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DEFINING THE FUTURE

Creating a Systems Architecture for an SOA-based IT System as Part of a Systems Engineering Process

Robert S. Ellinger, Ph.D.

Enterprise Architect

Gabriel Hoffman

Senior System Engineer

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Agenda

- Service Oriented Architecture?
- Service Oriented Architecture and Investment-Driven SOA (ID-SOA™)
- Creating a System Architecture for an SOA-based IT System

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DEFINING THE FUTURE

Services-Oriented Architecture?

The Problem

- IT organizations often focus on implementing technology yet not enough on helping a customer organization accomplish its mission
- Today's IT solutions tend to be based on COTS architectures that often enforce specific business processes and lack open technology upgrade paths
  - *Flexibility*: Large-scale COTS applications have limits on their configurability, so the application does not readily support the organization’s continuously changing processes
  - *Technology Upgrade*: Upgrading or replacing technology is often very difficult, that hinders the organization in achieving its mission with the current IT technology
- Therefore, too often the organization conforms to the IT needs, instead of IT conforming to what the organization requires

SOA as a Solution

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- Service Oriented Architecture (SOA) assists the organization with focusing its IT on solving business problems
  - Measurably links the applications to the organization's processes to enable the organization to understand the contribution of each application within the process. This enables the organization to determine whether its investment is worthwhile
  - Provides "line-of-sight"
    - From the Organization's Mission through its Strategies to its Processes to determine the optimal place for the next investment
    - To support the intent of the Federal Enterprise Architecture (FEA), a concept which is being incorporated into the DoD Architecture Framework version 2

SOA as a Solution

(Continued)

- The SOA enables the organization’s IT to support continuous process change
  - Existing “composite” applications can be reassembled to support a change in the organization’s processes in a *Continuous Operational and Development Environment (CODE)*
  - The “Composite” applications are the Services and are assemble from Service Components, each of which is a separate application (which may be a Web Service)
    - Each Service Component may be upgraded to new technology or replaced independently
    - These Service Components are assembled using a process flow which may be redesigned independently of the components being used

ID-SOA™

- A good SOA process will help management to:
  - Identify processes and IT systems that are producing minimal or no value for the organization, that is, IT systems that are good candidates for investment
  - Recommend deletion or investment (by updates/upgrades or replacement)
  - Execute projects that the customer has approved as IT investments
  - Evolve toward a service-based business vision/model with the agility to successfully respond to unexpected challenges and opportunities
- In other words, a good SOA process allows the organization to use an IT investment process to optimize its processes and the supporting IT systems and applications in a CODE
- Northrop Grumman's Investment-Driven Service-Oriented Architecture (ID-SOA™) is such a process

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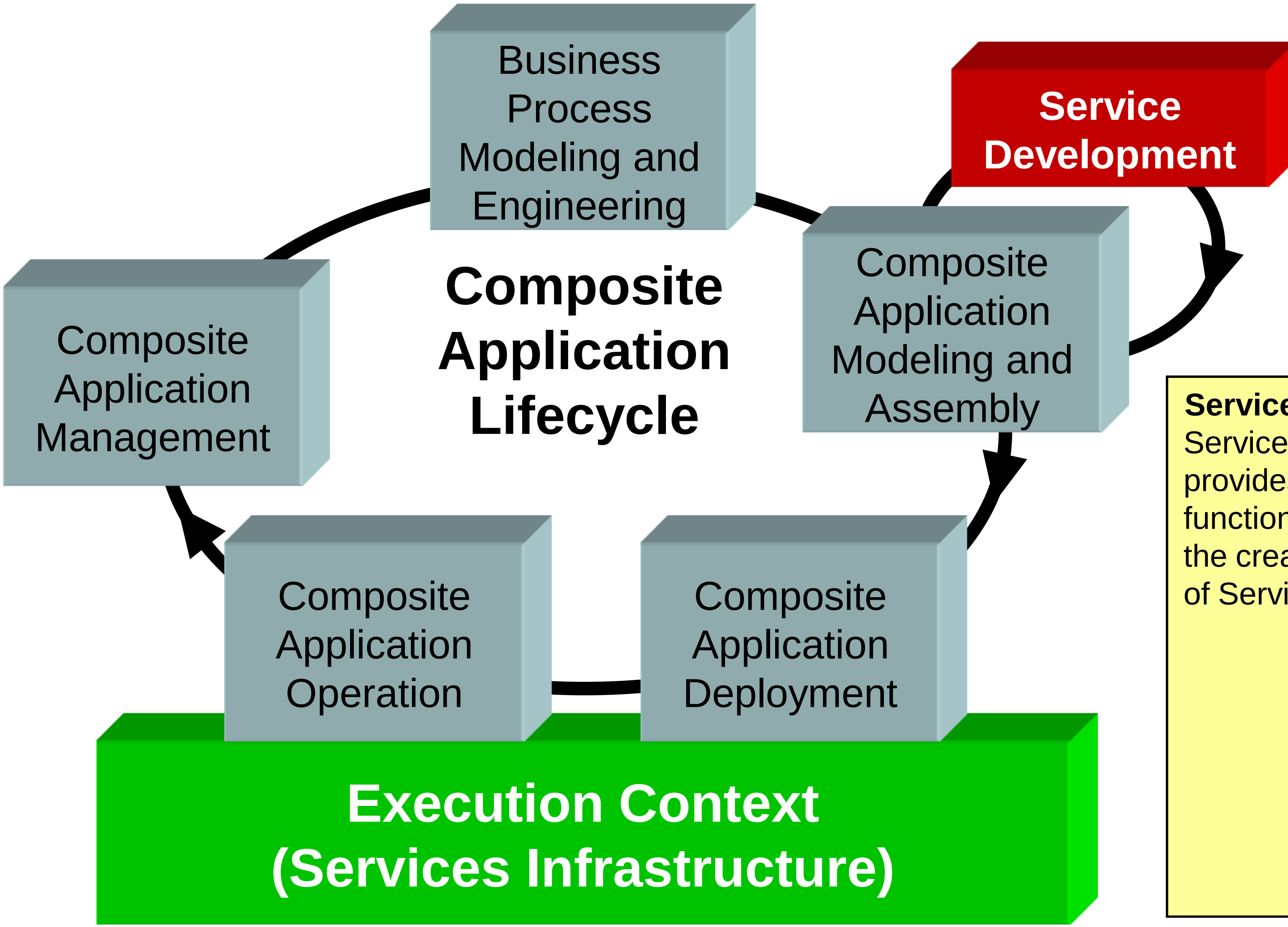
DEFINING THE FUTURE

The ID-SOA™ Process

Enterprise SOA



Service Development: Service Development provides activities and functions that support the creation and testing of Service Components

ID-SOA™ Simplified High-level Flow

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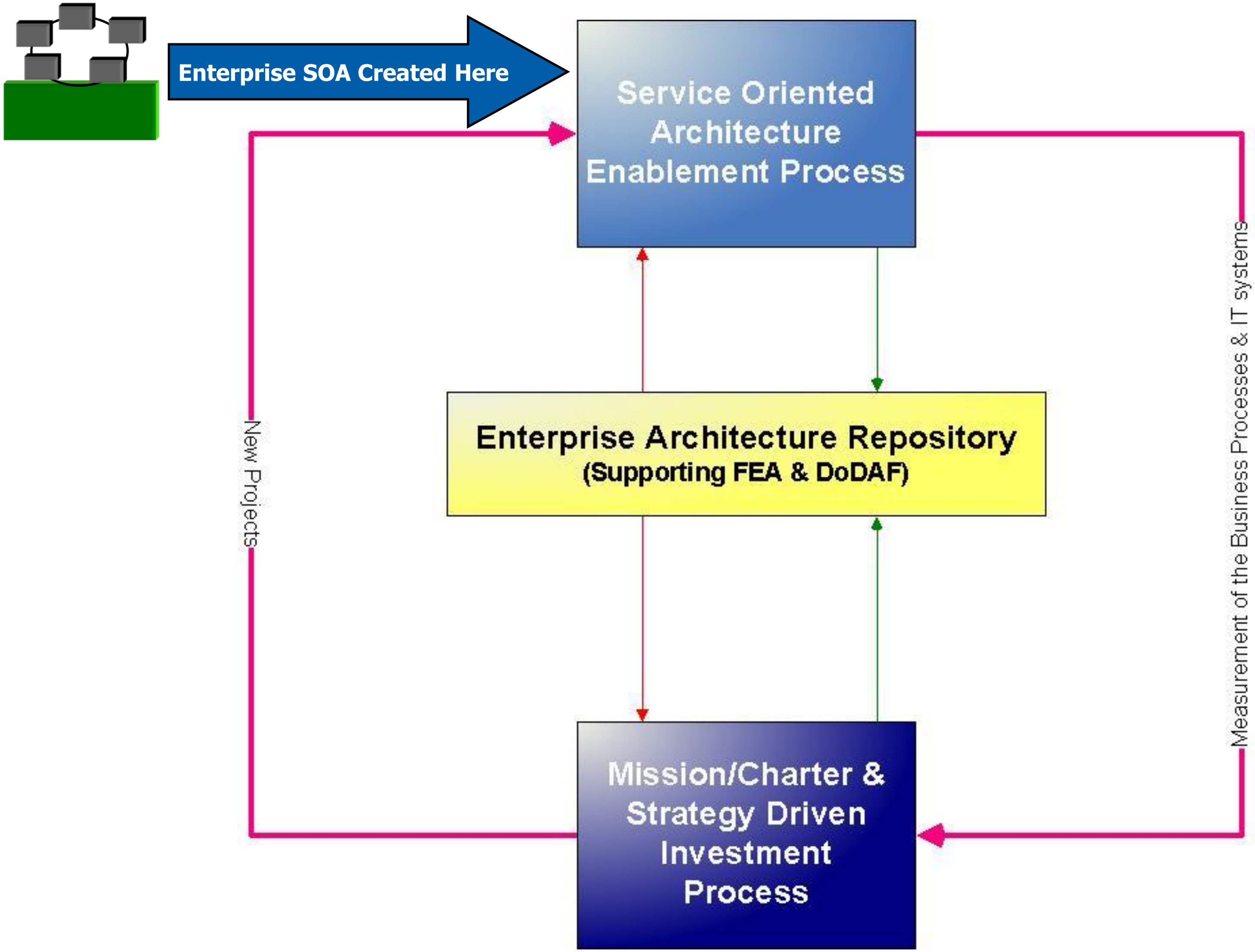
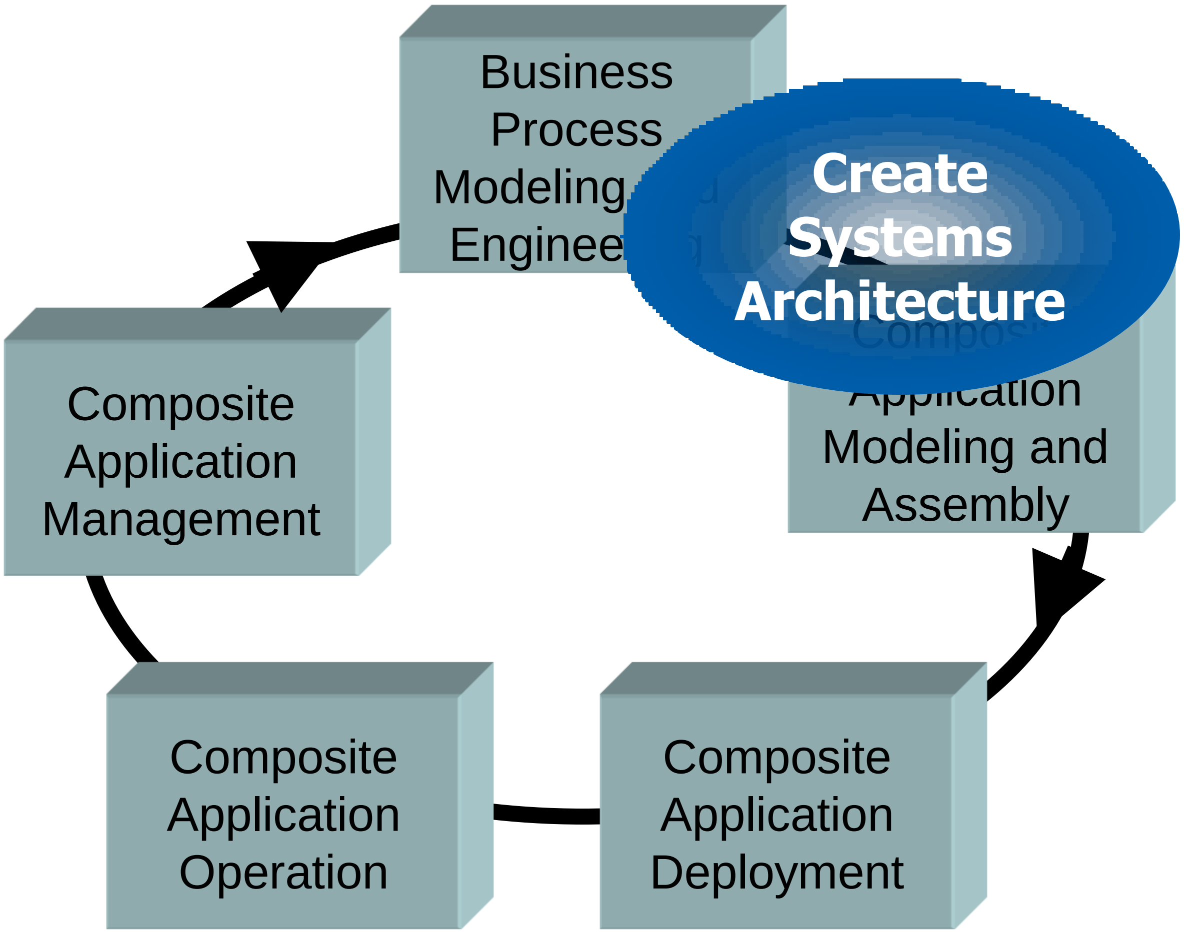


Creating a System Architecture for an SOA-based IT System

The Composite Application Lifecycle



Creating Systems Architecture–This activity:

- Decomposes the Business Process Model
- Derives the IT Functions required to enable and support the process—creating the "functional requirements"
- Structures the IT Functions to optimize communications among the functions and minimize the number of redundant functions
- Allocates the Functions to Components—creating the "Component Requirements"

The Overall IT System Architecture Process

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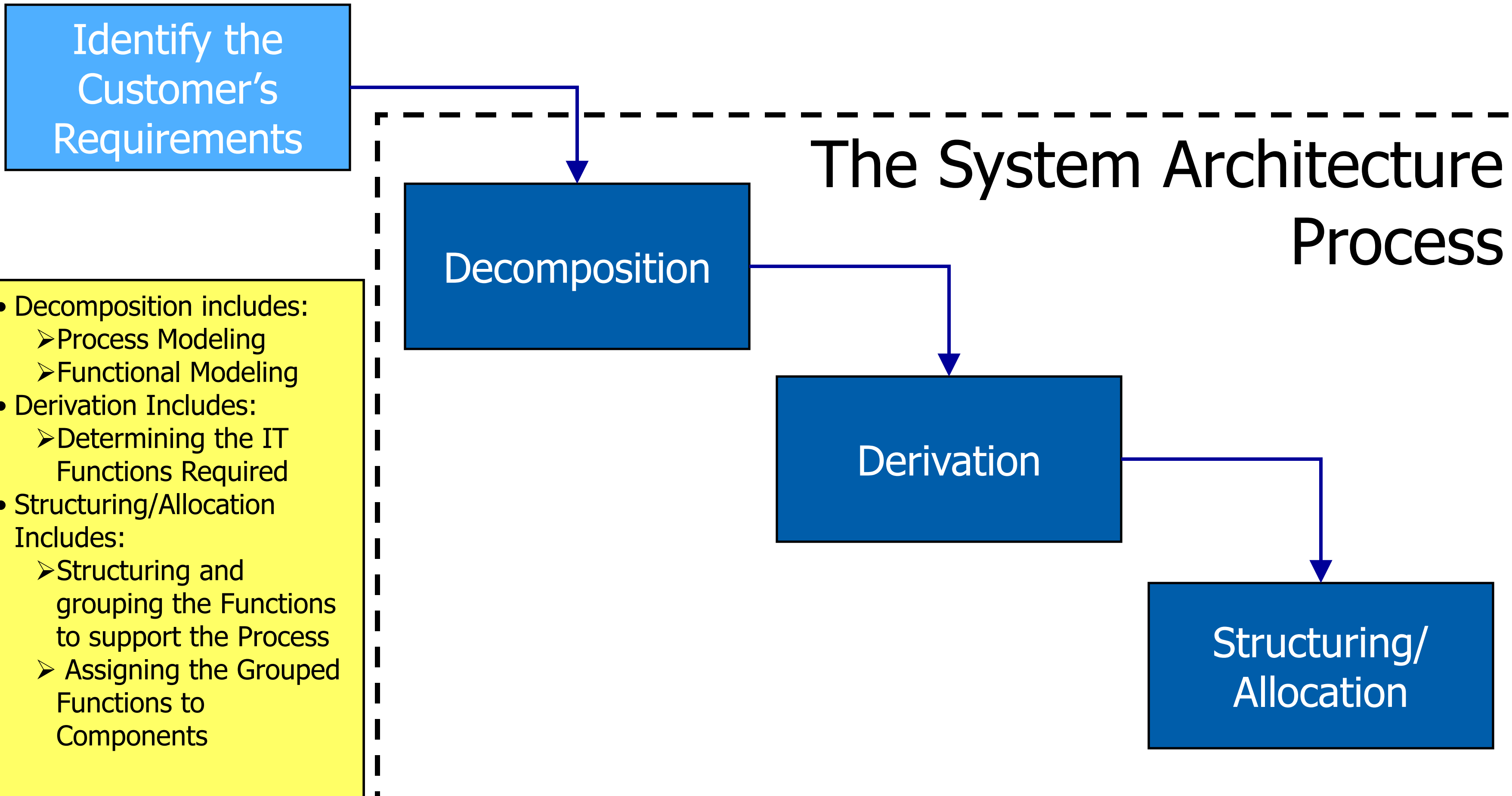
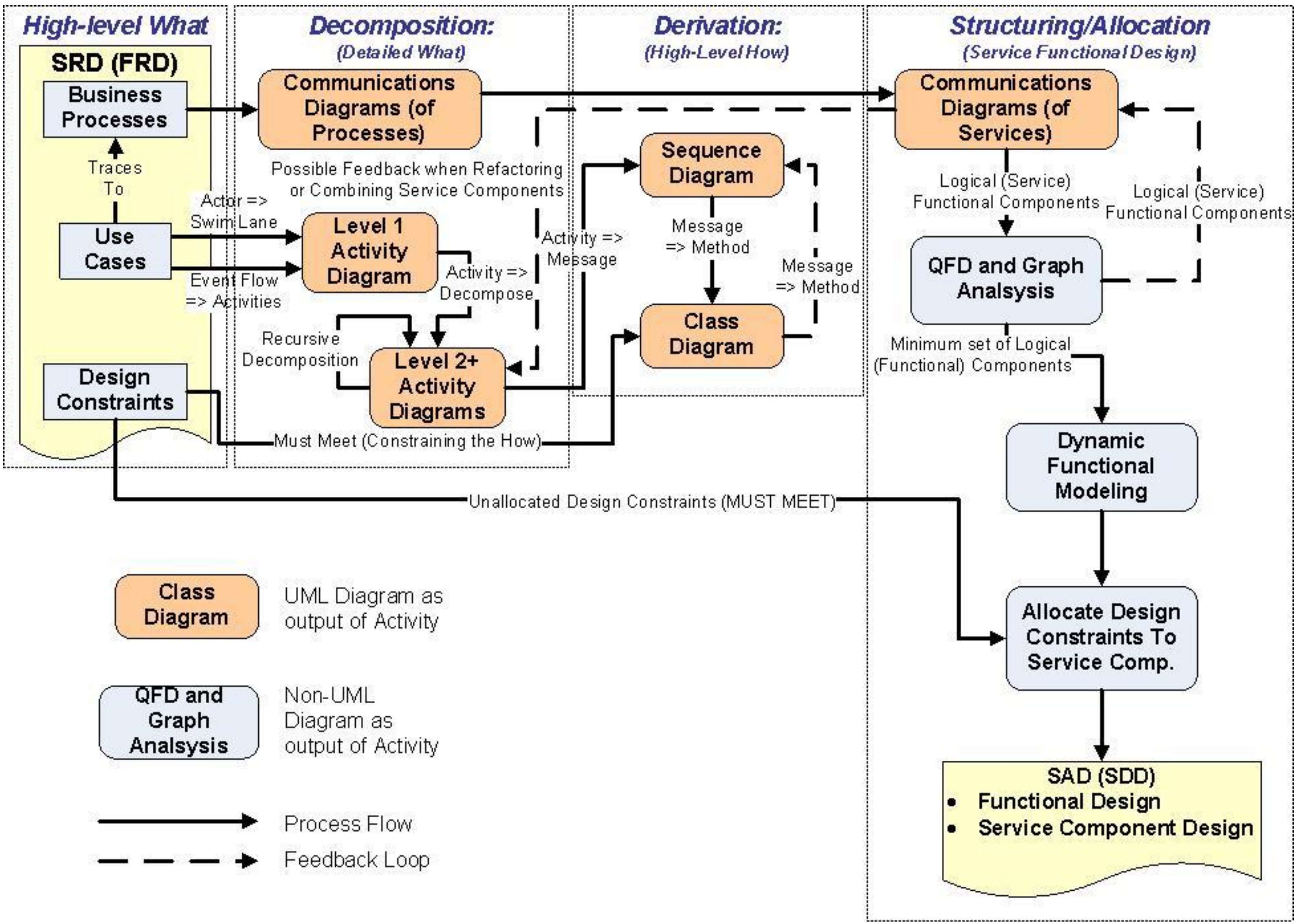


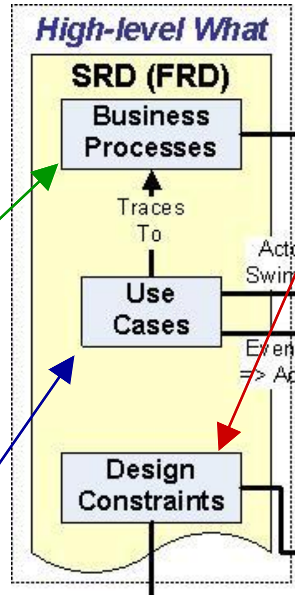
- Decomposition includes:
  - Process Modeling
  - Functional Modeling
- Derivation Includes:
  - Determining the IT Functions Required
- Structuring/Allocation Includes:
  - Structuring and grouping the Functions to support the Process
  - Assigning the Grouped Functions to Components

The Overall System Architecture Process (More Detail)



The System Requirements Document (SRD) Used as Inputs (Table of Contents)

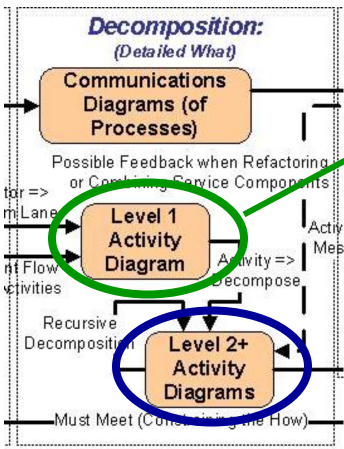
1 Introduction
1.1 Purpose
1.2 Scope
1.3 Background
1.4 Identification
1.5 Rapid Implementation Approach
1.6 Document Change Management
1.7 Referenced Documents
2 System Context
2.1 Organizational Mission, and Strategies
2.2 System Scope
2.2.1 In Scope
2.2.2 Out of Scope
2.3 Business Processes
2.3.1 BP1
2.3.2 BP2
2.3.3 BP3
2.3.4 BPi
2.3.5 BPn
3 Use Cases
3.1 Actors
3.2 Use Cases Identified by Actor, Business Process, and Release
3.3 Use Cases



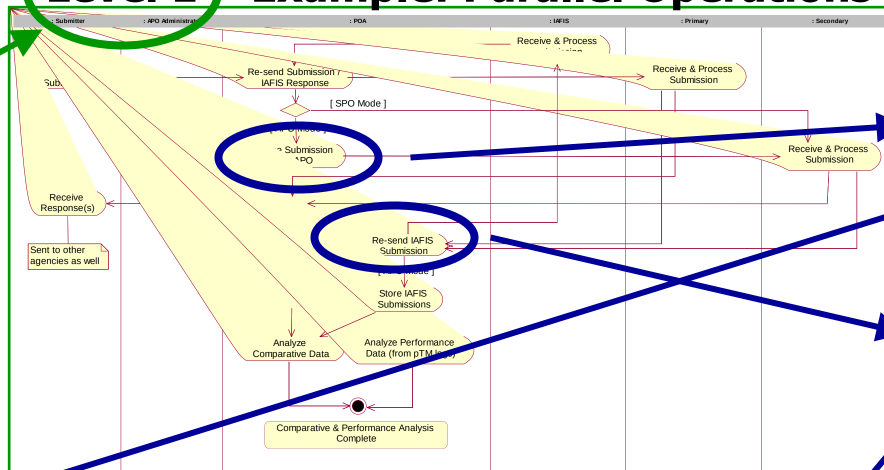
4 Design Constraints
4.1.1 Size and Location of User Community
4.1.2 Interfaces
4.1.3 Customer Furnished or Identified Components
4.1.4 Data Base
4.1.5 System Transition
4.1.6 Training
4.1.7 General Computing Controls & Security
4.1.8 Business Continuity (COOP)
4.1.9 Performance and Availability
4.1.10 Information Retention/Purging/Archiving
4.1.11 Other Constraints
4.1.12 Hardware and Software Standards
4.1.13 Communications and Network
4.2 Customer IT Standards Constraining the Design
4.2.1 Architectural Constraints
4.2.2 Scalability
4.2.3 Reliability/Availability
4.2.4 Service Infrastructure
4.3 Outside Standards and Specifications Constraining the Design
5 System Validation
Appendix A: Acronyms, and Abbreviations
Appendix B: Glossary

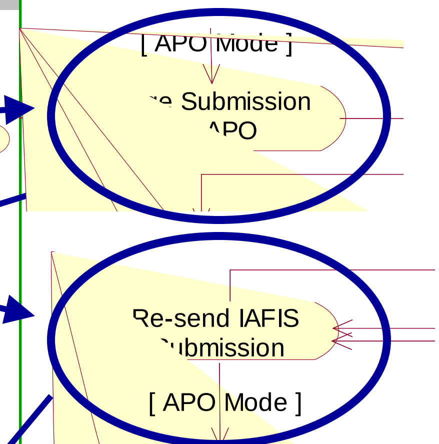
The Decomposition Activity

Objective: To define processes and activities in sufficient detail to allow the derivation of IT functions to support the process

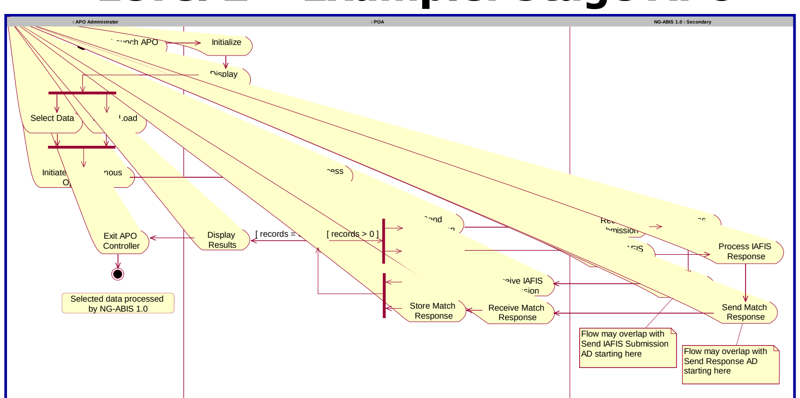


Level 1 – Example: Parallel Operations

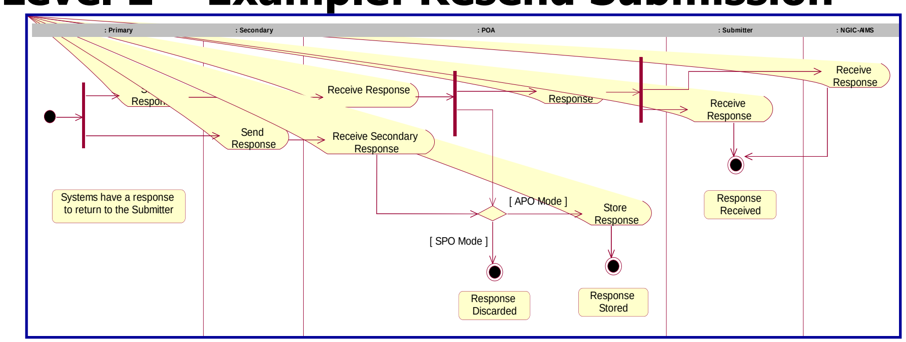




Level 2 – Example: Stage APO

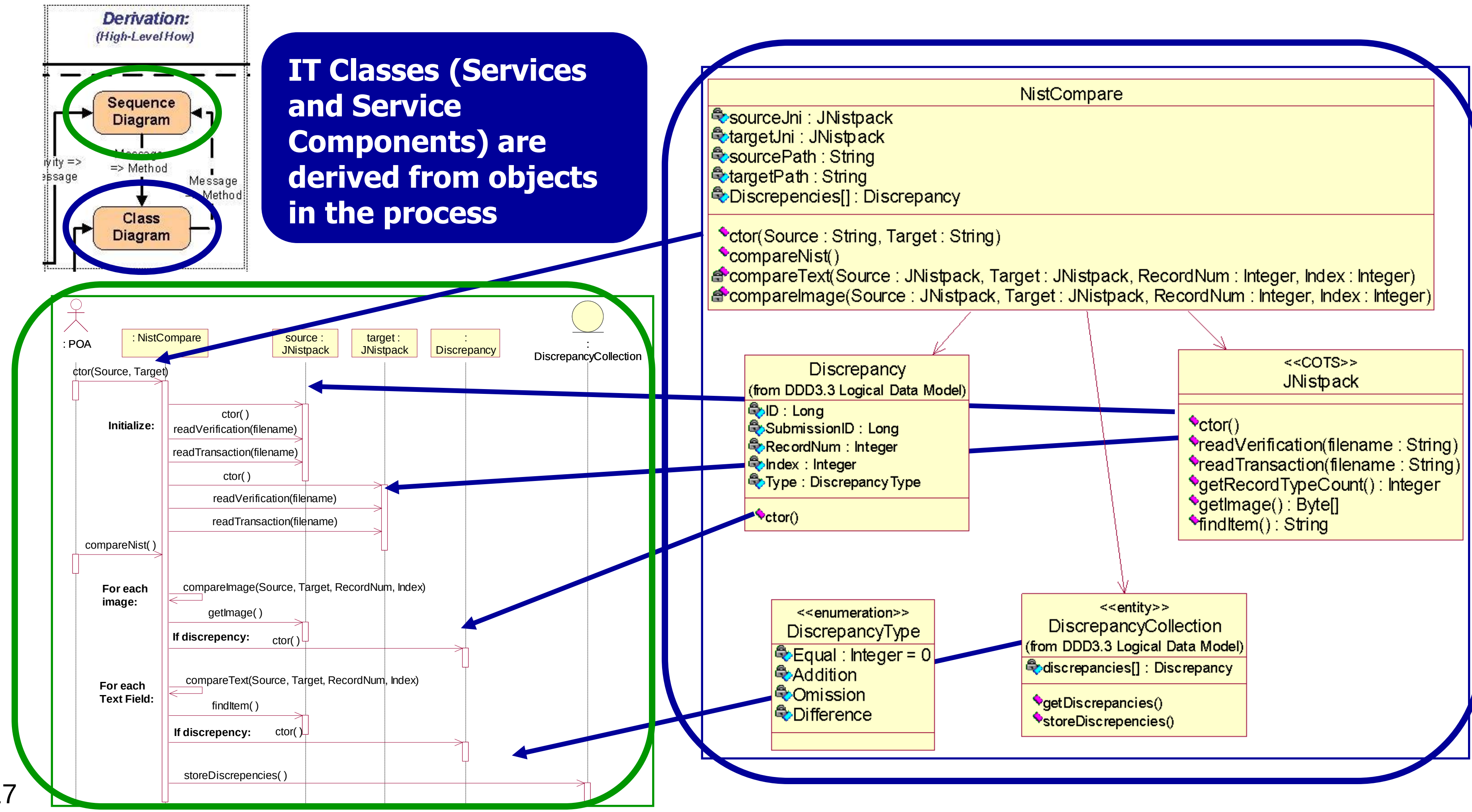


Level 2 – Example: Resend Submission



Derivation

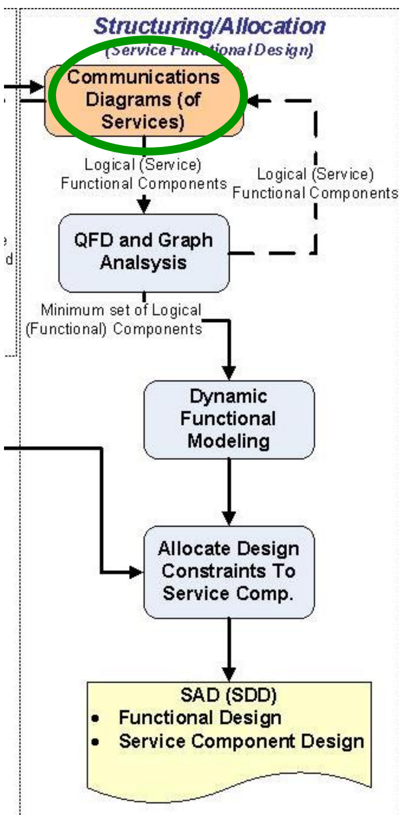
Objective: To determine what IT Functions are required to enable and support the processes and activities determined in decomposition



Structuring and Allocation: Step 1

Objective: To Structure and group IT functions into Services to:

- Minimize the number of redundant functions
- Optimize the grouping of IT functions for allocation
- And to Allocate the grouped functions to actual service components

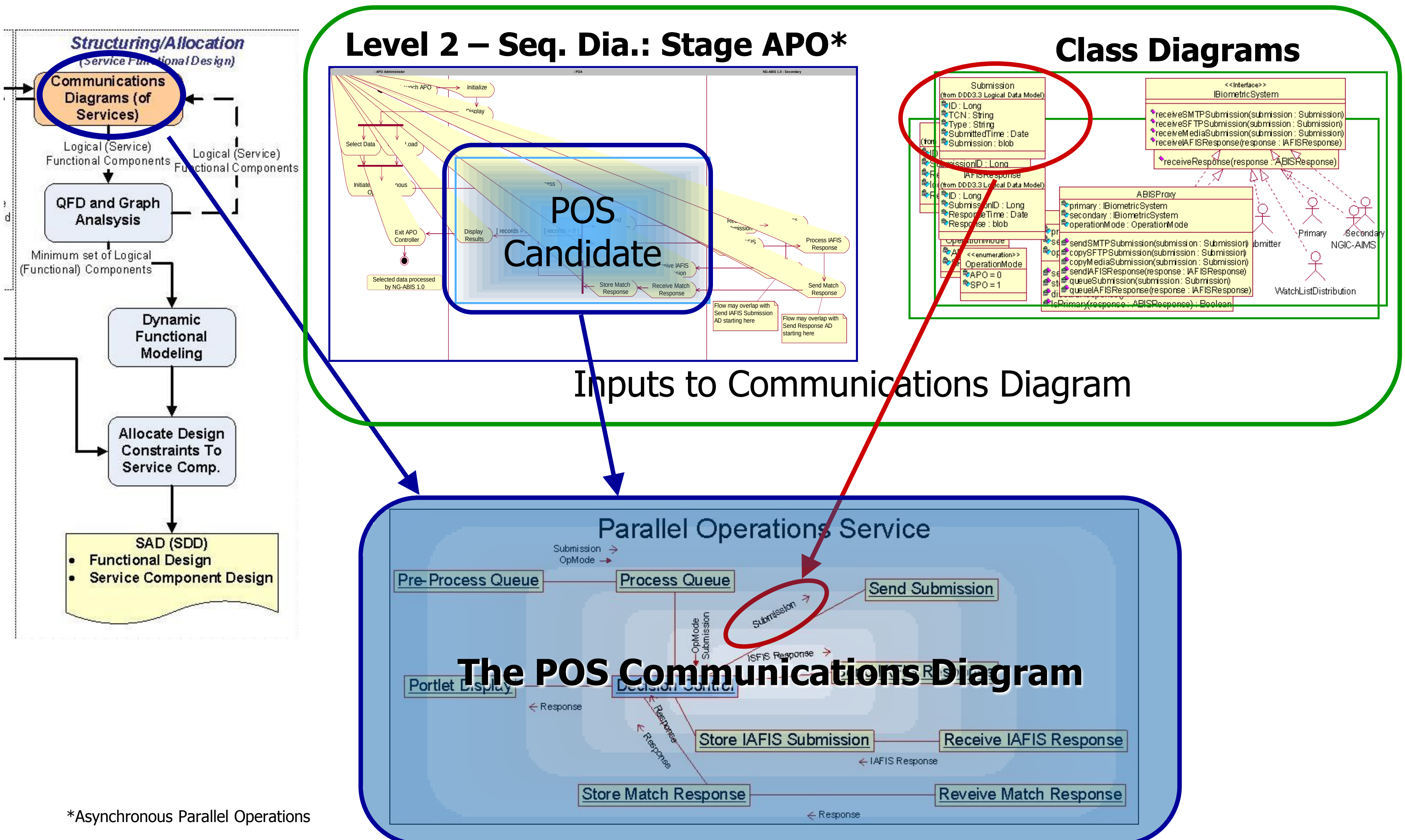


Step 1: Structure Classes with Communications Diagrams

Objective: Determine tightly and loosely coupled classes (and functions)

- Step 1.1 Create Communications Diagram
  - Initiate by Duplicating IT portions of Activity Diagrams as Communication Diagrams
  - Two Top-level Classes:
    - Service
    - Process Flow

Structuring and Allocation: Step 1

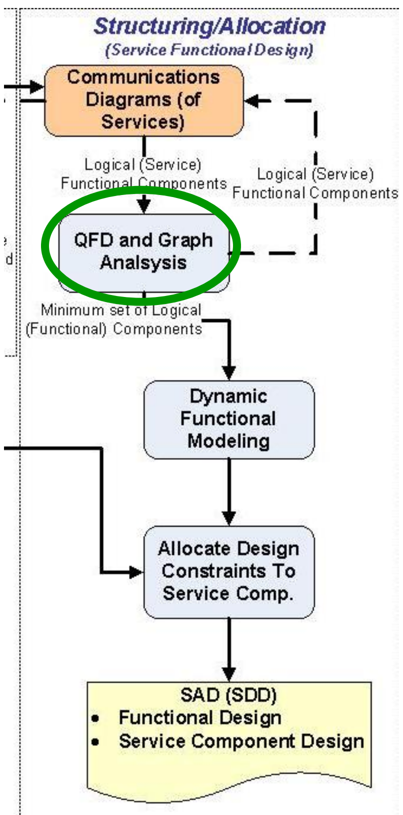


*Asynchronous Parallel Operations

Structuring and Allocation: Step 2

Objective: To Structure and group IT functions into Services to:

- Minimize the number of redundant functions
- Optimize the grouping of IT functions for allocation
- And to Allocate the grouped functions to actual service components

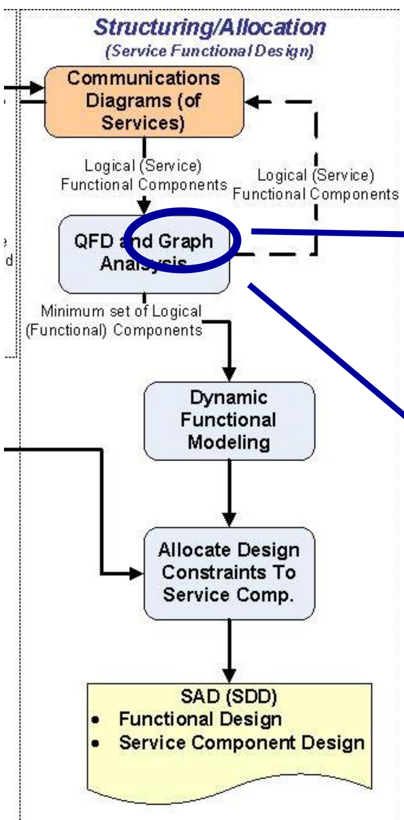


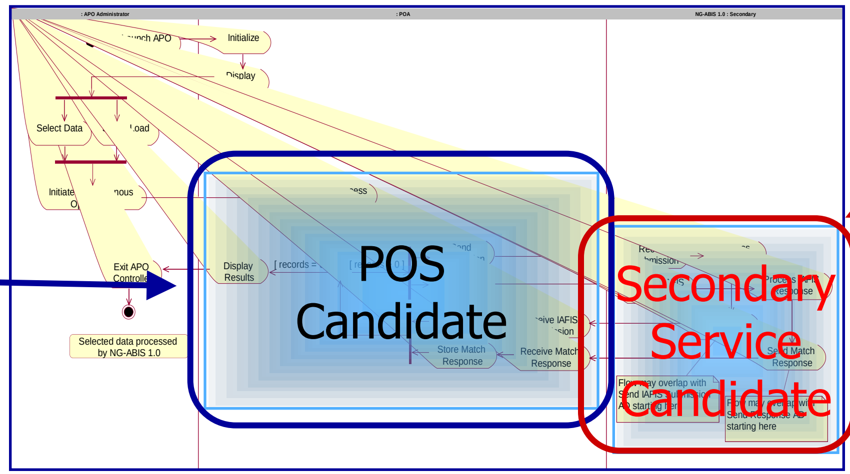
Step 2: QFD and Graph Analysis

Objective: Determine the minimum number of Logical Service Components Required

- Step 2.1 Graph Analysis—Analysis of Communications Diagrams
- Analysis Principles Include:
  - Noting where one class communicates only with one other class or a small group of classes
  - Noting where there is one or two links between groups of classes
- Step 2.2 Quality Functional Deployment Analysis

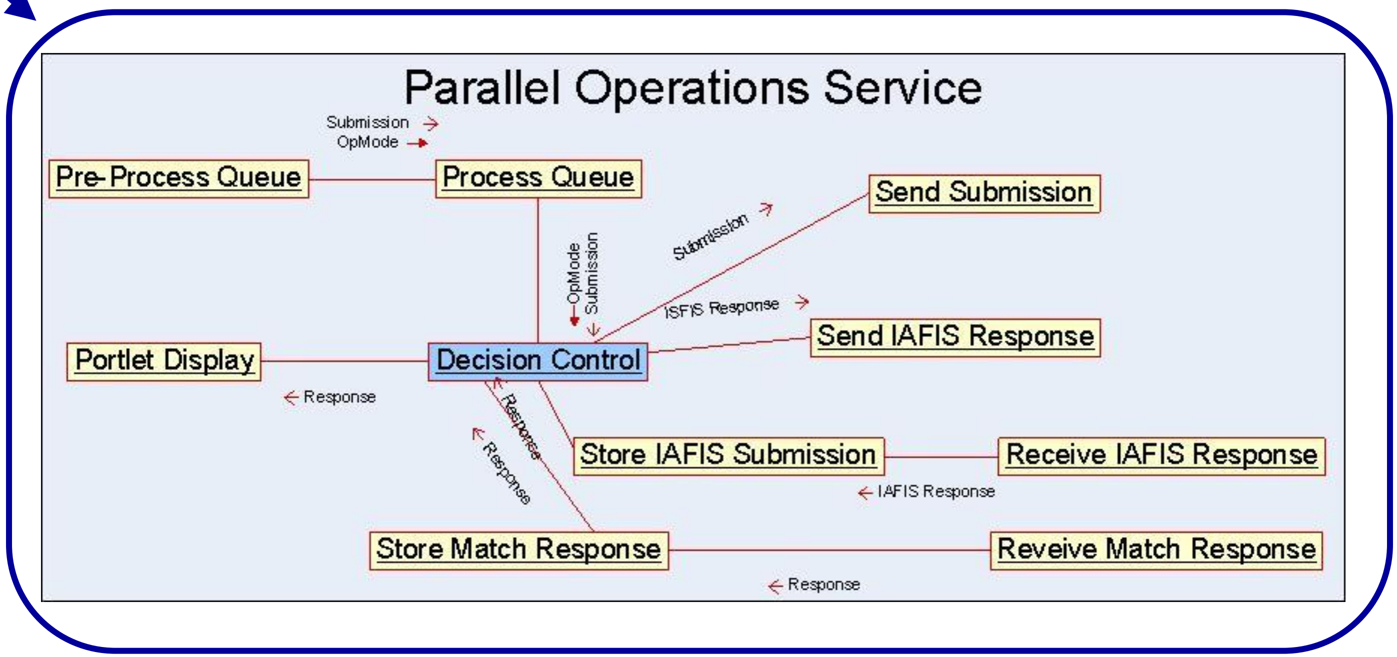
Structuring and Allocation: Graph Analysis





Service Candidates are identified by base grouping or clustering of functions and communications interfaces

Interface used here



Structuring and Allocation: QFD Analysis

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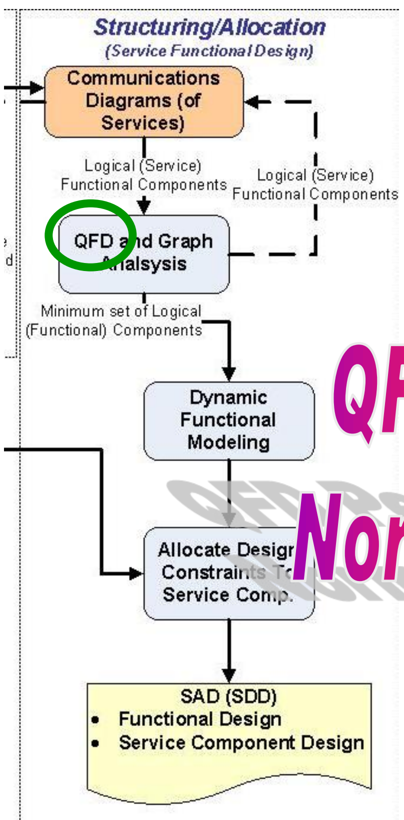


Quality Functional Deployment analysis is common sense with a template

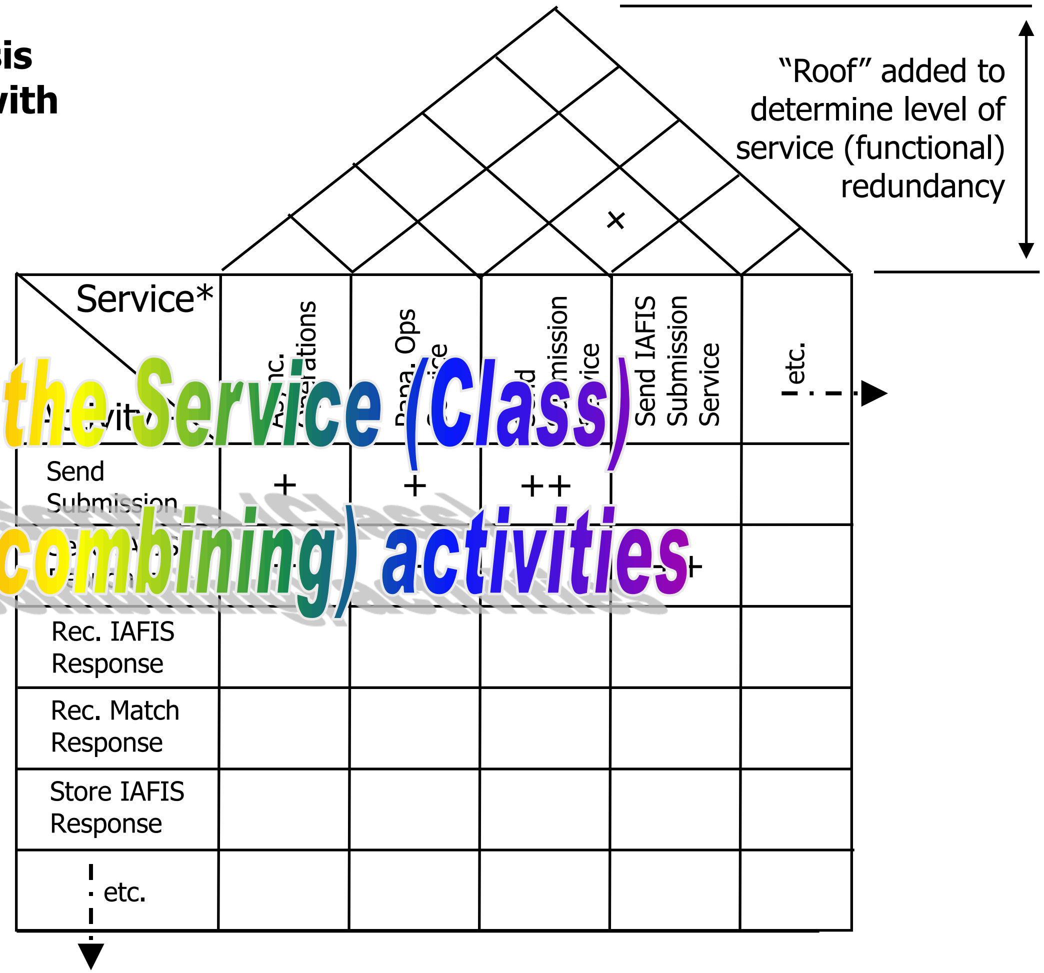
Note: QFD analysis is generally used to determine + or – correlations between two phenomena, but used here to determine:

[illegible] associated services

- Where services are highly correlated leading to redundant services

QFD Performs the Service (Class) Normalization (combining) activities

"The House of Quality"



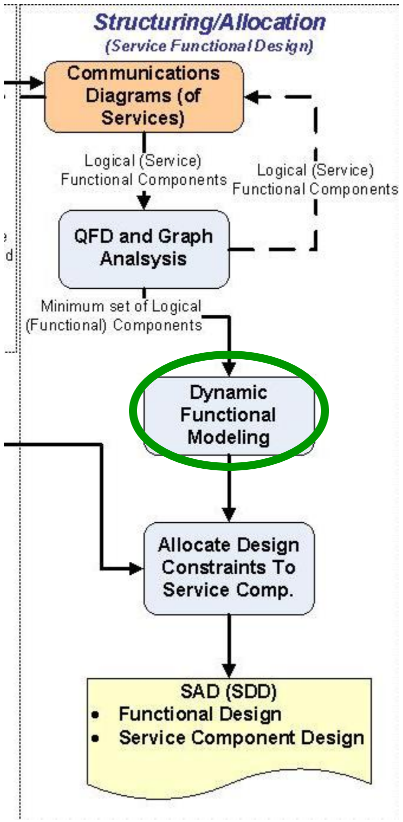
+Activity from Activity Diagram
*Service from Communications Diagram

+ = some correlation
++ = high correlation

Structuring and Allocation: Step 3

Objective: To Structure and group IT functions into Services to:

- Minimize the number of redundant functions
- Optimize the grouping of IT functions for allocation
- And to Allocate the grouped functions to actual service components



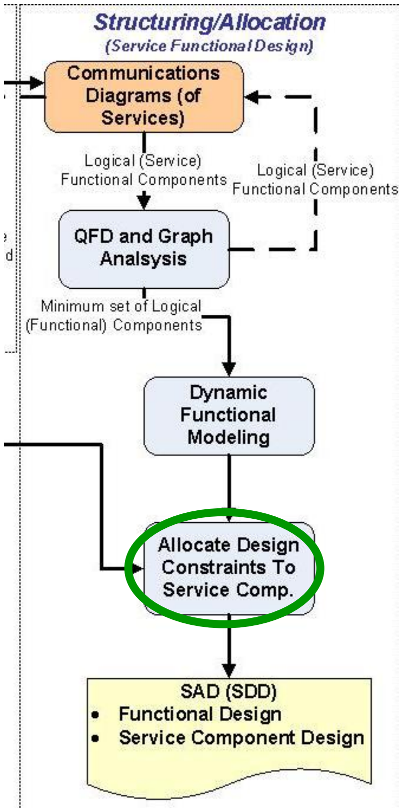
Step 3: Dynamic Service/functional Modeling

Objective: Use simulation to verify, within a confidence interval, that the functional model will meet the customer's system requirements

- Currently, the SOA and SA tools suppliers do not support this activity to the degree required by SOA

Structuring and Allocation: Step 4

Objective: To Structure and group IT functions into Services to:
- Minimize the number of redundant functions
- Optimize the grouping of IT functions for allocation
- And to Allocate the grouped functions to actual service components



Step 4: Allocation of Services/Functions to Actual Components

Objective: Allocate the services/functions to components using a make/buy/use tradeoff study procedure

- Step 4.1: Assign Design Constraints to Proposed Components
- Step 4.2: Perform Tradeoff Study
  - Make—the team develops the service component
  - Buy—the service component is purchased from a software supplier
  - Use—the team discovers and uses a service component in the SOA Ecosystem (across the Internet

Results to Date

- The team has completed the Systems Requirements Document (SRD) to establish the requirements baseline with the customer. This includes:
  - Identifying the processes and activities (in the form of use cases)
  - Identifying the design constraints
- The team has decomposed the requirements in the SRD into two levels of Activity Diagrams to define the "detailed what" with the customer. This was delivered as the System Design Document
- The team derived the IT functions by translating the detailed Activity Diagrams into Sequence and Class diagrams
- The team then allocated these into the specific components (COTS, existing software, new software, server scripts, hardware, and networks) to create the detailed design. This was integrated into the Detailed Design Document and presented to the customer for a very successful Critical Design Review

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Questions?

Contact Information

- Robert S. Ellinger, Ph.D.
  - robert.ellinger@ngc.com

- Gabriel Hoffman
  - gabriel.hoffman@ngc.com

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