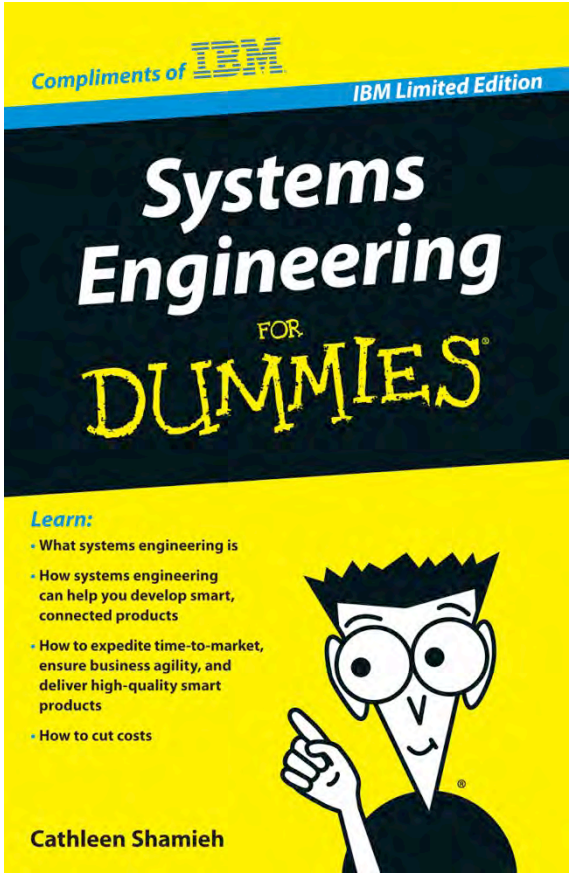
Simply Systems Engineering

We even made the PowerPoint® presentation simple…

Seriously Systems Engineering

- INCOSE Systems Engineering Handbook v. 3.2.2, 376 pp.
- Carnegie Mellon University Software Engineering Institute CMMI for Development v. 1.3, 482 pp.
- USDOT Systems Engineering Guidebook for ITS v. 3.0, 323 pp.
- IBM Limited Edition Systems Engineering for Dummies, 76 pp.



What is Systems Engineering?

Systems Engineering is an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem:

- Operations
- Cost & Schedule
- Performance
- Training & Support
- Test
- Disposal
- Manufacturing

Systems Engineering integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation. Systems Engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs.

http://www.incose.org/practice/whatissystemseng.aspx

What is Systems Engineering?

Systems Engineering is an interdisciplinary approach and means to enable the realization of **successful systems**. It focuses on defining **customer needs** and **required functionality early** in the development cycle**, documenting requirements**, then proceeding with **design** synthesis and system **validation** while considering the **complete problem**:

- Operations
- Cost & Schedule
- Performance
- Training & Support
- Test
- Disposal
- Manufacturing

Systems Engineering **integrates** all the **disciplines** and specialty groups into a **team effort** forming a **structured development process** that proceeds from concept to production to operation. Systems Engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs.

What is Systems Engineering?

- Goal is **successful systems**
- Define **customer needs** and **required functionality early**
- **Documenting requirements**
- **Design** and **validation** in light of the **complete problem**
- **Integrates disciplines** in a **team effort**
- **Structured development process**

What is Systems Engineering?

For **successful** systems:

- **Write it down**
- **Begin with the end in mind**
- **Consider various viewpoints**
- **Build** and **test** to **defined outcomes**
- Use a **structured development process**

A Simple Plan

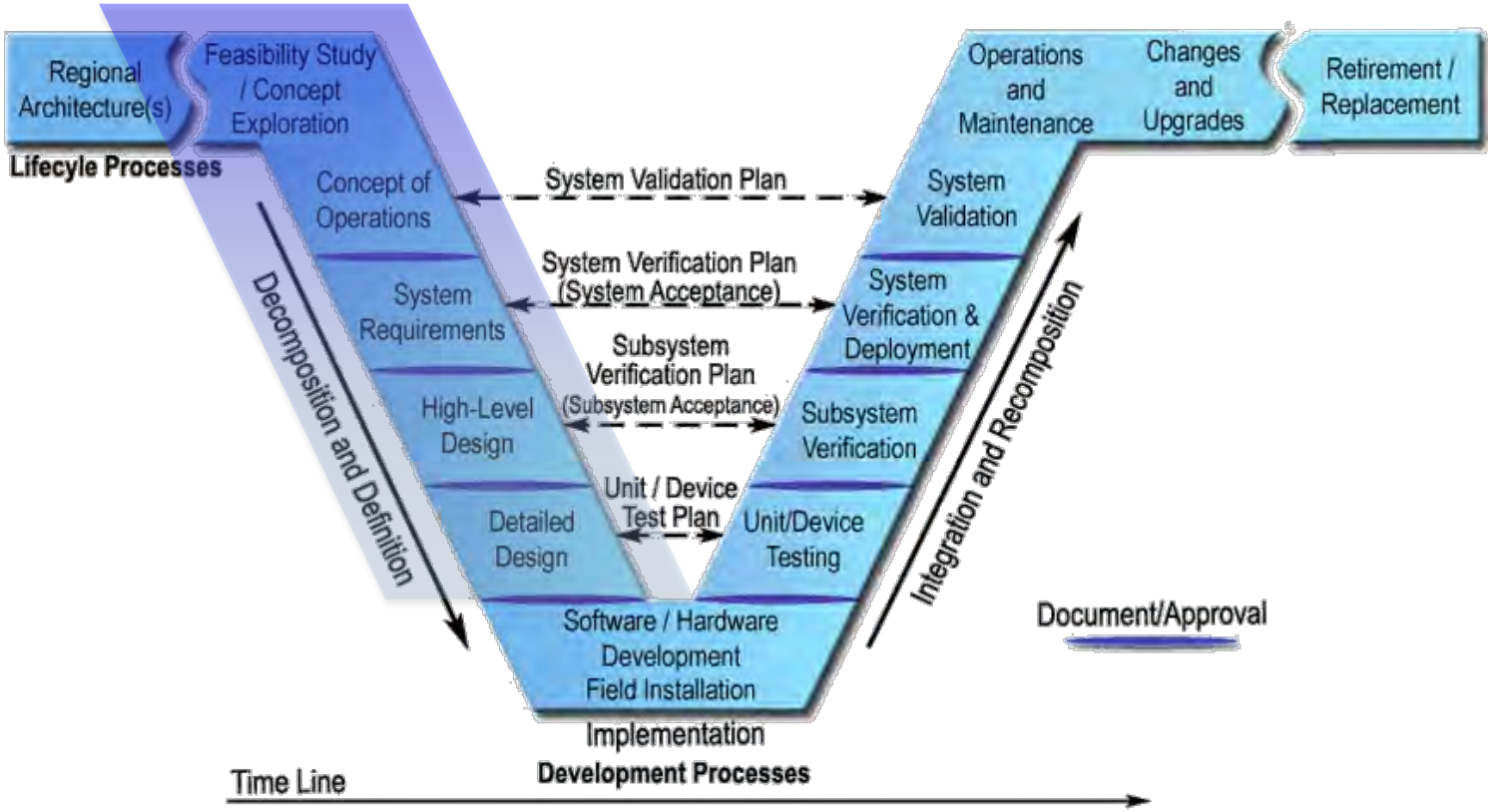
For successful systems:

1. Write it down
2. Begin with the end in mind
3. Consider various viewpoints
4. Build and test to defined outcomes
5. Use a structured development process

1. Write It Down

- Keeps a record in time
- Builds consensus
- Provides a measuring stick
- Identifies variances
- Provides a verification standard
- Provides a validation standard

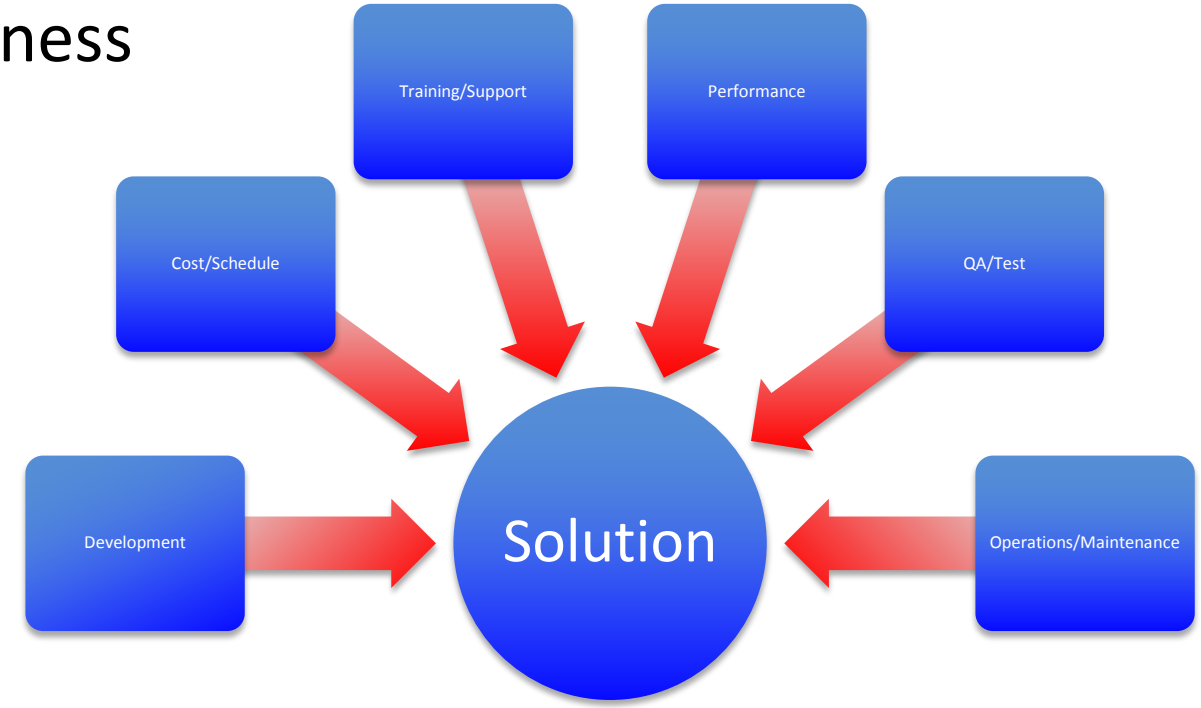
2. Begin With The End In Mind



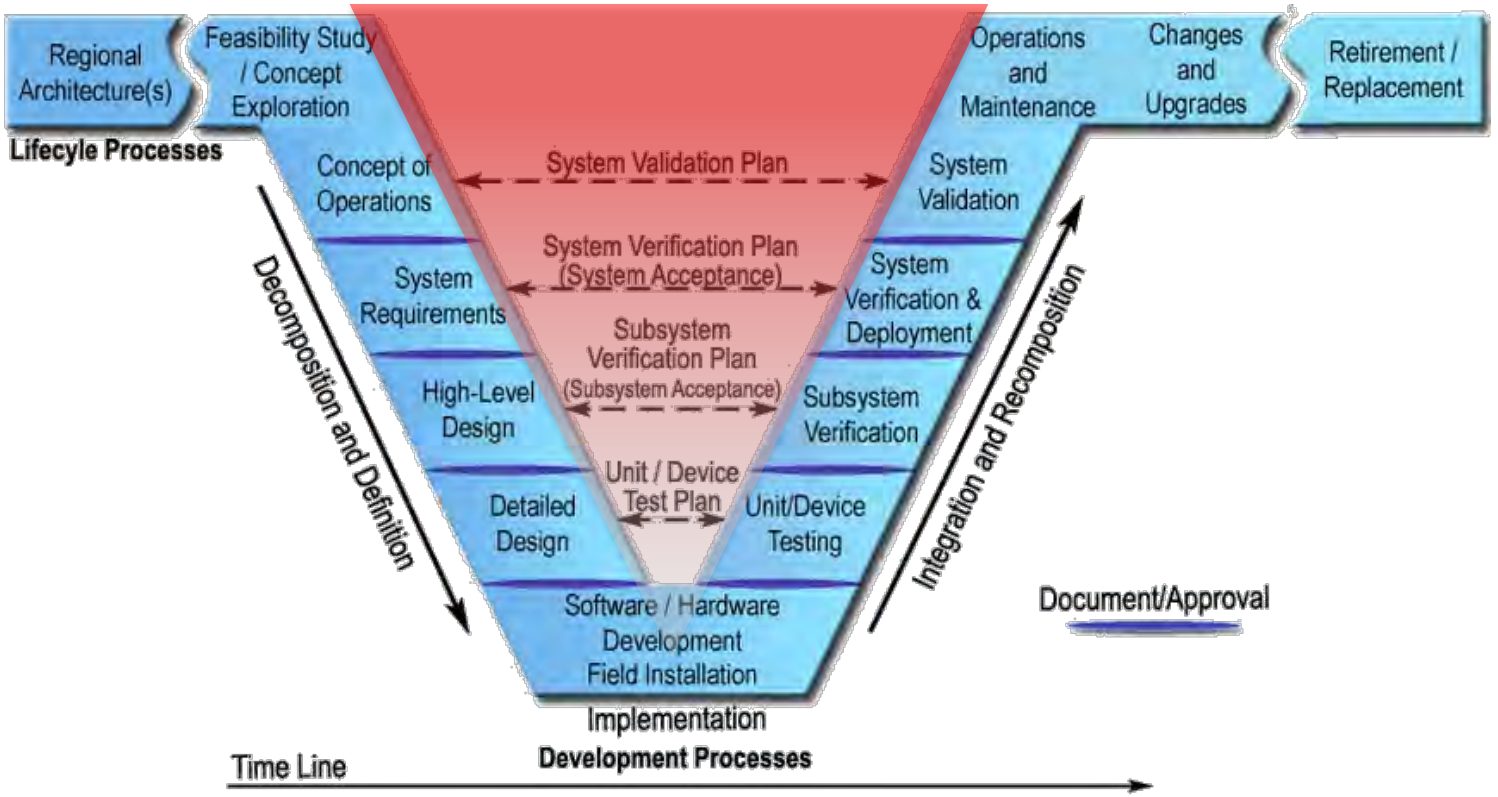
http://ops.fhwa.dot.gov/publications/seitsguide/section3.htm

3. Consider Various Viewpoints

- Subjects the design to different perspectives
- Provides integration of disciplines
- Avoids disappointments
- Increases robustness of solution
- Guaranteed to cause “good” compromise



4. Build and Test to Defined Outcomes



http://ops.fhwa.dot.gov/publications/seitsguide/section3.htm

5. Use a Structured Development Process

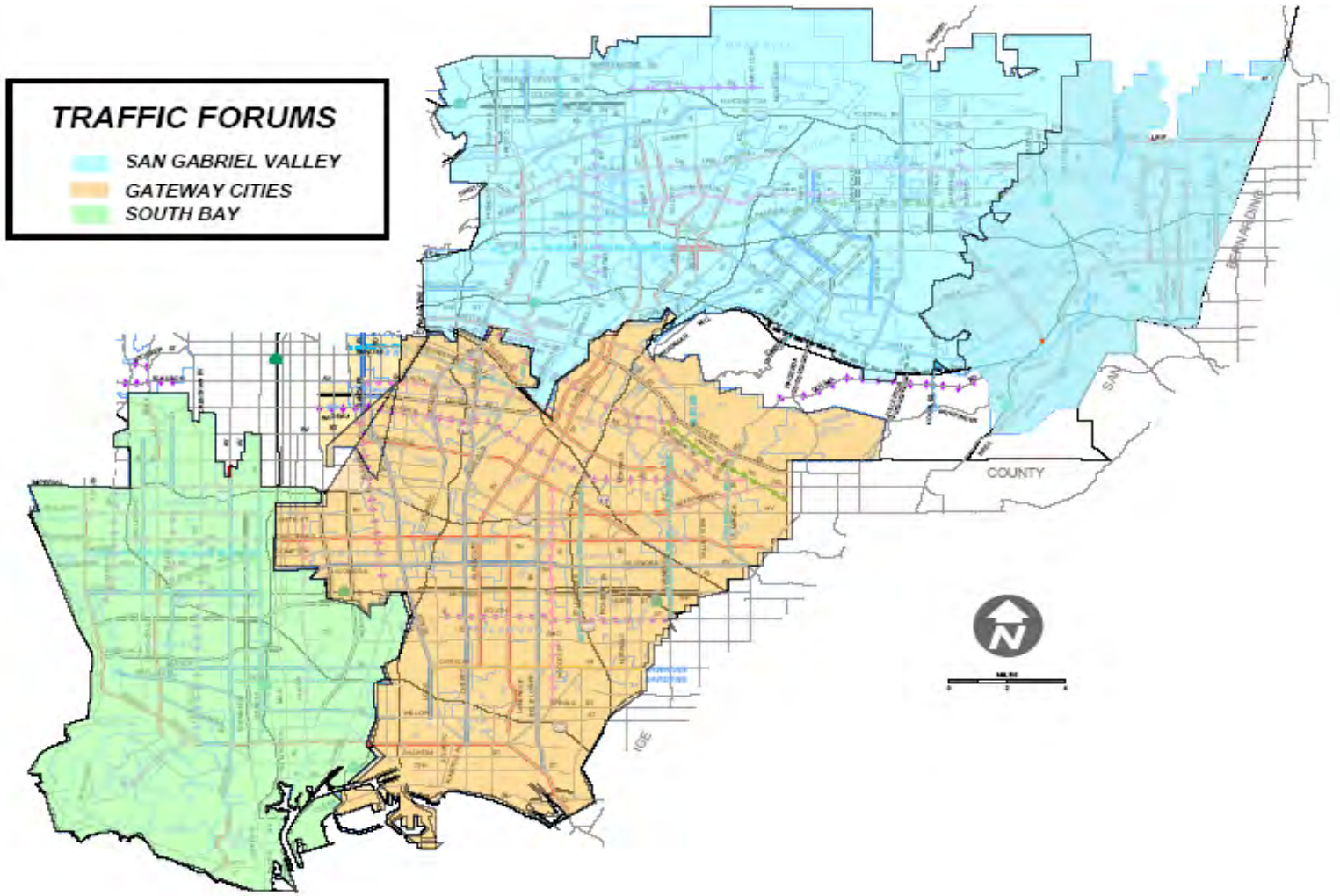
- Somewhat more advanced
- May be internal to development group
- Select development group based on qualifications
- Ask what standards and processes they use
- Structure and order are imperative in areas like
  - Design documentation
  - Configuration management
  - Requirements traceability
  - Issue tracking

http://qatestlab.com/

Los Angeles County Information Exchange Network

- Primary component of the Regional Traffic Forum Program
- Focused in three sub-regional, geographic areas called Forums.
  - Gateway Cities – 14 Agencies
  - San Gabriel Valley – 21 Agencies
  - South Bay – 16 Agencies

Los Angeles County Information Exchange Network



Regional Traffic Forum Program

- Over $250 million in MTA Call for Projects grant funds to date
- Traffic Signal Synchronization
  - Signal upgrades, detection to enable full traffic actuation, time of day coordination
- Intelligent Transportation Systems
  - Traffic Control System (TCS)
  - Closed Circuit Television Cameras (CCTV)
  - Communications System
- **Information Exchange Network (IEN)**

Regional Traffic Forum Program

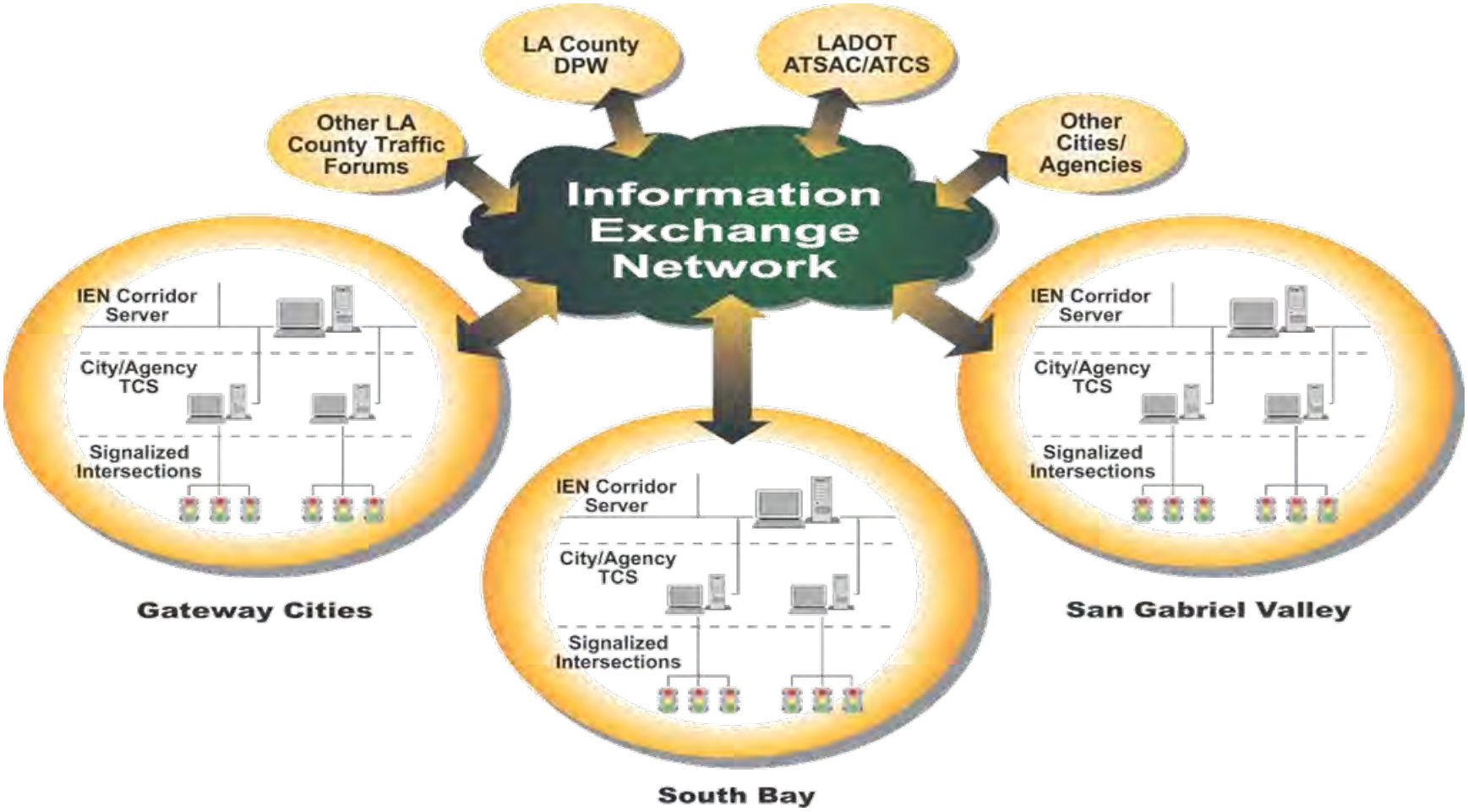
- We provided funding to 17 Cities to purchase and/or upgrade their TCS
- Each City selected their traffic control system:
  - Quicnet (existing)
  - Centracs
  - TransSuite
  - KITS
  - ATCS
  - Intelight

Regional Traffic Forum Program Integration Solution

- Information Exchange Network (IEN)
  - Enables each local Agency to operate & maintain its own traffic control system (TCS) independently
  - Provides for data exchange among Agencies to enhance coordination
  - Ability to monitor traffic signal operations & congestion in adjacent jurisdictions

Operational since Feb '02

Information Exchange Network



Information Exchange Network

- Define customer needs and required functionality early

Phase II – Countywide Signal Synchronization, Operation and Maintenance Program Final report stated:

"The overall goal of the Pilot Project is to provide an infrastructure on the arterials which will assist in supporting the integrated management of the freeways and arterials".

Information Exchange Network

- Documenting requirements
- Design and validation in light of the complete problem
- Integrates disciplines in a team effort

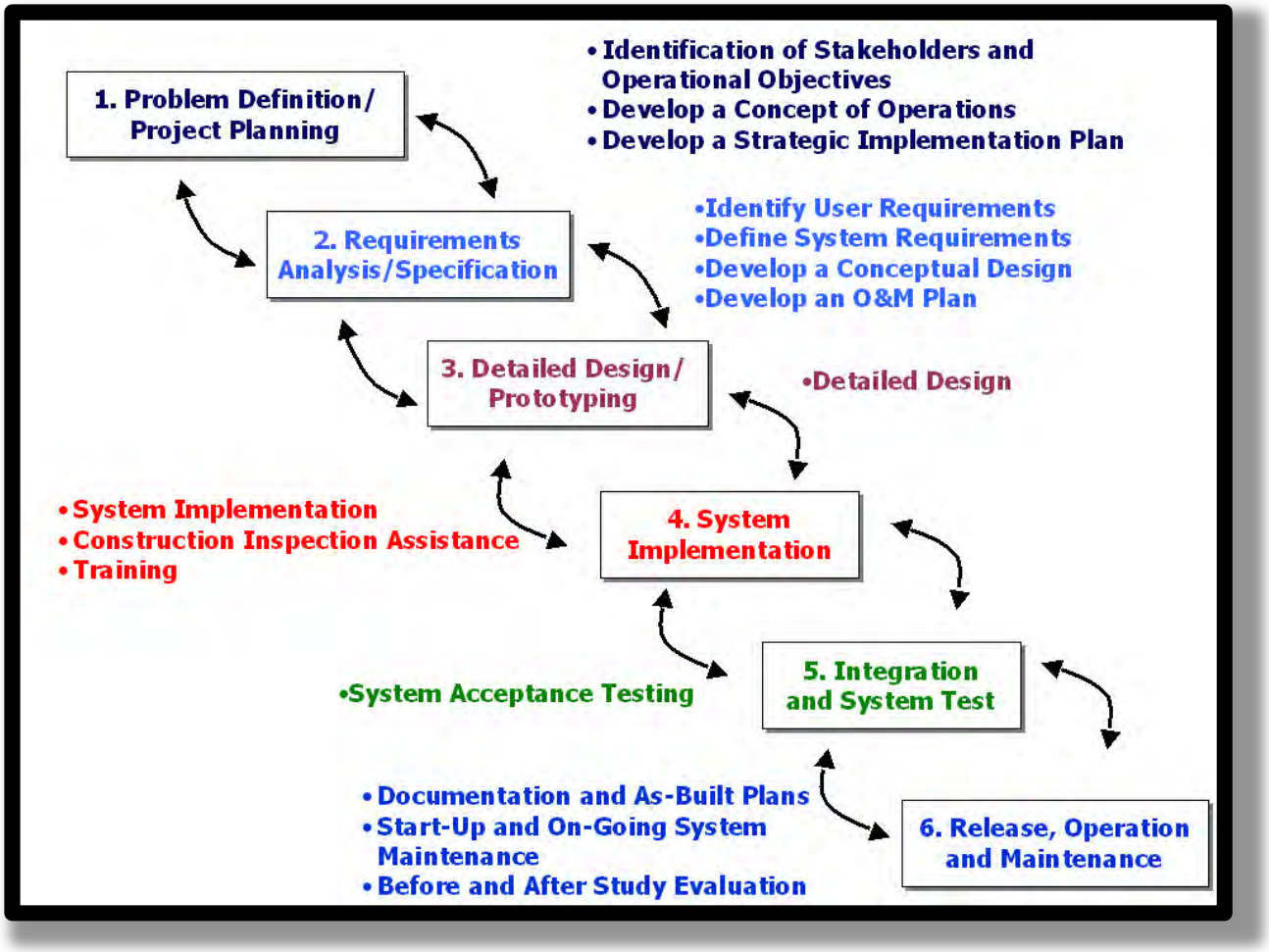
Concept Design for Limited Geographic Area included:

- Pre-Design meeting (Stakeholder interviews)
- Requirements
- Alternative Analysis
- Concept Design
- End result – split the project – deploy off the shelf traffic control system and a separate inter-jurisdictional system, the Information Exchange Network

Phase I - IEN Pilot Project

- Limited Geographic Area
- Baseline Requirements
- System Design
  - Project Architecture
- Performance Requirements
  - Intersection data (summary status) real-time second-by-second within a corridor
  - Sizing for a single corridor
    - 2000 intersections, 2000 detectors per corridor
    - 9 Traffic Control Systems, 18 operator workstations per corridor
    - 50 Intersection detail – (Bandwidth limited Design)
- Operational February 2002

Phase I – IEN Pilot Project



Phase II – Countywide IEN

- Countywide Capabilities, Multiple Corridors
- First step – Requirements Walk-through
- Results – Software builds 1-3
  1. Increase the capacity of the Countywide IEN
  2. Make the distribution of data between Agencies more efficient
  3. Add several new features to improve inter-Agency signal coordination
- ATP completed 2009

Phase III – IEN Enhancements

For a successful Phase III IEN system:

- Write it down
  - Requirements Walk-through, Round 2
- Begin with the end in mind
  - Preliminary scoping underway
    - Thin client, Web based, CMS and Bluetooth data support
    - Standards based XML Outbound interface
- Consider various viewpoints
- Build and test to defined outcomes
- Use a structured development process

IEN Summary

- At least SOME elements of systems engineering are worthwhile for ANY technology application
- Concept of operations is key, BUT must be realistic, i.e. how are you going to do it tomorrow, not in the far distant future
- We found a walkthrough of the prior phase requirements to be extremely useful in developing and refining requirements for the next phase enhancements.
- Good systems engineering is flexible enough to take advantage of new opportunities, i.e. be responsive to changing conditions.

Summary

- First step in good systems engineering is to start
- Good SE does not require a graduate degree or a defense contractor
- Cannot have good SE without documentation
- Good SE and good PM have much in common
- Loads of resources are available to help you get in the game
- Some SE is better than no SE, every time

Contact info

Jane White

LA County DPW

jwhite@dpw.lacounty.gov

(626) 300-2020

Doug Terry, P.E.

Aegis ITS, Inc.

dterry@aegisits.com

(714) 575-5701