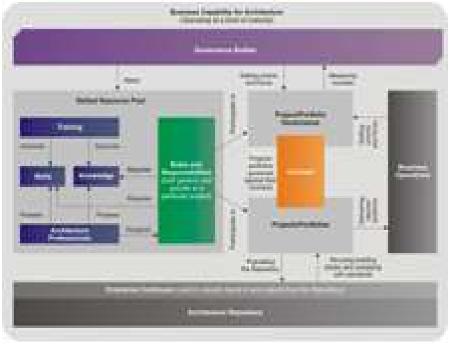
ADM Guidelines & Techniques



Enterprise Continuum



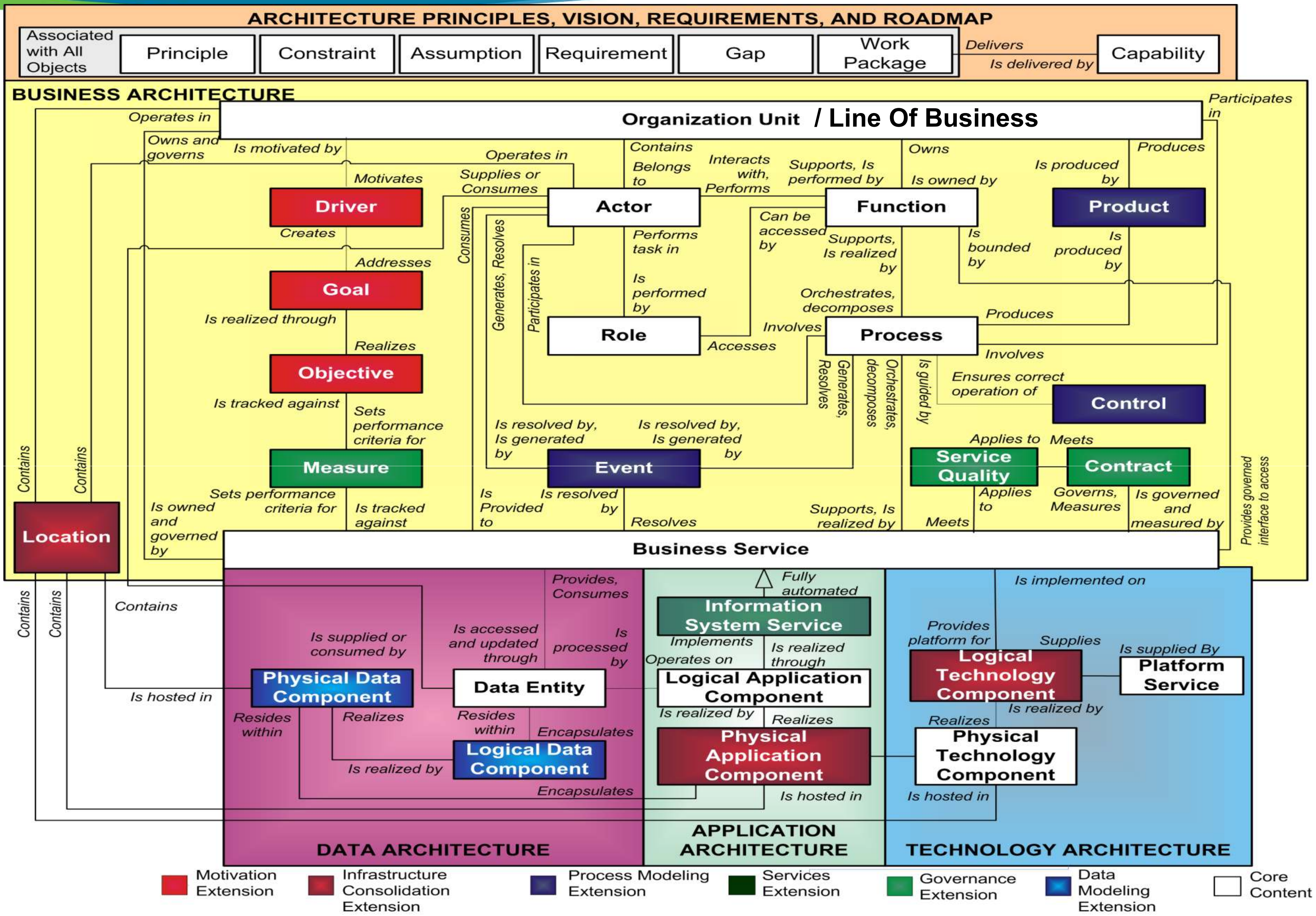
Architecture Capability Framework



Background — EA Definition — EA Modelling — Testable Architecture — Case Study

TOGAF 9 – Architecture Relationships

Source: www.opengroup.org



ARCHITECTURE PRINCIPLES, VISION, REQUIREMENTS, AND ROADMAP

Associated with All Objects

Principle

Constraint

Assumption

Requirement

Gap

Work Package

Delivers

Is delivered by

Capability

BUSINESS ARCHITECTURE

Organization Unit / Line Of Business

Participates in

Operates in

Owns and governs

Is motivated by

Operates in

Contains

Belongs to

Interacts with, Performs

Supports, Is performed by

Owns

Is owned by

Is produced by

Produces

Motivates

Supplies or Consumes

Driver

Actor

Function

Product

Creates

Consumes

Generates, Resolves

Participates in

Performs task in

Can be accessed by

Supports, Is realized by

Is bounded by

Is produced by

Addresses

Goal

Is performed by

Orchestrates, decomposes

Is realized through

Involves

Produces

Role

Process

Realizes

Accesses

Involves

Objective

Resolves

Generates,

decomposes

Orchestrates,

Is guided by

Ensures correct operation of

Control

Is tracked against

Sets performance criteria for

Is resolved by, Is generated by

Is resolved by, Is generated by

Applies to

Meets

Measure

Event

Service Quality

Contract

Contains

Contains

Sets performance criteria for

Is owned and governed by

Is tracked against

Is Provided to

Is resolved by

Resolves

Supports, Is realized by

Applies to

Meets

Governs, Measures

Is governed and measured by

Provides governed interface to access

Location

Business Service

Contains

Contains

Contains

Provides, Consumes

Fully automated

Is implemented on

Information System Service

Is supplied or consumed by

Is accessed and updated through

Is processed by

Implements

Operates on

Is realized through

Provides platform for

Supplies

Is supplied By

Physical Data Component

Data Entity

Logical Application Component

Logical Technology Component

Platform Service

Is hosted in

Resides within

Realizes

Resides within

Encapsulates

Is realized by

Realizes

Realizes

Is realized by

Physical Application Component

Physical Technology Component

Logical Data Component

Is realized by

Encapsulates

Is hosted in

Is hosted in

DATA ARCHITECTURE

APPLICATION ARCHITECTURE

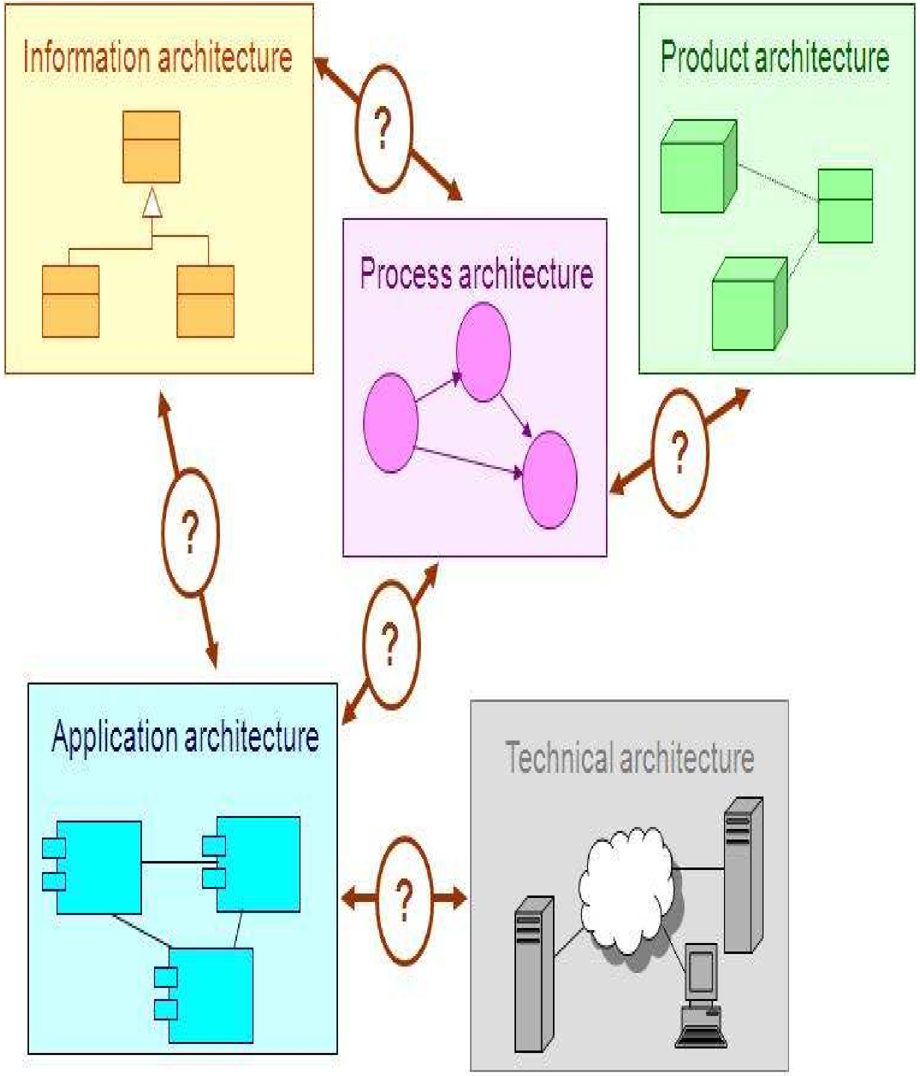
TECHNOLOGY ARCHITECTURE

🟥	Motivation Extension
🟥	Infrastructure Consolidation Extension
🟦	Process Modeling Extension
🟩	Services Extension
🟩	Governance Extension
🟦	Data Modeling Extension
□	Core Content

TOGAF 9 ADM – Real life benefits

- **Benefits using ADM we have seen:**
  - **Integration**
    - Integrates with other enterprise architecture processes/frameworks (i.e. Zachmann, Gartner etc)
    - Facilitates integration of enterprise wide processes (i.e. by collecting artefact etc..)
  - **Efficiency**
    - Creates a repeatable and predictable process of developing enterprise architecture content
    - Can be extended and customised as per the specific needs of the enterprise for e.g. scaling
  - **Simplicity**
    - Process Driven : Inputs, Outputs and Steps are specified for each phase
  - **Predictability** of the Outcome
    - The Outputs from one phase could be traced back to the inputs of another phase – i.e. it links inputs to the outcomes
  - **Complexity**
    - Not really a bad thing if you learn how to manage the complexity of ADM

EA Modelling - Archimate



Source: Telematica Instituut

- **Benefits of usage:**
  - Precise language to document at the enterprise architecture level focusing on structure and semantics
  - Enabling Consistent Architecture Communication
  - Integrated and Coherent modelling
  - Driving Architecture Analysis before actual implementation
  - Excellent *High- Level* modelling *within* a domain through visualisation techniques

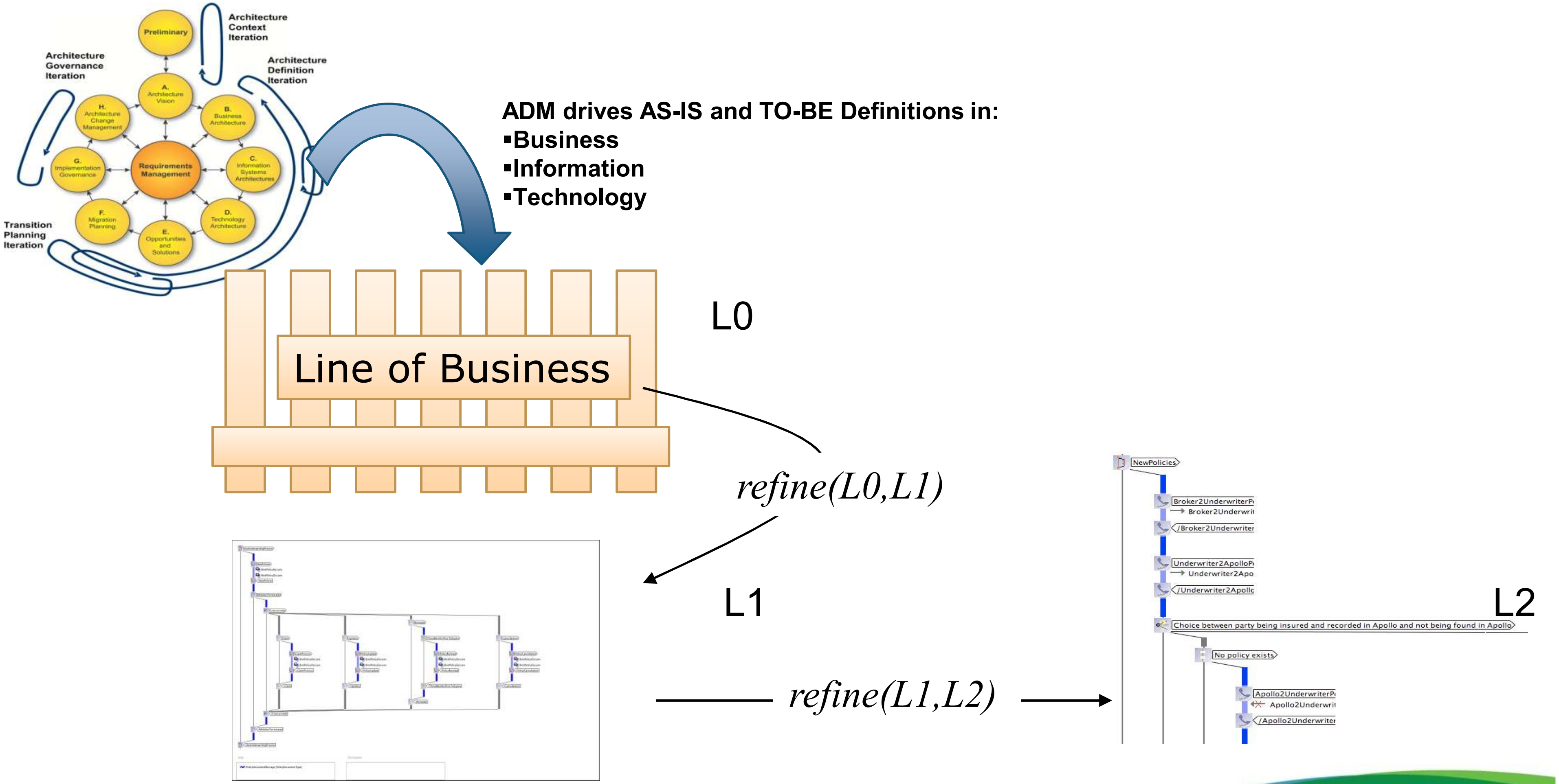
Background — EA Definition — EA Modelling — Testable Architecture — Case Study

Models and Levels – as we see it?

- Models are for humans.
- Models are used to create some representation of one or more domain/s .
- The level of a model and the semantics of that level are entirely to do with the level of abstraction that we wish to use in order to make the points that need to be made.
- Abstraction can be seen as a scoping operator over a domain in which some things are hidden that do nothing to make the points that need to be made.
- Models and their levels should be complete and unambiguous with respect to their level.
- A model at any level should be able to be type checked and checked for consistency so that it may be said to be correct against that level.
- Levels should support operators that enable a full or partial mapping from one level to another.

Transformation – AS-IS to TO-BE

- Say a set of requirements at R0 is said to be met by a model L0 and that model L0 is comprised of several parts (usually aligned to lines of business) then a phased approach could be adopted such as:



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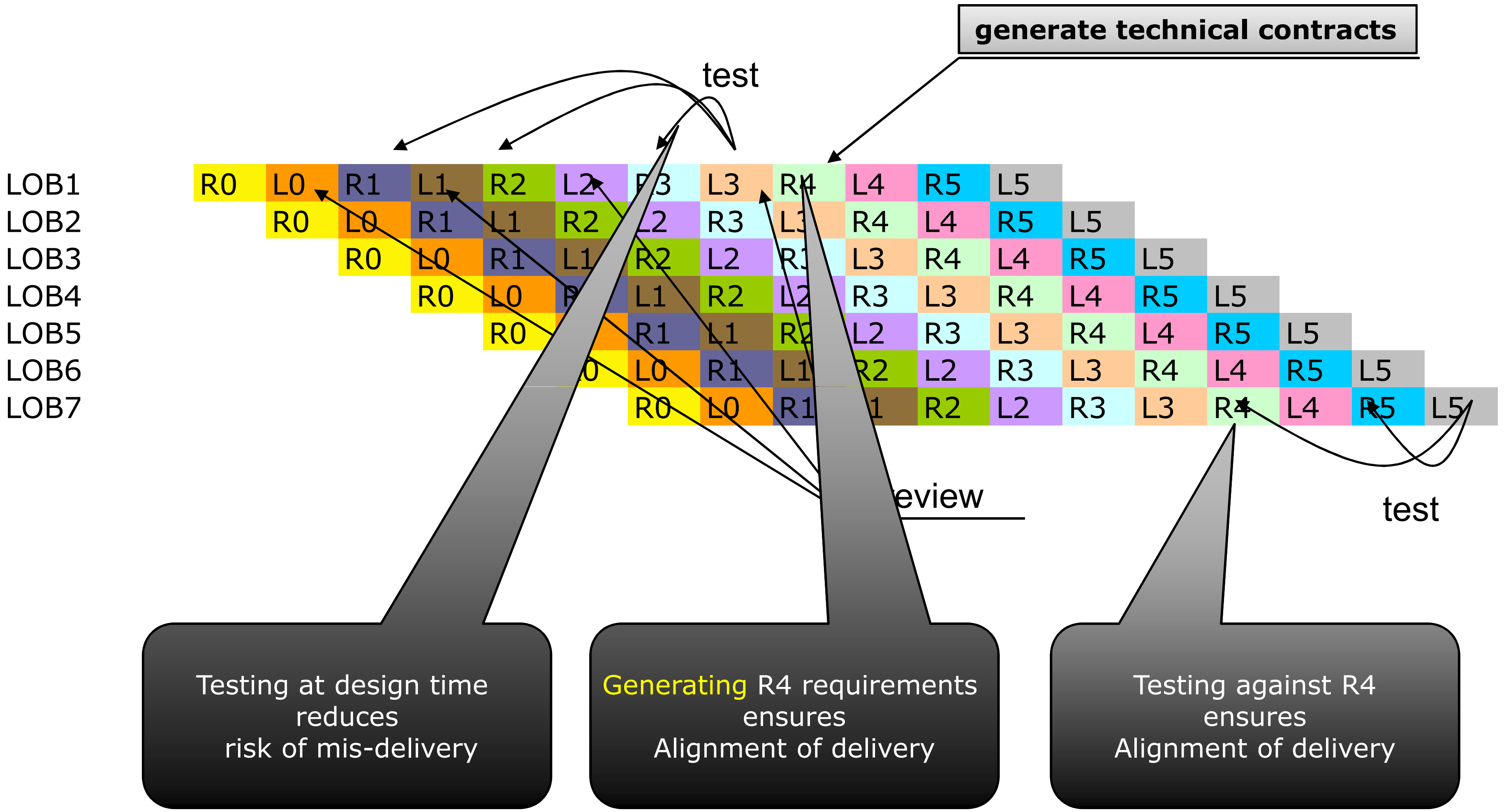
Requirements Management
Transition Planning Iteration
Line of Business
L0
refine(L0,L1)
L1
refine(L1,L2)
L2
NewPolicies
Broker2UnderwriterP
Broker2Underwrit
/Broker2Underwriter
Underwriter2ApolloP
Underwriter2Apo
/Underwriter2Apollo
Choice between party being insured and recorded in Apollo and not being found in Apollo
No policy exists
Apollo2UnderwriterP
Apollo2Underwrit
/Apollo2Underwriter

ADM drives AS-IS and TO-BE Definitions in:

- **Business**
- **Information**
- **Technology**

Transformation – AS-IS to TO-BE



LOB1	R0	L0	R1	L1	R2	L2	R3	L3	R4	L4	R5	L5						
LOB2		R0	L0	R1	L1	R2	L2	R3	L3	R4	L4	R5	L5					
LOB3			R0	L0	R1	L1	R2	L2	R3	L3	R4	L4	R5	L5				
LOB4				R0	L0	R1	L1	R2	L2	R3	L3	R4	L4	R5	L5			
LOB5					R0		R1	L1	R2	L2	R3	L3	R4	L4	R5	L5		
LOB6						R0	L0	R1	L1	R2	L2	R3	L3	R4	L4	R5	L5	
LOB7							R0	L0	R1	L1	R2	L2	R3	L3	R4	L4	R5	L5

Testing at design time reduces risk of mis-delivery

Generating R4 requirements ensures Alignment of delivery

Testing against R4 ensures Alignment of delivery

Background — EA Definition — EA Modelling — Testable Architecture — Case Study

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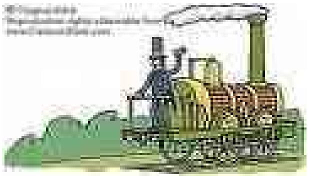
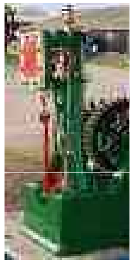
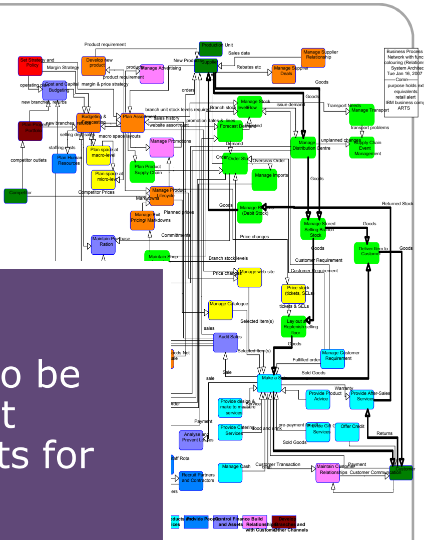
Introduction of Testable Architecture



Stevenson's Rocket



Steam E



Testable architecture enables the architecture of a system to be described unambiguously such that it may be tested against requirements and used to generate implementation artefacts for delivery thereby improving governance and control.

If we can deliver a solution that connects requirements to architecture and architecture to implementation we shall change the nature of complex solution delivery, reducing costs, risks and time to market in the process.

The r
betw
leading to both Stevenson's rocket and the
off shoring of production of the Enfield rifle during the US Civil War.

we draw
ext for the
nich are
disjoint

A lot of disjoint artefacts which breeds ambiguity with no real hope of measuring implementation against specification in any automated computable manner.

Introduction of Testable Architecture

Definition

An unambiguous formal description of a set of components (CDL) and their ordered interactions coupled with any constraints on their implementation and behaviour (RuleML).

Formal Grounding

❑ Testable architecture has originated from & has strong foundations in "**pi-calculus**"

  ❑ a formal communication framework developed by *Prof. Robin Milner* – Professor Emeritus of Computer Science at the University of Cambridge and Turing Award Recipient

❑ Enables reasoning of descriptions to ensure consistency and correctness against requirements

Benefits

↓ **RISK** → reduced risk of mis-delivery

↓ **COST** → reduced cost of implementation and testing

↑ **QUALITY** → increased quality of overall solution

↑ **AGILITY** → increased agility of overall solution

Repositioning the cost of errors

Testable Architecture is FORMAL hence it reduces defects injection

defects”

“Fact 2: H

Fact#: Real Implementations using Testable Architecture (CDL)

HL7

- Life sciences principle message interchange standard
- CDL provides the dynamic model for message order enabling rapid deployment of HL7 compliant services (aka SOA)

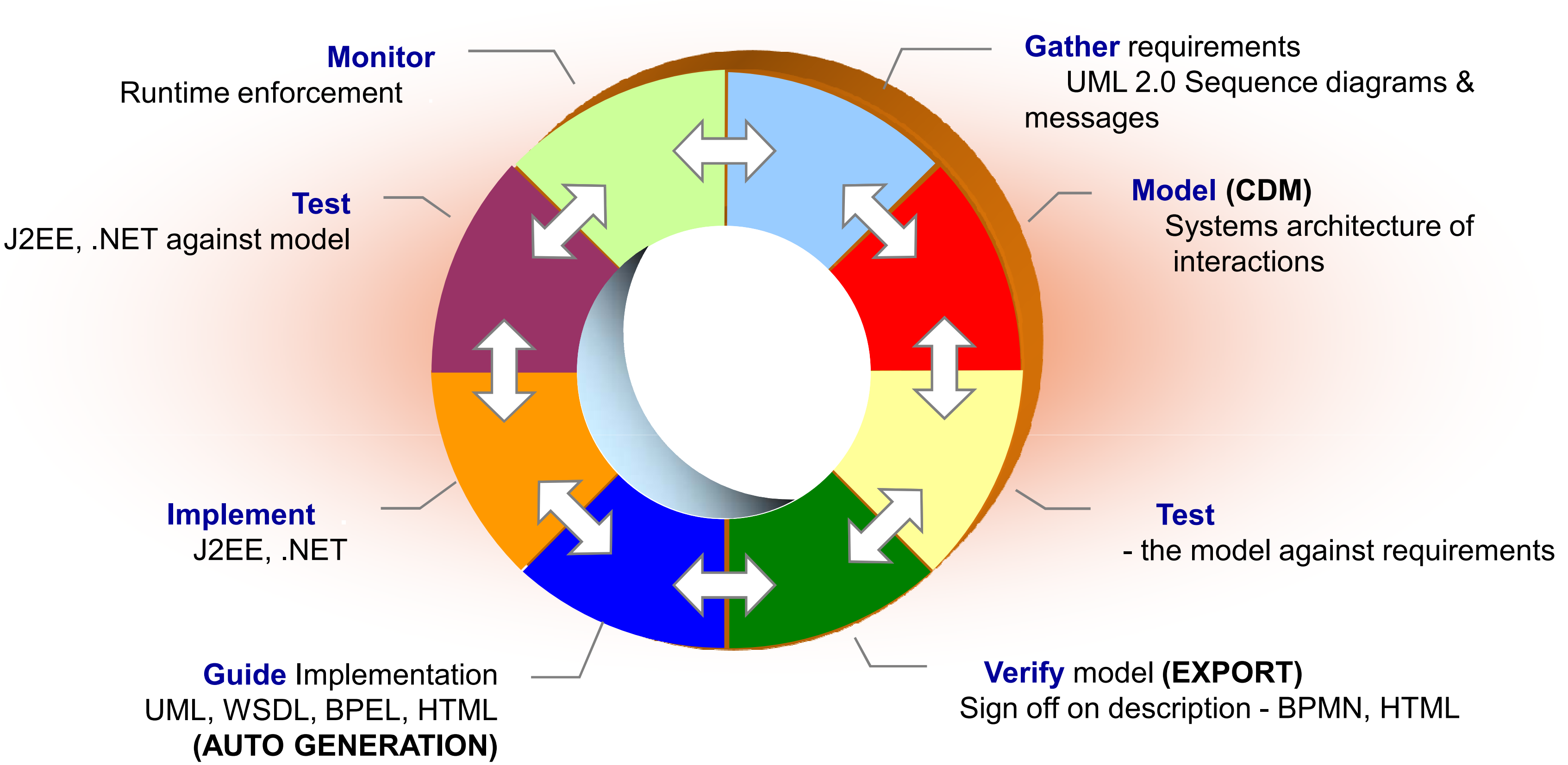
ISDA

- Derivatives principle message interchange standard
- CDL provides the dynamic model for confirmations, affirmation, etc.
- Enabled rapid compliance to business protocols reducing lifecycle costs

Redhat

- Principle system description providing unique differentiator for Redhat’s SOA platform
- Part of the community edition of Overlord

Testable Architecture Methodology



Monitor
Runtime enforcement

Gather requirements
UML 2.0 Sequence diagrams & messages

Test
J2EE, .NET against model

Model (CDM)
Systems architecture of interactions

Implement
J2EE, .NET

Test
- the model against requirements

Guide Implementation
UML, WSDL, BPEL, HTML
(AUTO GENERATION)

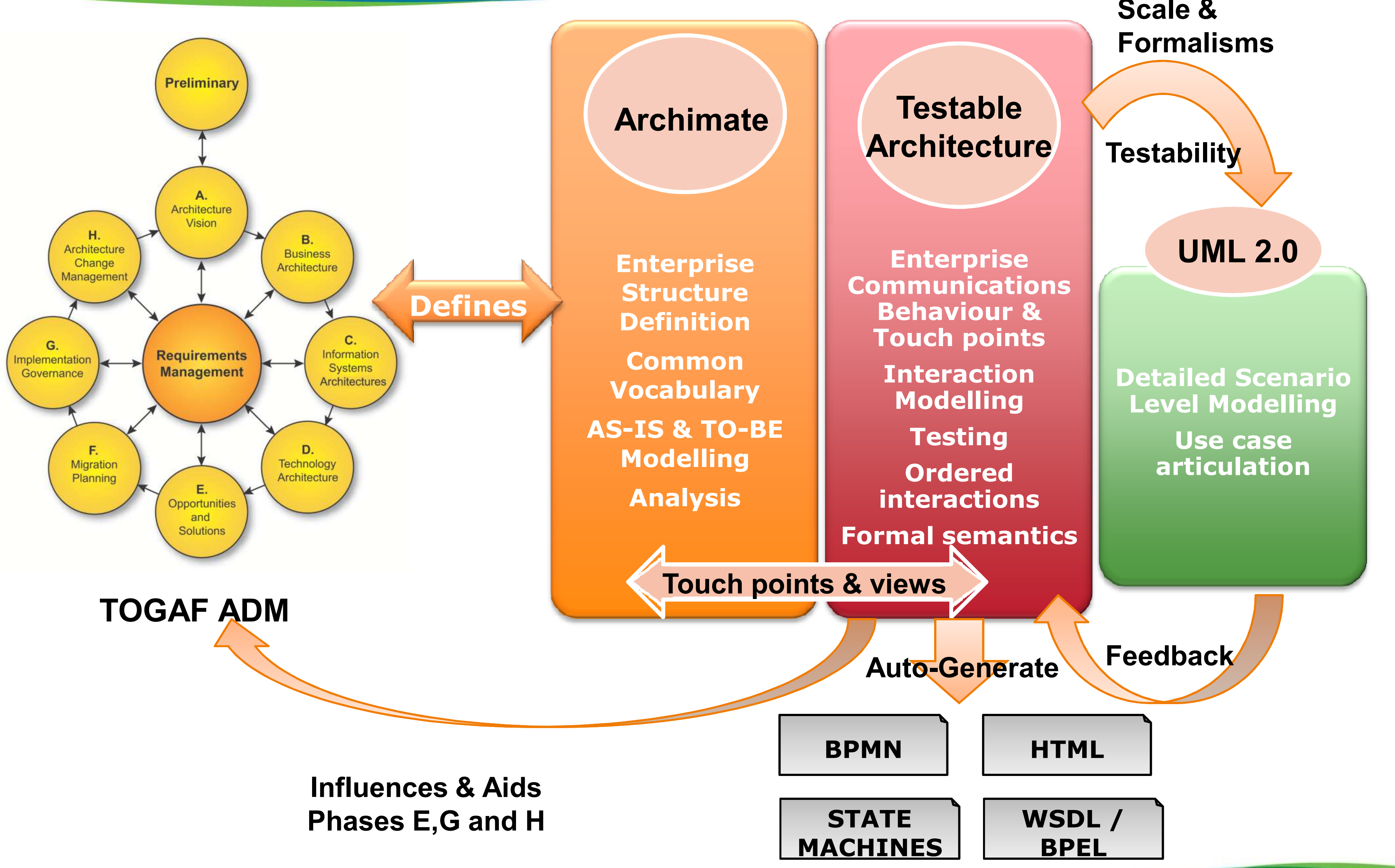
Verify model **(EXPORT)**
Sign off on description - BPMN, HTML

Removing Ambiguity means:

- ***Driving up quality***
- ***Driving down costs***
- ***Increasing agility in a controlled manner***

Background — EA Definition — EA Modelling — Testable Architecture — Case Study

Alignment of Modelling Methods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Requirements Management

TOGAF ADM

Defines

Archimate

Enterprise Structure Definition

Common Vocabulary

AS-IS & TO-BE Modelling

Analysis

Testable Architecture

Enterprise Communications Behaviour & Touch points

Interaction Modelling

Testing

Ordered interactions

Formal semantics

Touch points & views

Scale & Formalisms

Testability

UML 2.0

Detailed Scenario Level Modelling

Use case articulation

Feedback

Auto-Generate

BPMN

HTML

STATE MACHINES

WSDL / BPEL

Influences & Aids
Phases E,G and H

Background — EA Definition — EA Modelling — Testable Architecture — Case Study

Case Study - Background

Current

- A Major Global Underwriting Business
- Recent M&A issues
- Federated Policy Admin Systems
- Inadequate Process Automation

Business Strategy

- Be Customer Centric
- Diversification to high margin products
- Operational Inefficiencies
- Global Expansion through M&A
- Better integration with partners and across channels

Enterprise Transformation

Technology Drivers

- Componentised Core Architecture
- Service Oriented Architecture & BPM
- Digital Asset Management
- Portal Based Solutions – Underwriting and Causality
- Enterprise Data warehouse & BI

IT Strategy

- Speed-to-Market
- Global Platform for Causality – Model office
- E-claims and PAS Consolidation
- Automation of Business Processes
- System Modernization Strategy

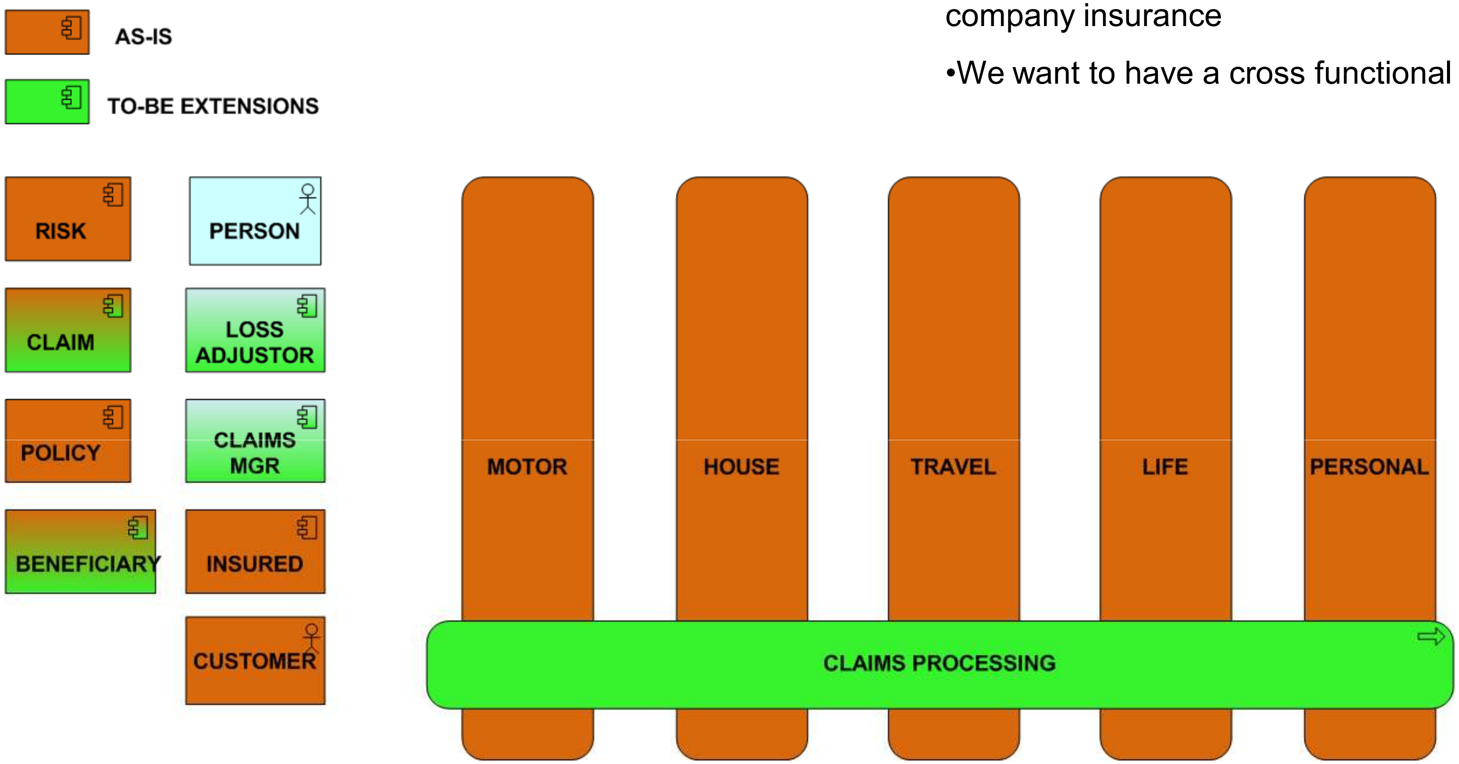
Case Study - Level 0 TO-BE

R0 Driven by business goals

For e.g.

•We want to open up a new line of business for company insurance

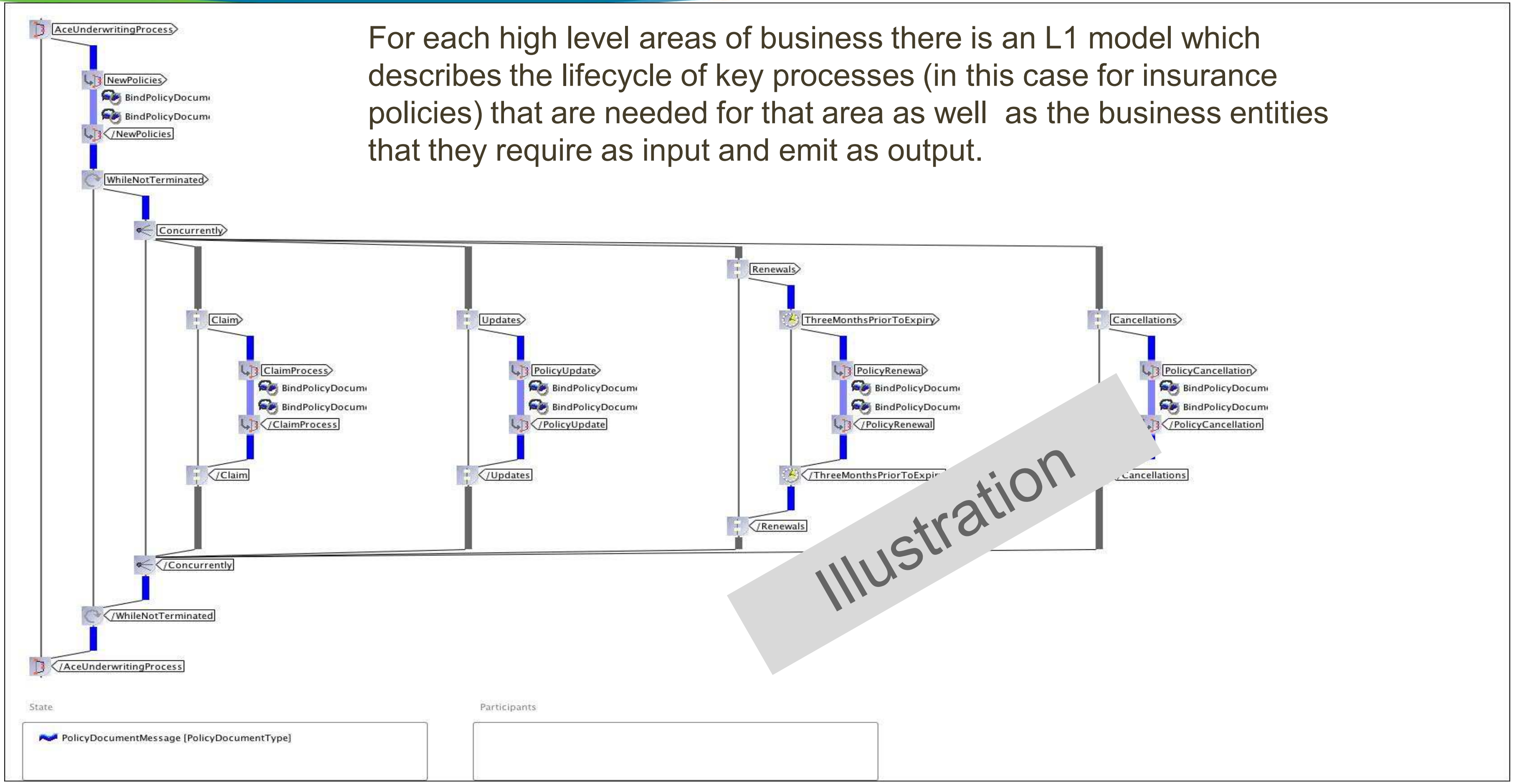
•We want to have a cross functional claims process



Level 0 describes only the **functional business decomposition** of an enterprise in terms of high level areas of business and business/information entities

Case Study - Level 1

For each high level areas of business there is an L1 model which describes the lifecycle of key processes (in this case for insurance policies) that are needed for that area as well as the business entities that they require as input and emit as output.



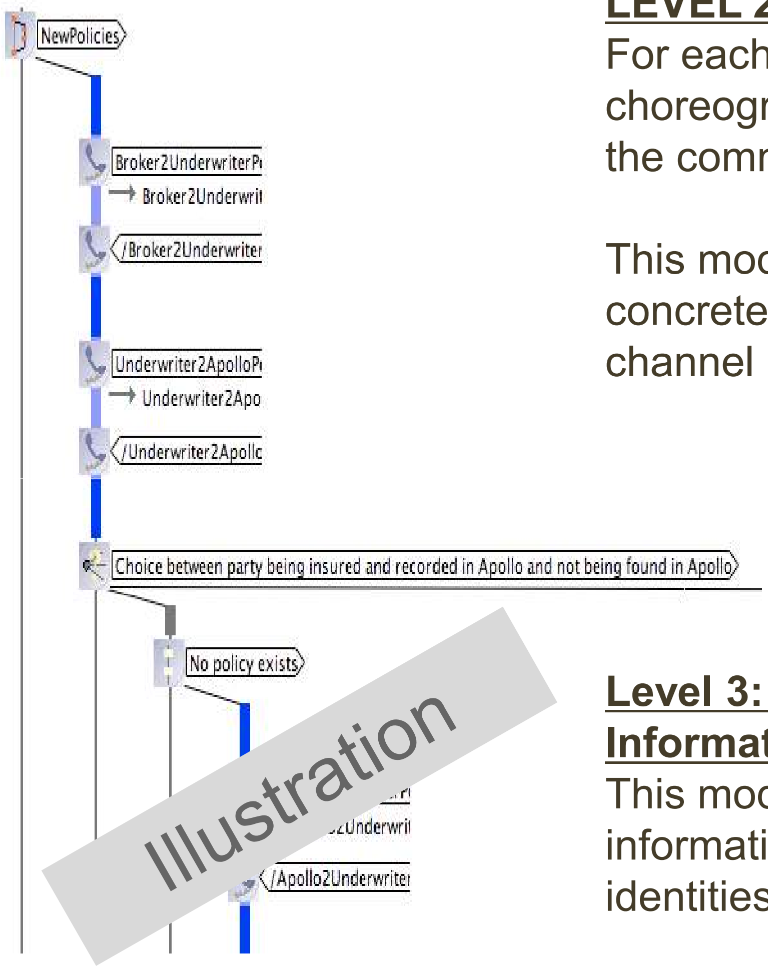
R1 Driven by high level - Lifecycle requirements

•There must be a policy in existence prior to updating, renewing, canceling or querying a policy.

•Updating, renewing, cancelling and querying can happen at any time

•Updating, renewing, cancelling and querying can happen zero or more times until a policy is terminated

Case Study - Level 2 and 3



LEVEL 2: - Driven by Solution Requirements

For each lifecycle process in L1 define one or more sub choreographies that describe the dynamic behaviour of the communication model.

This model **does not need** to bind to an underlying concrete information model and is abstract. So no channel identities and no xpath expressions.

Level 3: Technical Requirement and Constrained by Information Model

This model **does need** to bind to an underlying information model and is concrete with channels having identities and conditionals with expressions.

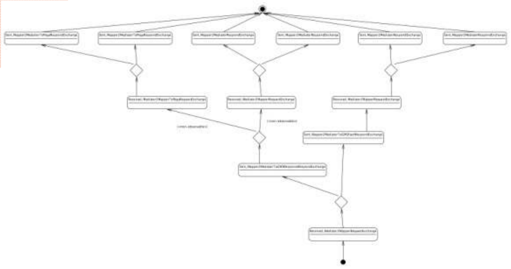
Case Study - Level 4 and 5

Level 4

(Driven by L3 contracts)

- Generation of state machines that represents the observable behaviour of that participant.

State Machine Participant



Level 5

- Generation or Development of a fully executable application or process that retains the state behavior that is observable in L3 but adds non-observable business logic to the state machine.

Fully executable Participant

WSDL / BPEL

Testable Architecture in Action! [e-Claims process - movie]

In Summary

- **Better "Enterprise" Architecture is achieved through:**
  - Focus on components (Business, Information, Application and Technology) and their inter-relationships across the enterprise
  - Adherence to best practices for modelling to describe enterprise states
- **Adoption of:**
  - Formal methods of enterprise modelling to ensure consistency and predictability of outcomes
  - Testable architecture to improve architecture governance and control over implementation artefacts
  - Testable architectures as an extension to Enterprise architecture methods to help clearly articulate formal descriptions for component inter-relationships
  - Testable architecture methodology to auto-generate detailed contracts and implementation artefacts in adherence to functional and non functional requirements

Thank you

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Further Reading:

realisticenterprisearchitecture.blogspot.com
pi4tech.blogspot.com
opengrouppresentations.blogspot.com