S.E. Regulations for ITS ("Rule 940") – Expectations & Reality

Prepared for:

INCOSE TWG

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Presentation Topics:

1. **Evolution of Technology in Transportation**
2. **Emergence of S.E. Regulations**
3. **California Development of S.E. for ITS**
4. **Experiences with S.E. in Calif.**
   a) **Challenges**
   b) **Benefits**
   c) **Lessons learned**
5. **Conclusions**

Transportation Technology is >100 years old!

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Huge Boost ~1992: "IVHS" Brand and Organization

STRATEGIC PLAN FOR

Intelligent Vehicle-Highway Systems

in the United States

Report No: IVHS-AMER-92-3
Prepared by IVHS AMERICA
May 20, 1992

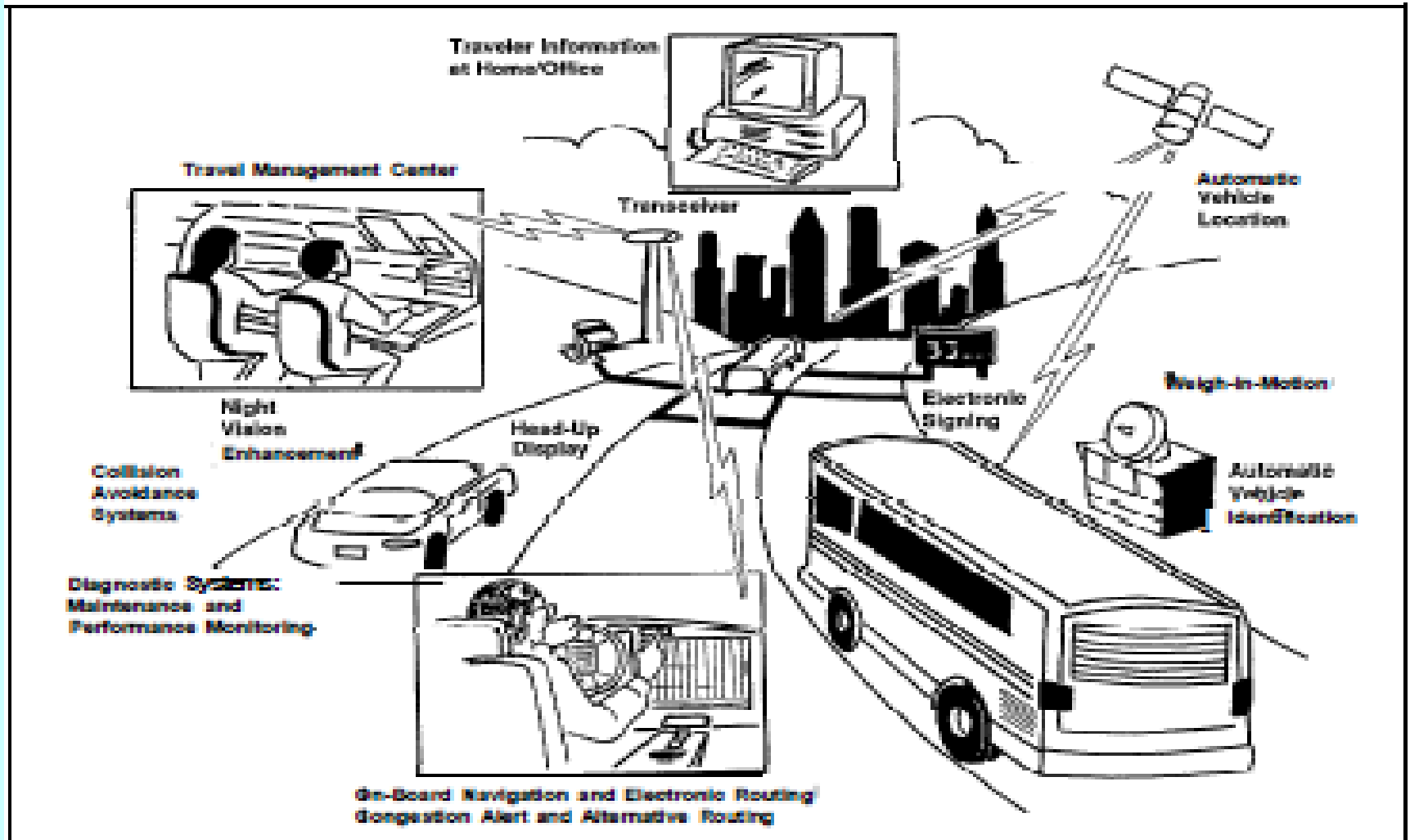**($$ followed)**
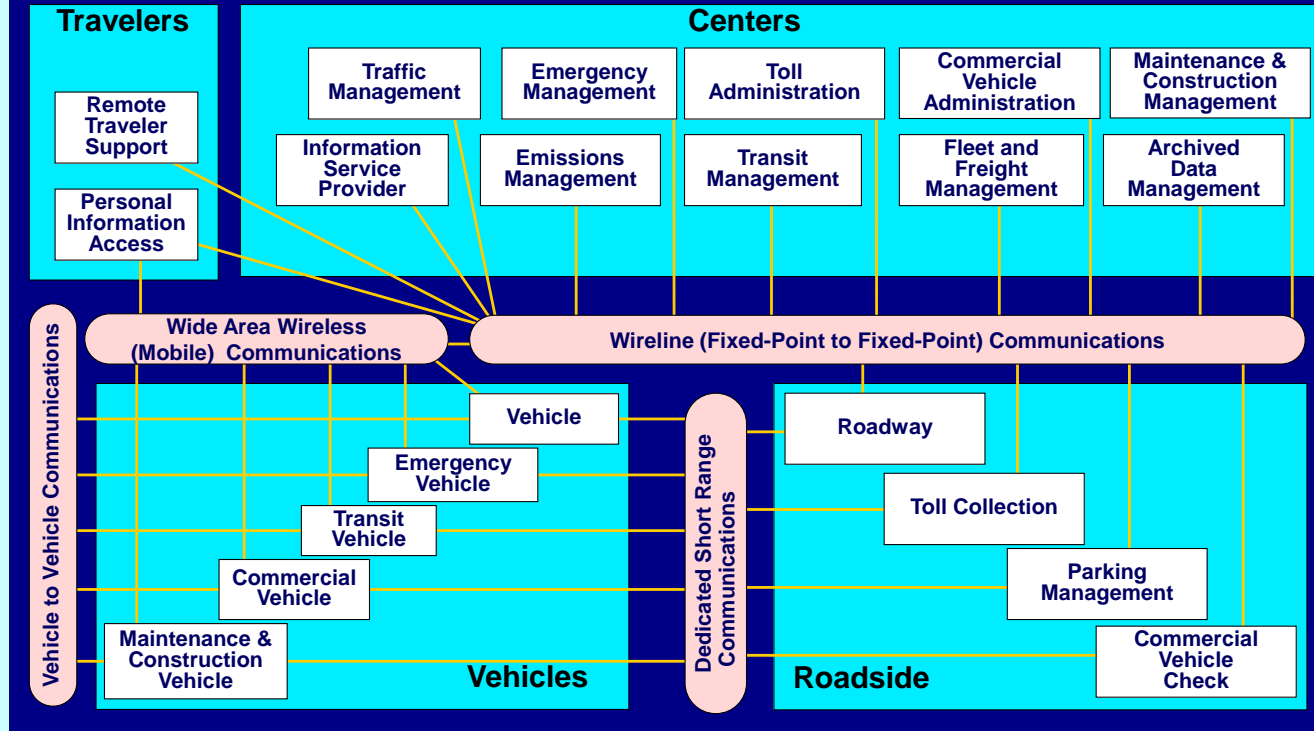
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The original IVHS Vision…

Figure 11-1. Some components of an Intelligent Vehicle-Highway System (Adapted from U.S. Department of Transportation National Transportation Strategic Planning Study, March 1990).

5

Mid-1990s:

National ITS Architecture

- **Created by USDOT**
- **Goal: Define a standard, national, interoperable, ITS structure**
- **Guideline for future transportation systems**
- **Built upon S.E. concepts & terminology**

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Late 1990's – ITS Arch. & SE "Rule"

- **Codified in: 23 CFR 940**
- **Defined ITS and ITS Projects (940.3)**
- **Required:**
  - **Regional ITS Architectures in all Urban Areas (940.9)**
  - **"Systems Engr. Analysis" for all ITS projects (940.11)**
- **Defined ITS Architecture & S.E. concepts and terminology; still widely used today.**
- **(Drew heavily on aerospace & I.T. concepts, terminology, and people.)**
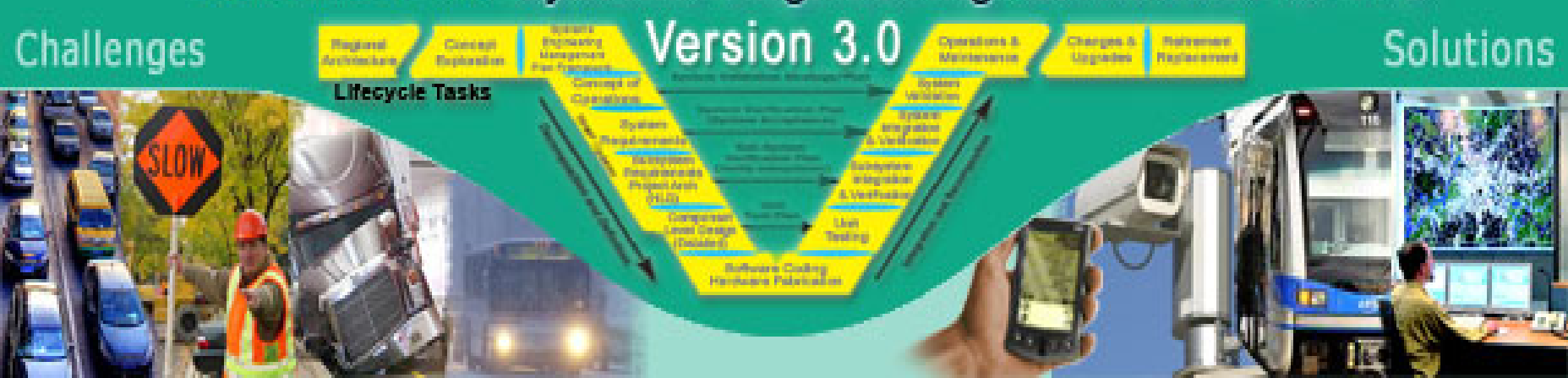
23 CFR 940.11 says …

"All ITS projects … shall be based upon a Systems Engineering Analysis…" SEA shall include:

1. **Regional ITS Architecture elements**
2. **Roles & Responsibilities**
3. **O&M Resources & Procedures**
4. **Requirements Definition**
5. **ITS Standards & Testing Procedures**
6. **Alternatives Analysis**
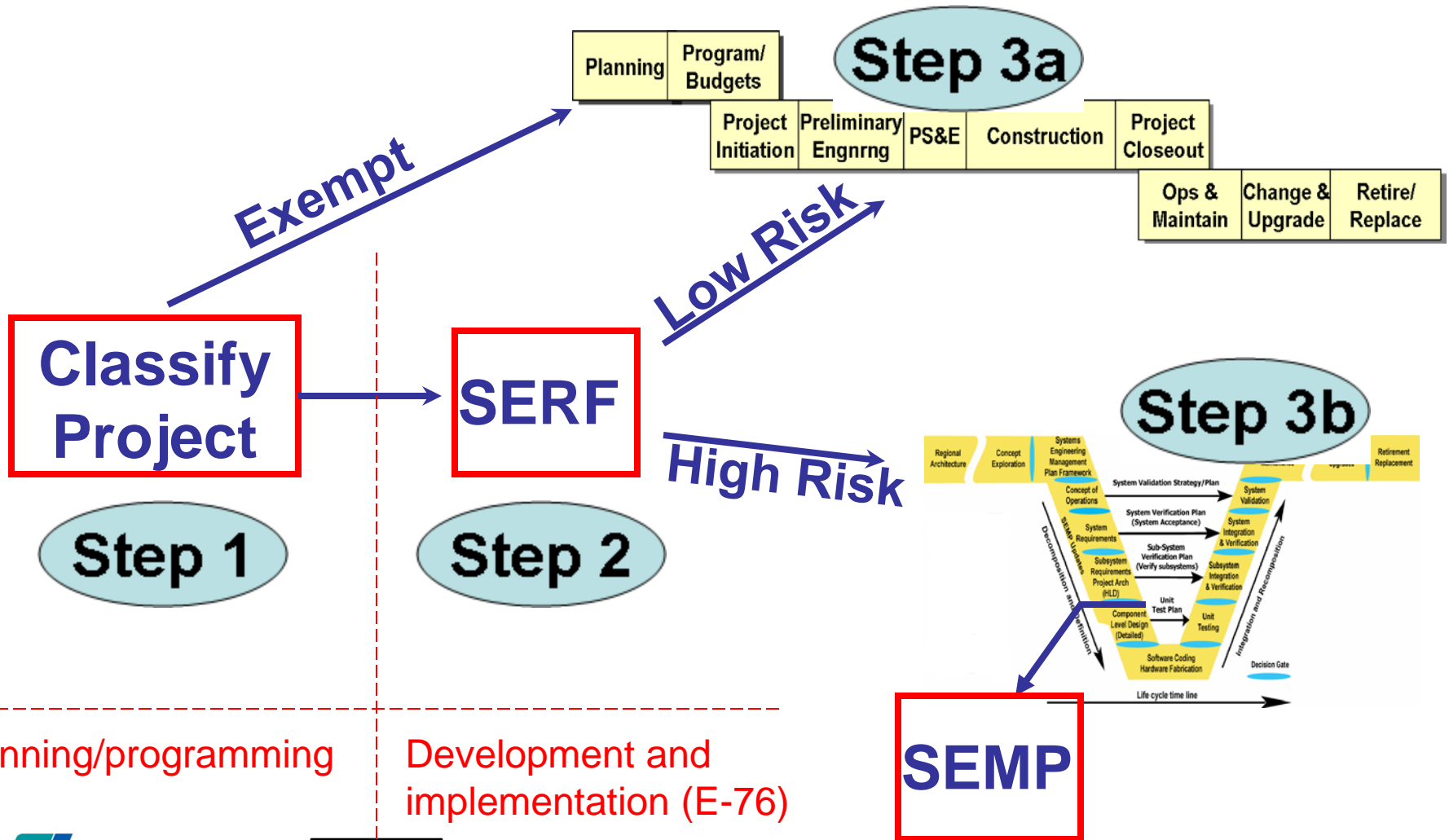7. **Procurement Options**

Early 2000's – FHWA-CA + Caltrans Defined S.E. for ITS Projects

- **Early emphasis on "High-Risk" ITS projects**
- **Published funding-approval procedures (LAPG)**
- **Defined a 3-step process (see next)**
- **Conducted extensive training statewide**
- **Developed "S.E. Guidebook for ITS" (www.fhwa.dot.gov/cadiv/segb/)**

3 Steps to 940.11 Compliance

Step 3a

Planning	Program/ Budgets
Project Initiation	Preliminary Engnrng	PS&E	Construction	Project Closeout
Ops & Maintain	Change & Upgrade	Retire/ Replace

Exempt

Low Risk

High Risk

Classify Project

SERF

Step 3b

Step 1

Step 2

Planning/programming

Development and implementation (E-76)

SEMP

TOC

SERF Includes
7 Risk-Assessment Questions:

Will the project…

1. ... require **only your agency** to implement/operate?

2. … use only **proven software** (no new software)?

3. … use only **proven hardware** and communications?

4. … use only **existing interfaces** (no new interfaces)?

5. … use existing, **written system requirements**?

6. … use existing, **written operating procedures**?

7. … use only technology with **service life >2-4 years**?
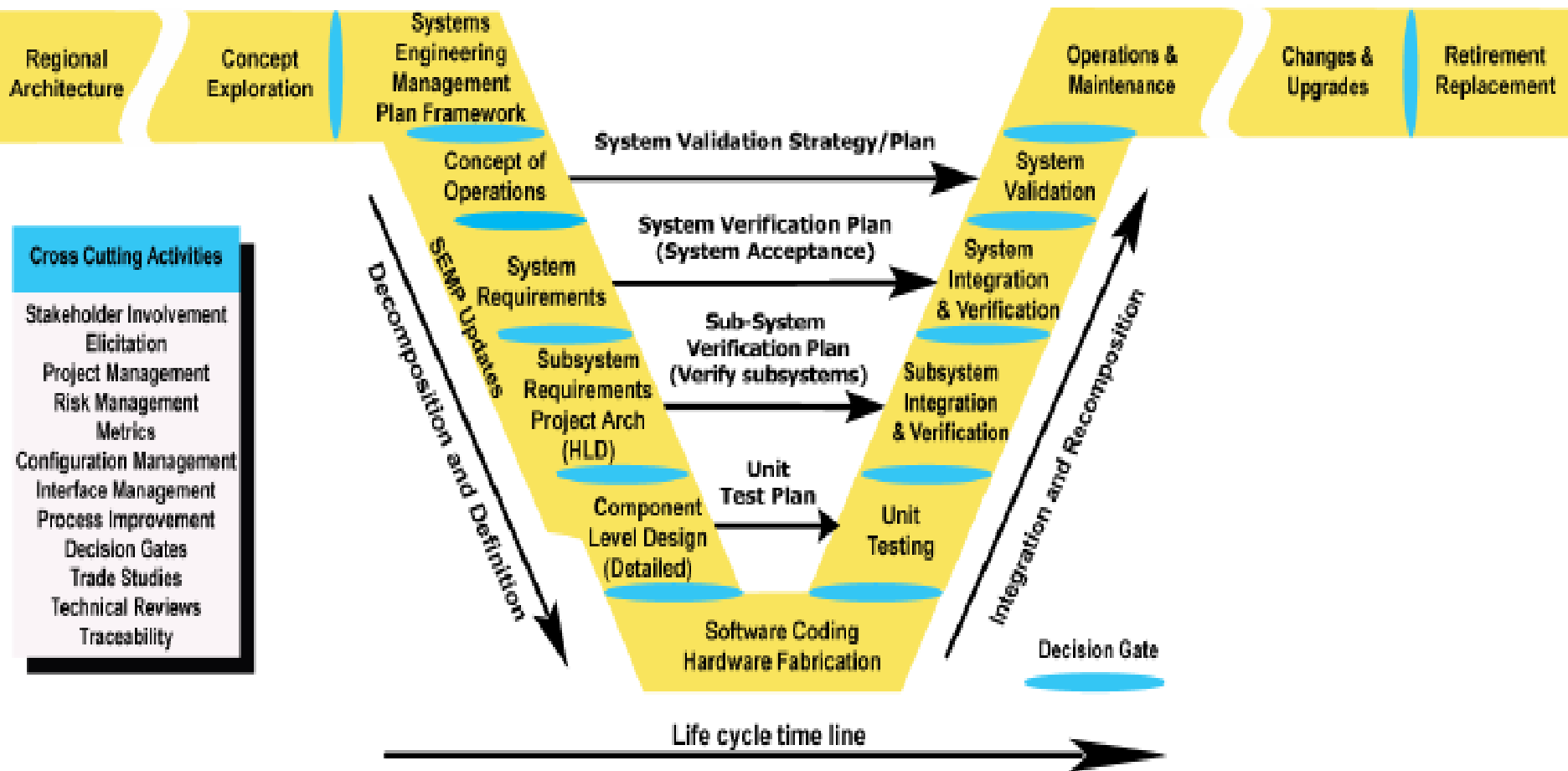
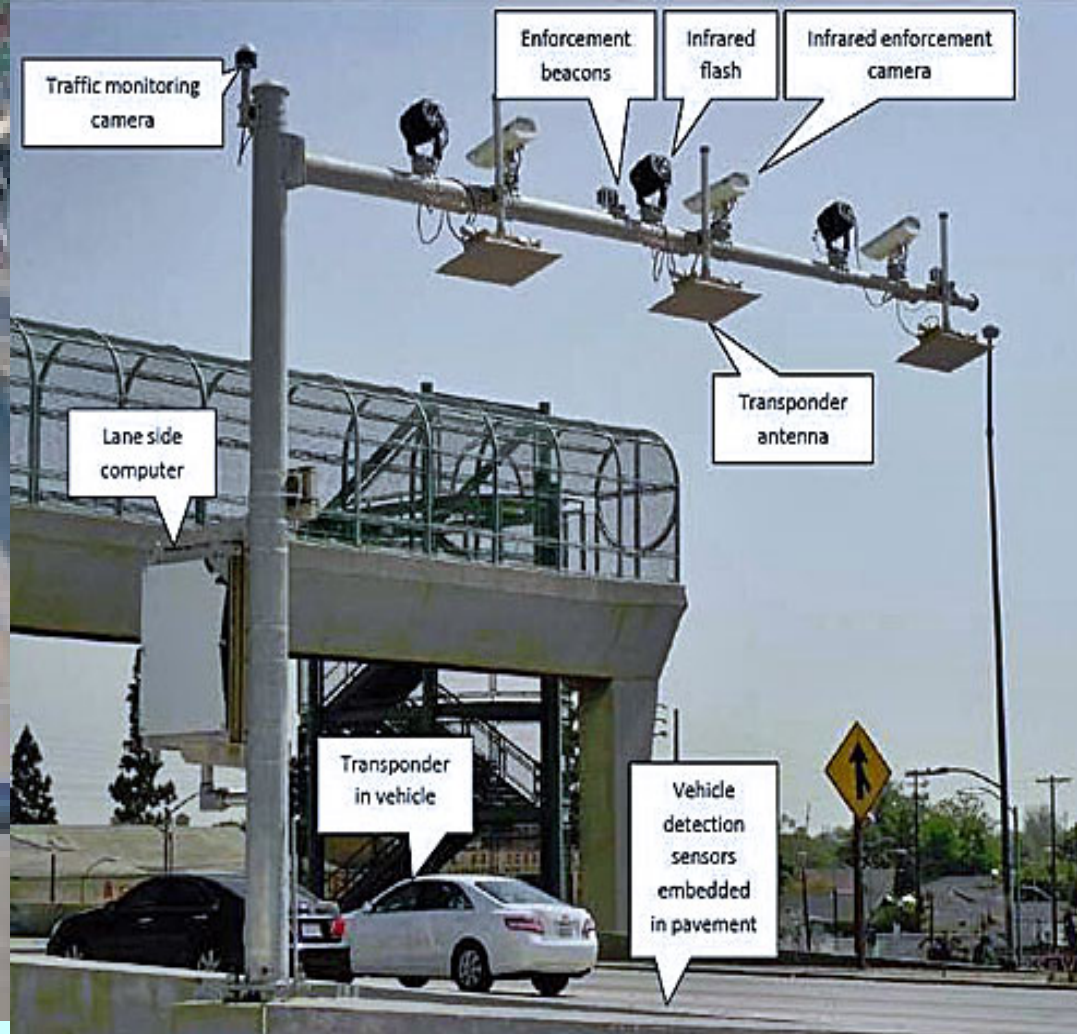# High-Risk Projects Must use S.E. Process

Figure 1-2 ITS Project Life cycle Phases and the Life cycle Tasks in this Guidebook

Examples of S.E. in Calif. ITS Projects

- **ExpressLanes (I-10, I-110, I-680, etc.)**
- **Parking Pricing/Info System (L.A. ExpressPark)**
- **Traffic Management Systems**
- **Truck scheduling at Ports ("FRATIS")**
- **I-15-SD Integrated Corridor Management**
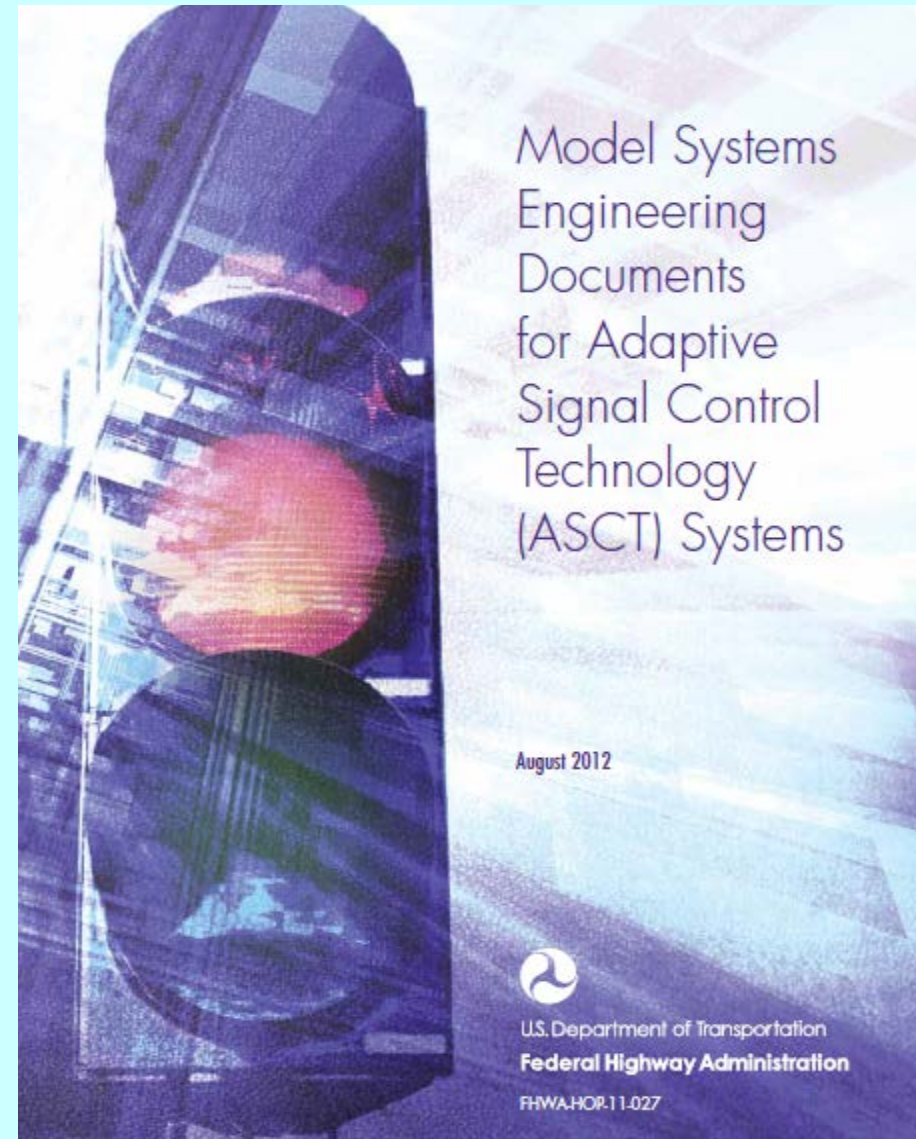
Los Angeles ExpressLanes (I-10, I-110)

Los Angeles ExpressPark

Truck Scheduling at POLA/POLB ("FRATIS")

Traffic Management Systems

Model Systems Engineering Documents for Adaptive Signal Control Technology (ASCT) Systems

August 2012

U.S. Department of Transportation
Federal Highway Administration

FHWA-HOP-11-027

Lessons Learned: Benefits

Better outcomes = schedule, budget & products

- **Standardized terminology & processes**
- **Fewer contract disputes & change orders**
- **Clearer documentation of development process**
- **Efficient oversight by FHWA & Caltrans**

Lessons Learned: Challenges

1. **S.E. difficult to learn: new concepts, terminology (some want "SE Lite")**
2. **Few SE-ITS Training Opportunities (Univ. + OJT)**
3. **Lack of SE skills in public sector → over-reliance on consultants and poor contract management**
4. **Poor document reviews by public agencies**
5. **Inadequate Verification testing.**
6. **Limited FHWA & Caltrans oversight resources**

See handout (ITS-WC Paper) for detailed info.

Observations & Conclusions

1. **S.E. institutionalized in California (also in some other states)**

2. **"V" model is most common; a few projects use "Agile" development.**

3. **S.E. is "Best Professional Practice" for some ITS applications**

4. **FHWA-CA continues to require S.E. for high-risk ITS**

5. **Some folks love S.E.; some hate it.**

References

1. Calif. S.E. Guidebook for ITS:
    www.fhwa.dot.gov/cadiv/segb/

2. Caltrans Local Assistance Program Guidelines (LAPG), Chapter 13 (ITS):
    http://dot.ca.gov/hq/LocalPrograms/ITS/ITS.htm

3. "ITS Challenges and Solutions for Small and Medium Agencies" – See attached file.

Are We There Yet …?

Comments?

Questions?

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