The FAA: Goals, Process Improvement, and Metrics

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Arthur Pyster

Chief Scientist for Software Engineering

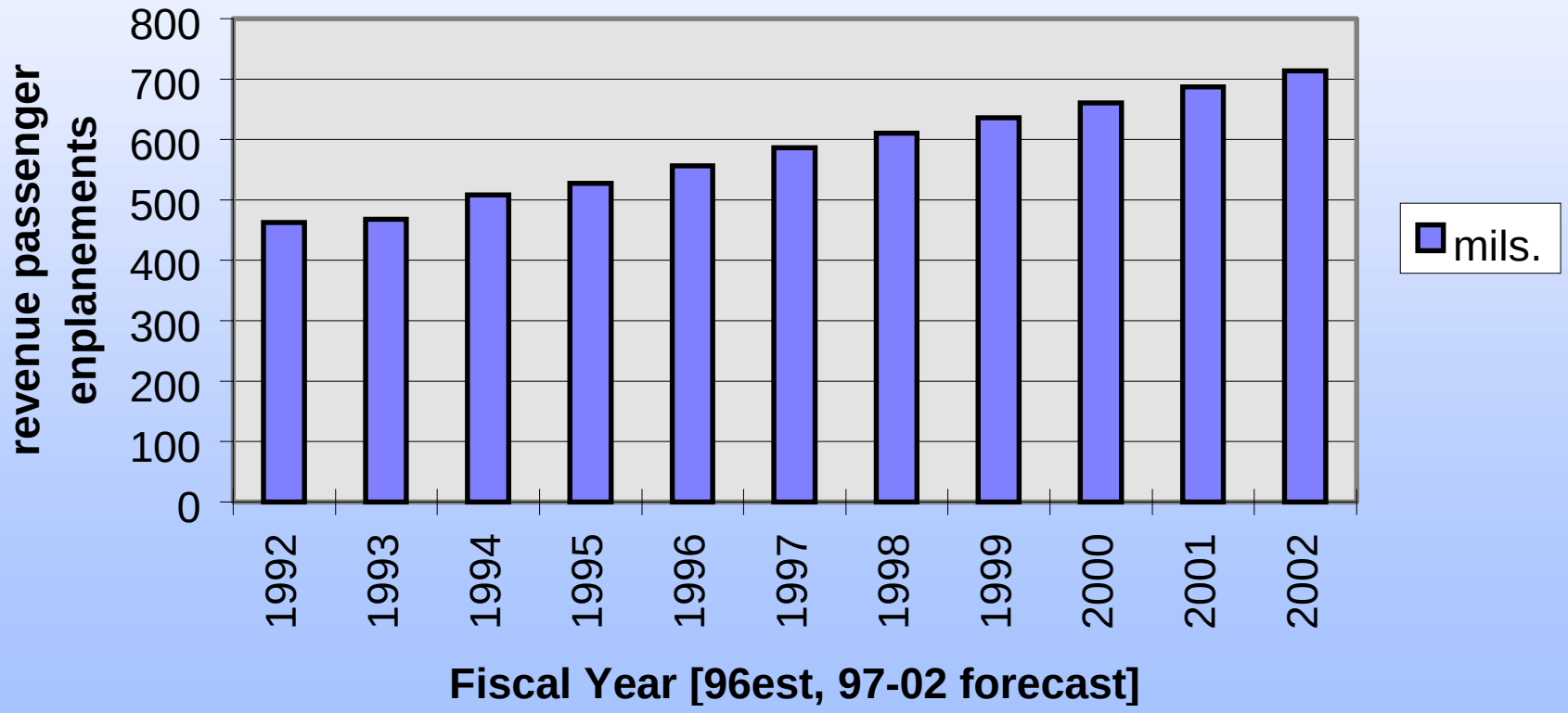
[arthur.pyster@faa.dot.gov]

The Message

- FAA has a daunting but critical job
- FAA must improve its processes to meet its commitments
- Measurement is a key to process improvement

US Domestic Air Passenger Trend

US Commercial Air Carriers & Regionals
Total Scheduled US Passenger Traffic



Impact of Aviation on the Economy

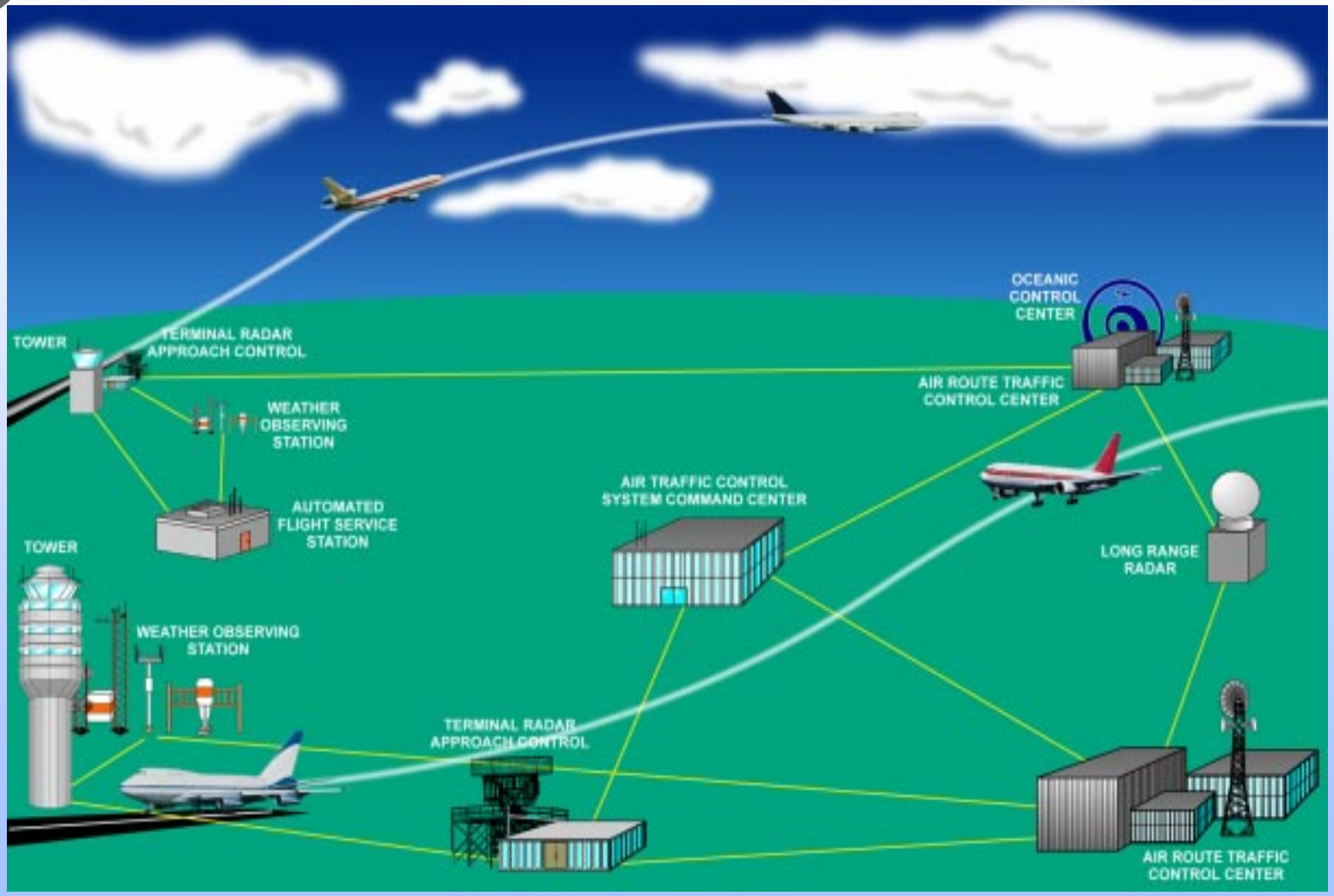
- Aviation has large positive contribution to U.S. balance of trade ($40 billion)
- Aviation and related economic activity in 1993 totaled $771 billion
- Aviation and associated businesses in 1993 employed 8.8 million people
- Aviation and related activities made up 5.9% of GDP

Procedures not recommended for controllers and pilots.

FAA Mission

FAA provides a safe, secure, and efficient national airspace system.

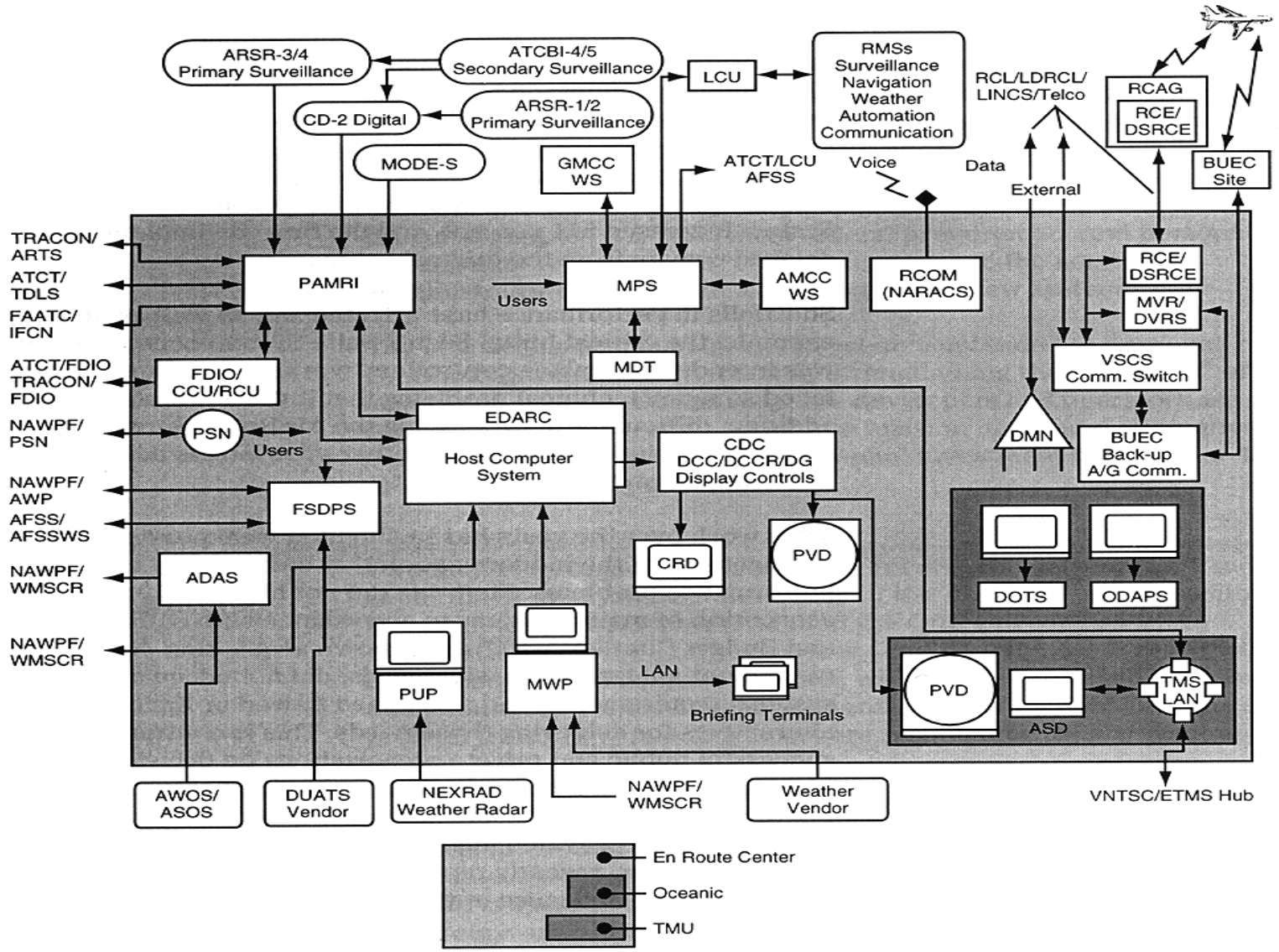
National Airspace System



National Airspace System Size

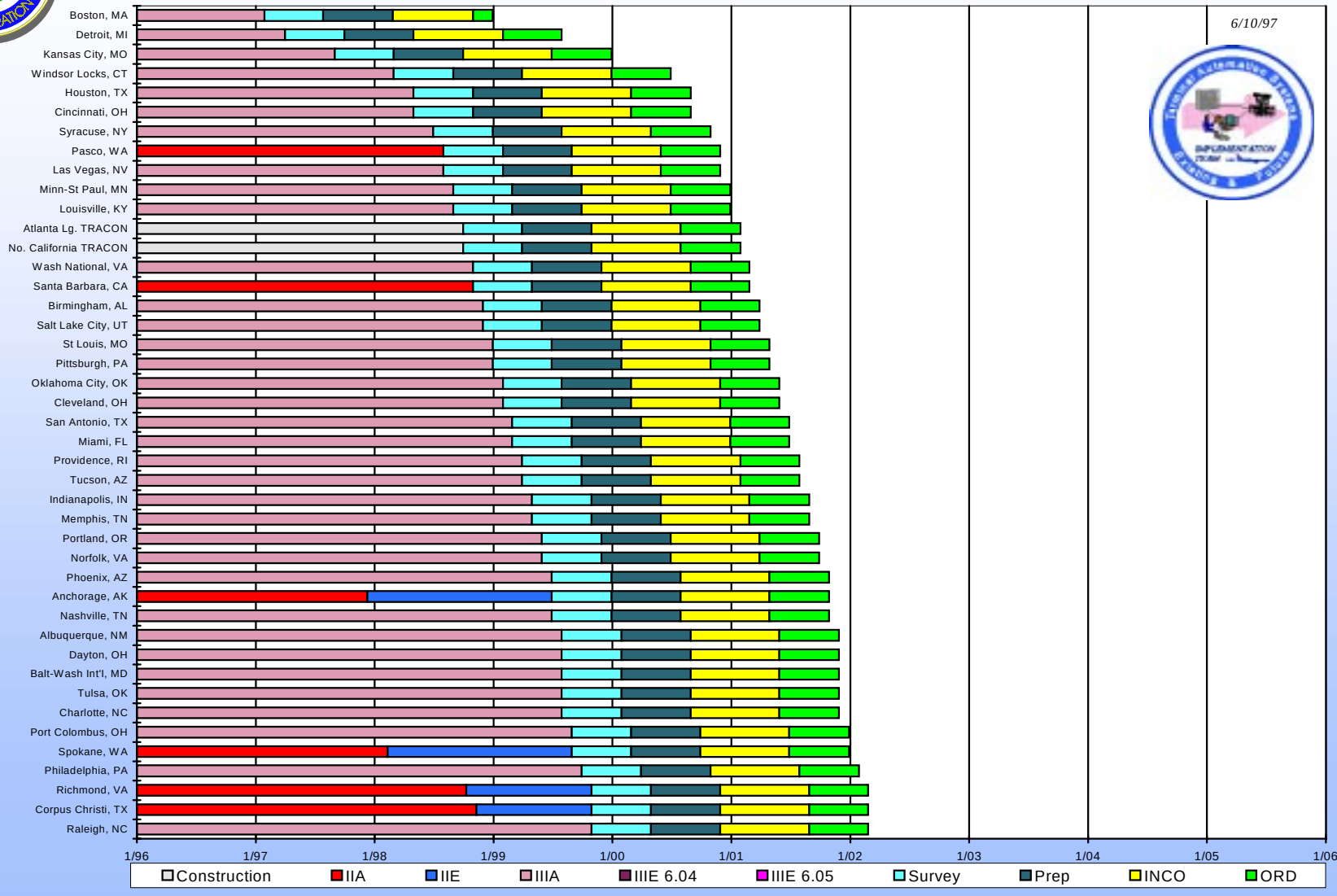
- 17,000 operational controllers
- 3,500 flight service personnel
- 8,000 field maintenance personnel
- 580 million emplanements annually
- 665,000 pilots
- 2,000 manufacturers
- 180,000 aircraft
- 20 en route centers
- 94 Flight Service stations
- 476 air traffic control towers
- 195 terminal radar approach control facilities
- 34,000 surveillance, communications, navigation, landing aids, weather sensing, and other equipment

ATC Infrastructure



Terminal Automation Transition Schedule

(1 of 4)



Terminal Automation Transition Schedule

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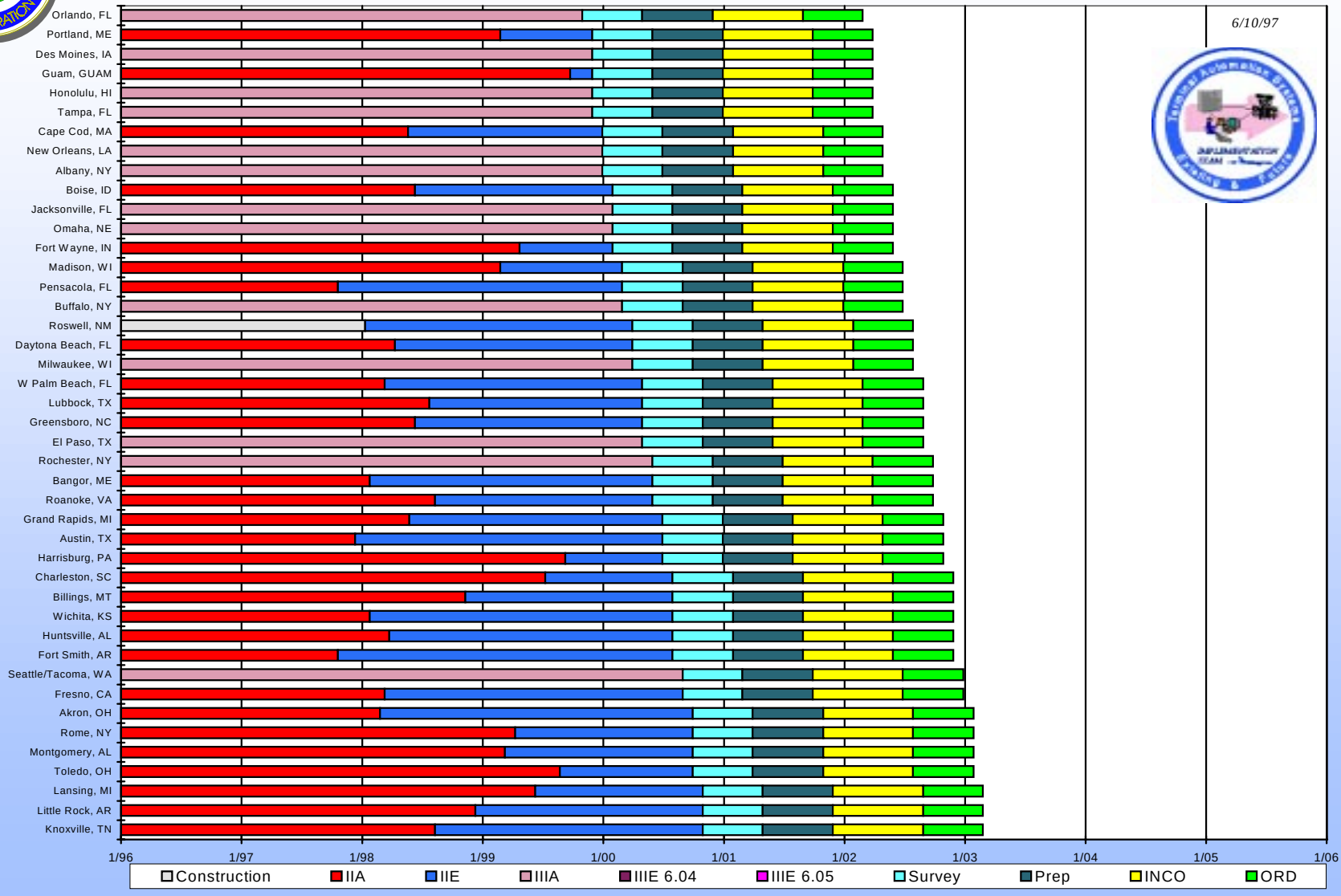

Terminal Automation Transition Schedule

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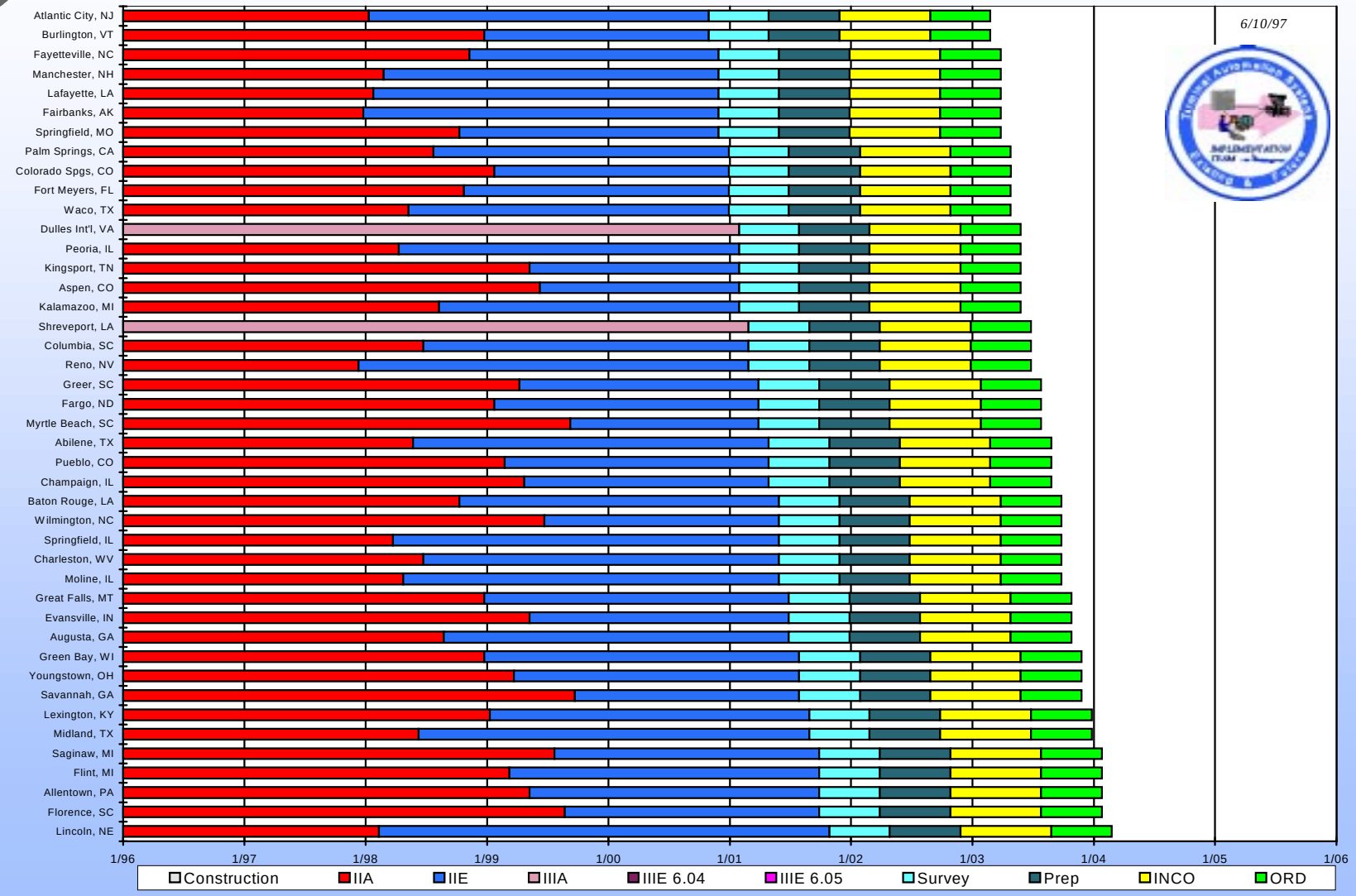

Terminal Automation Transition Schedule

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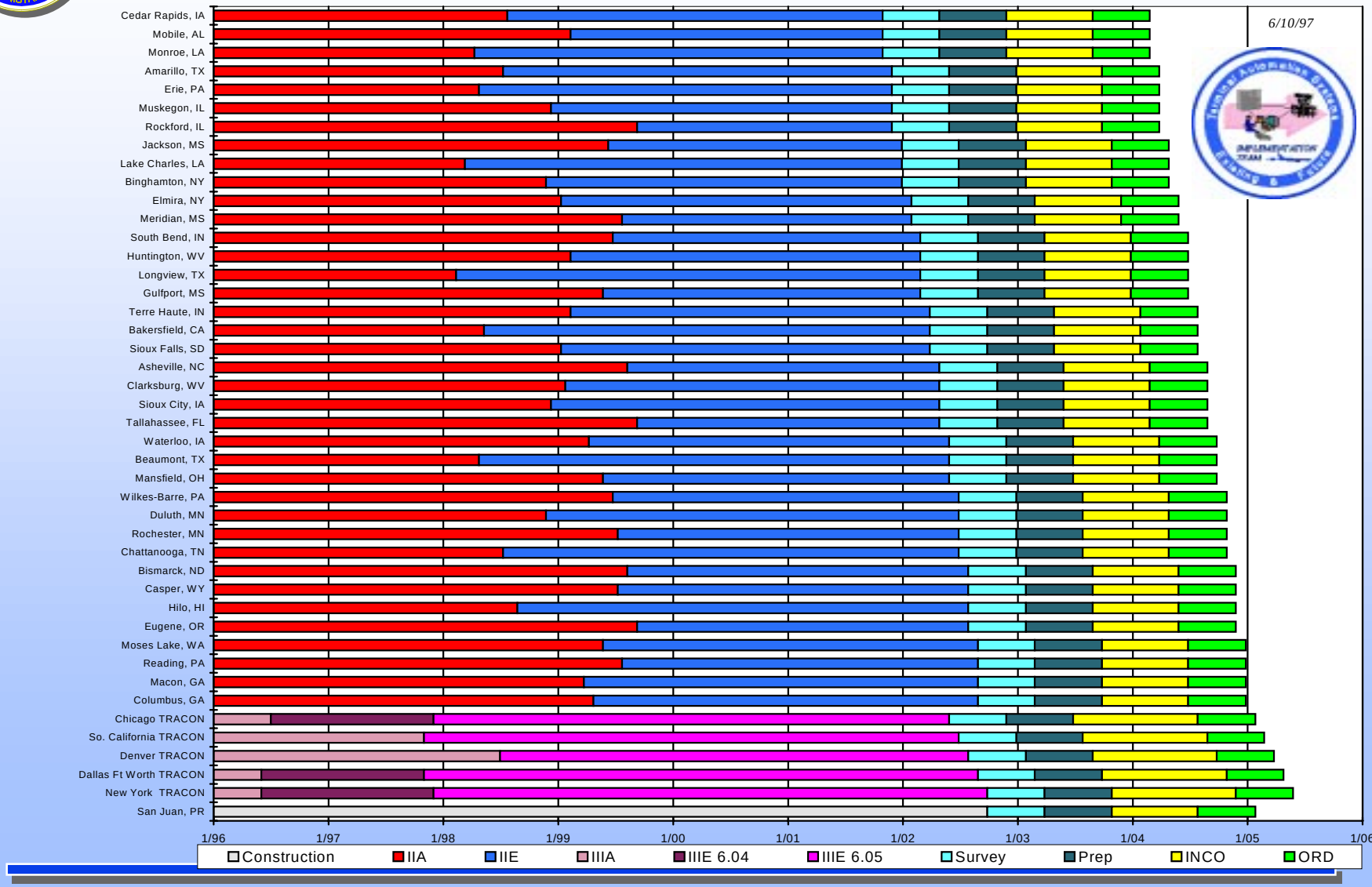
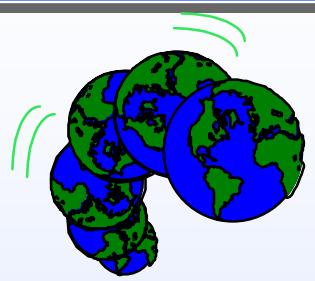




Things are changing so fast that the only thing we can hope for is that our areas of ignorance are fortuitously chosen.

Scott Burns

Recent Challenges

- Vice President Gore's Commission on Aviation Safety recommended the FAA reduce the fatal accident rate by a factor of 5 in 10 years.
- The Commission also recommended the FAA accelerate the modernization of the air traffic control system from 2012 to 2005.
- Recognition that, without change, the National Airspace System capacity will be reached around 2002.

Free Flight

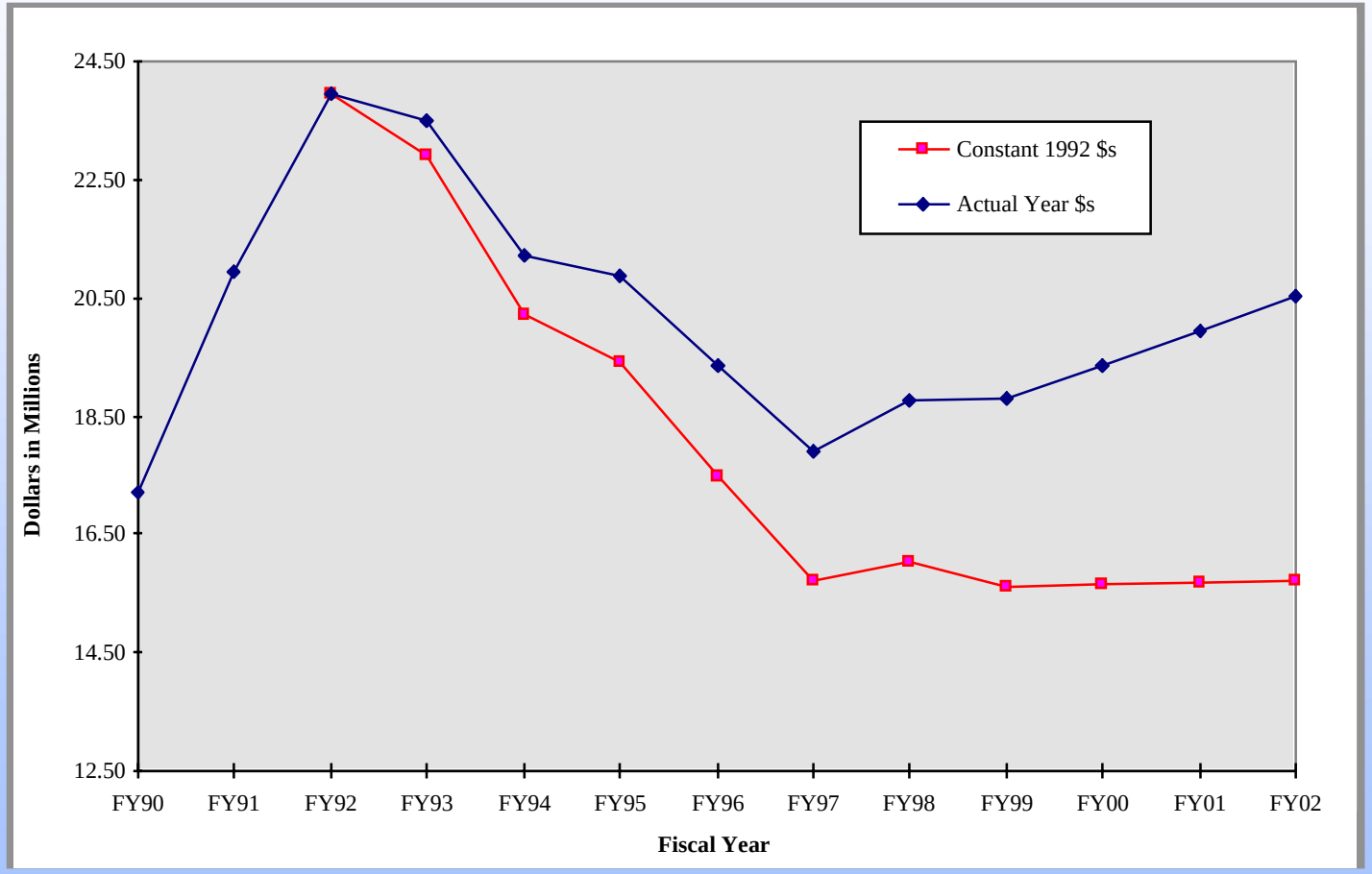
- New concept for controlling air traffic that puts more routing control in the hands of pilots and airlines - partially implemented at high altitudes now
- Flight plan can include direct routes rather than pre-defined airways within broad set of *safe* conditions
- Requires new GPS-based systems for navigation and surveillance + more sophisticated traffic management systems + new procedures + trained work-force + international agreements + ...

FAA Constraints

- Current Air Traffic Control System technology spans 4 decades
- Growth in air traffic by 38% from 1995 to 2003
- One of the largest most complex operational environments of any organization in the world - 24 x 7 operation
- Cannot shut down system to modernize it
- Declining FAA budgets - $12 billion gap through 2005 for research and acquisitions

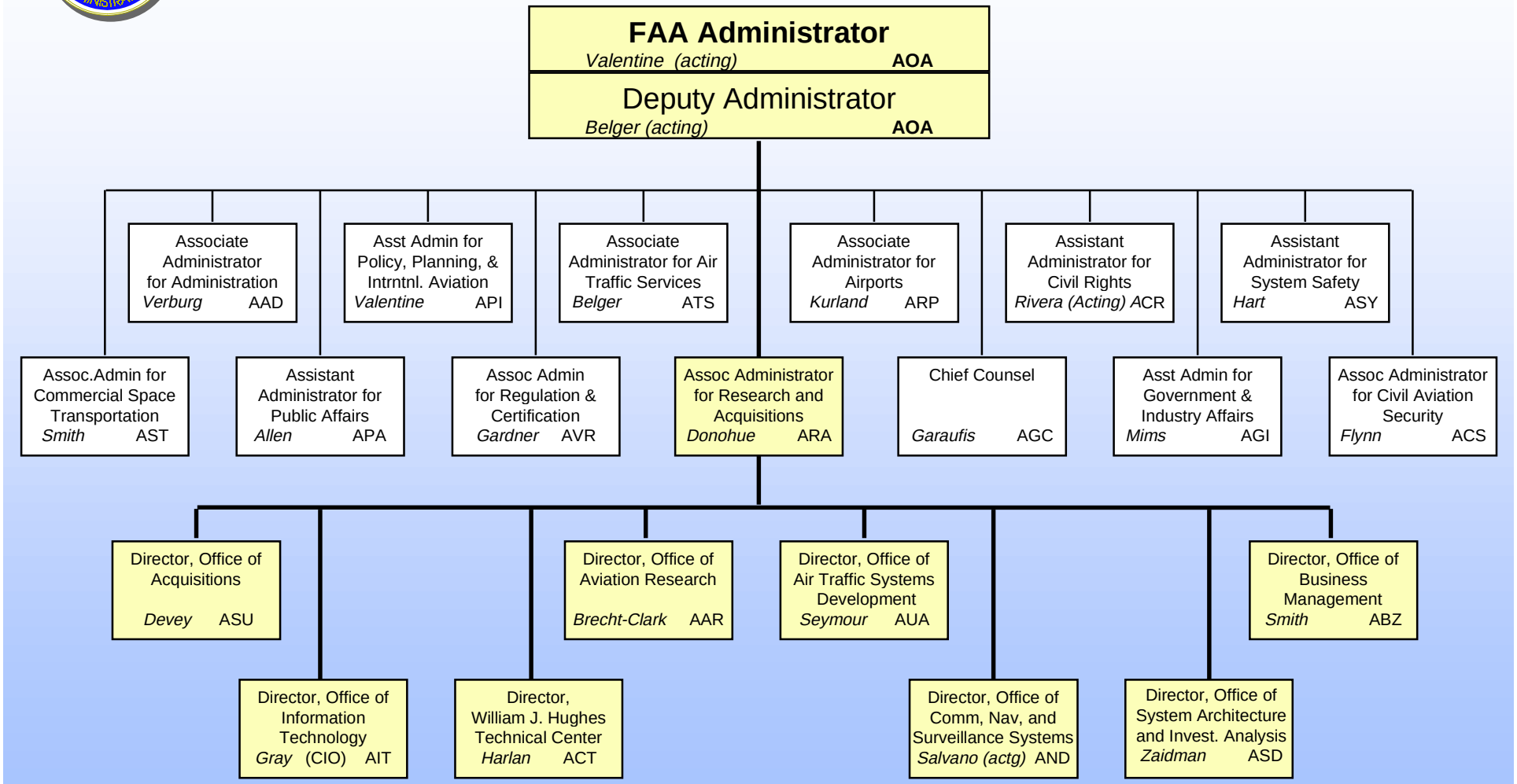
FAA F&E Budget

FY 1990 - 2002



FAA Capital funding peaked in 1992 at $2.4B, and will decline to $1.5B annually (a 37.5% spending reduction) under one balanced budget scenario.

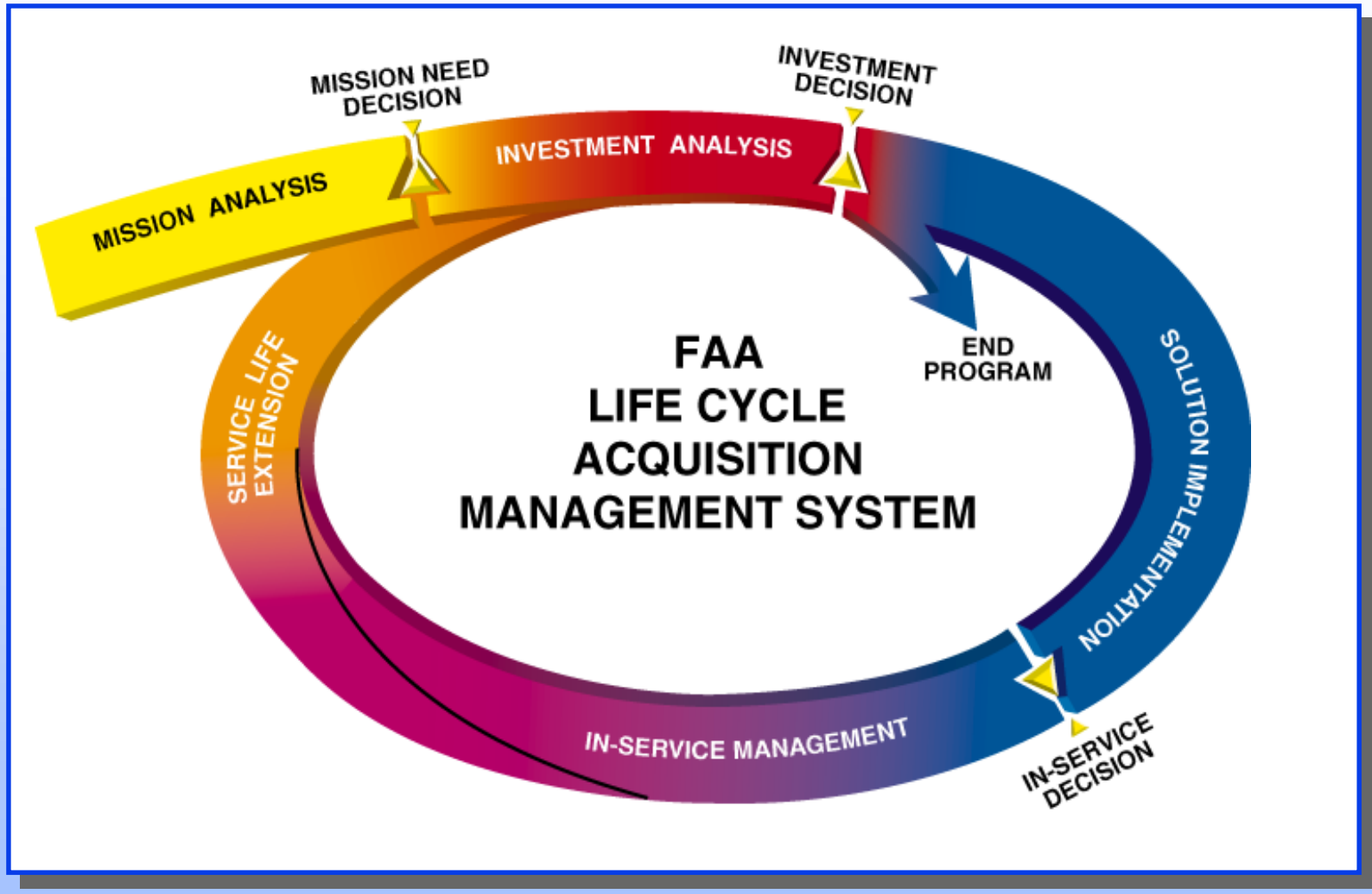
FAA Organization



Acquisition and Development

- FAA primarily acquires systems implemented by contractors
- FAA acquires systems, not software
- Over 150 systems currently being acquired at cost of over $2 billion annually
- Multi-year acquisitions with annual budget uncertainties
- FAA often maintains systems after delivery by contractors

Acquisition Management System



COTS/NDI Becoming Dominant

- Following same trends as other government agencies
- Less custom development
- More use of COTS/NDI with “glue code”; e.g., NAS Information Management System will have virtually no custom software other than glue code. Will monitor health of most of the 34,000 major pieces of equipment distributed across NAS.
- Enormous challenges using COTS components providing primary functionality of system over which FAA has little or no control.

Example Software Size Estimates

(kSLOC)

- STARS - 800
- DARC - 133
- NIMS - 200
- WAAS - 200
- Weather-related - 245

Host - 750

URET - 520+

PAMRI - 100

TMA/FAST - 300

total ~ 3.3 million LOCs

The FAA lacks uniform sizing method, so estimates are approximations and generally does not include size of COTS.

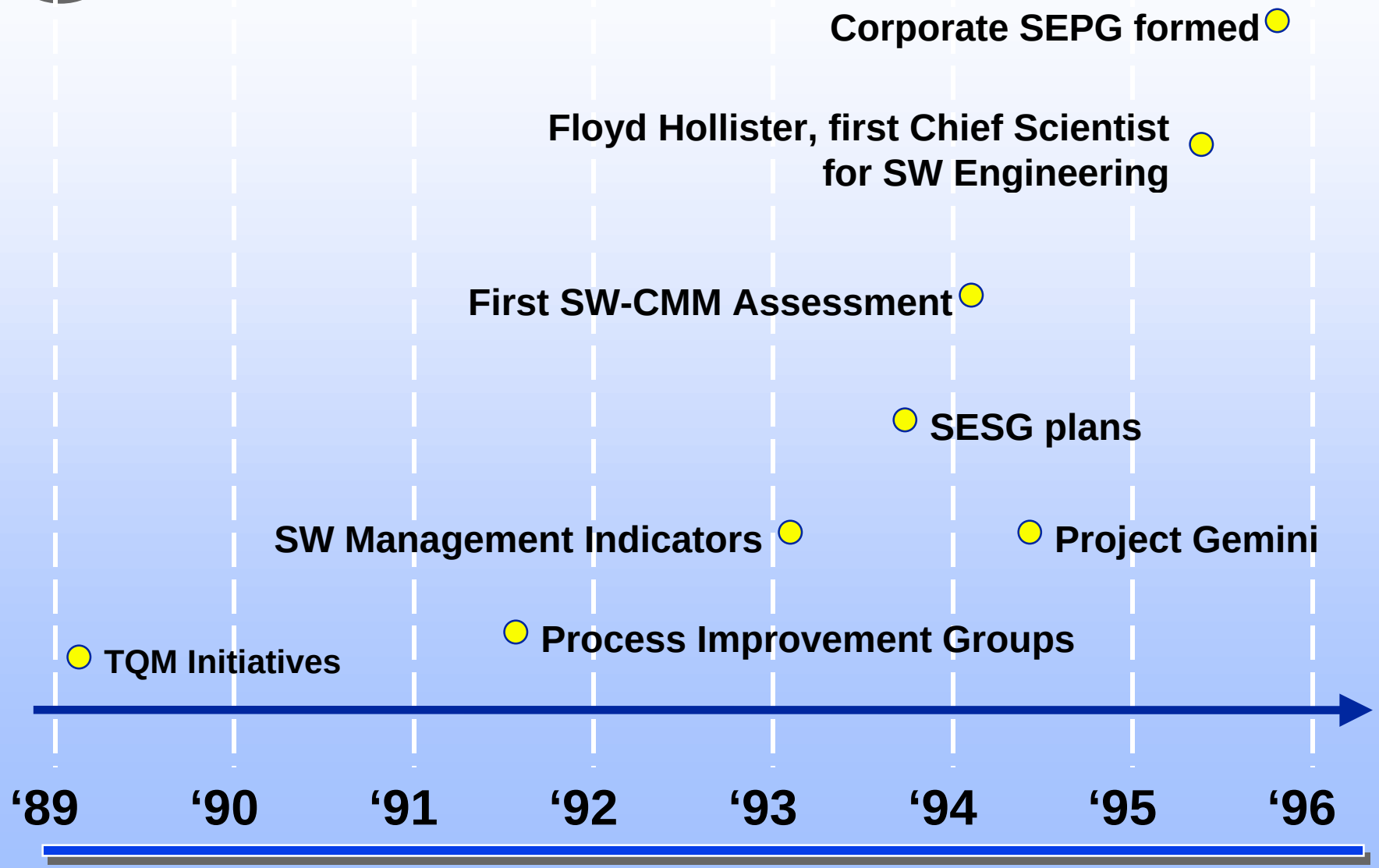
Hope is not a method.

Nathaniel Speight

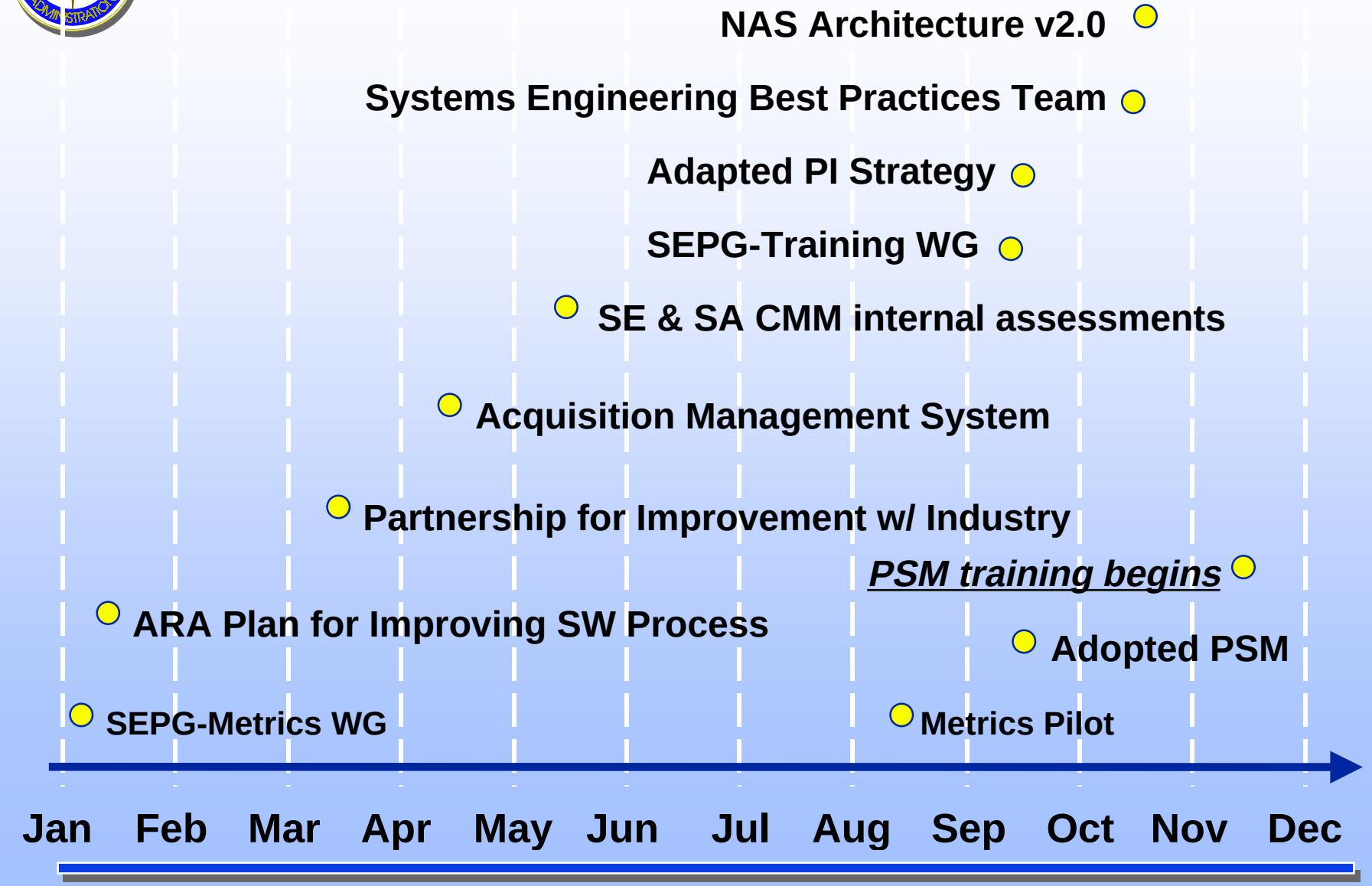
Recent GAO Findings

- FAA Lacks Complete Systems Architecture
  - it has a ‘logical’ description, but does not have a “technical description which defines all required information technology”; e.g. no standard data communications protocols thus resulting in different protocols
- Based on assessment of 5 programs, the “FAA did not fully satisfy any of the 7 KPAs [LEVEL 2] for System Acquisition...”
- “FAA’s ATC modernization program’s cost estimating processes do not satisfy recognized estimating requisites, and its cost accounting practices do not provide proper accumulation of actual project costs”.

1989-1995 Process Improvement

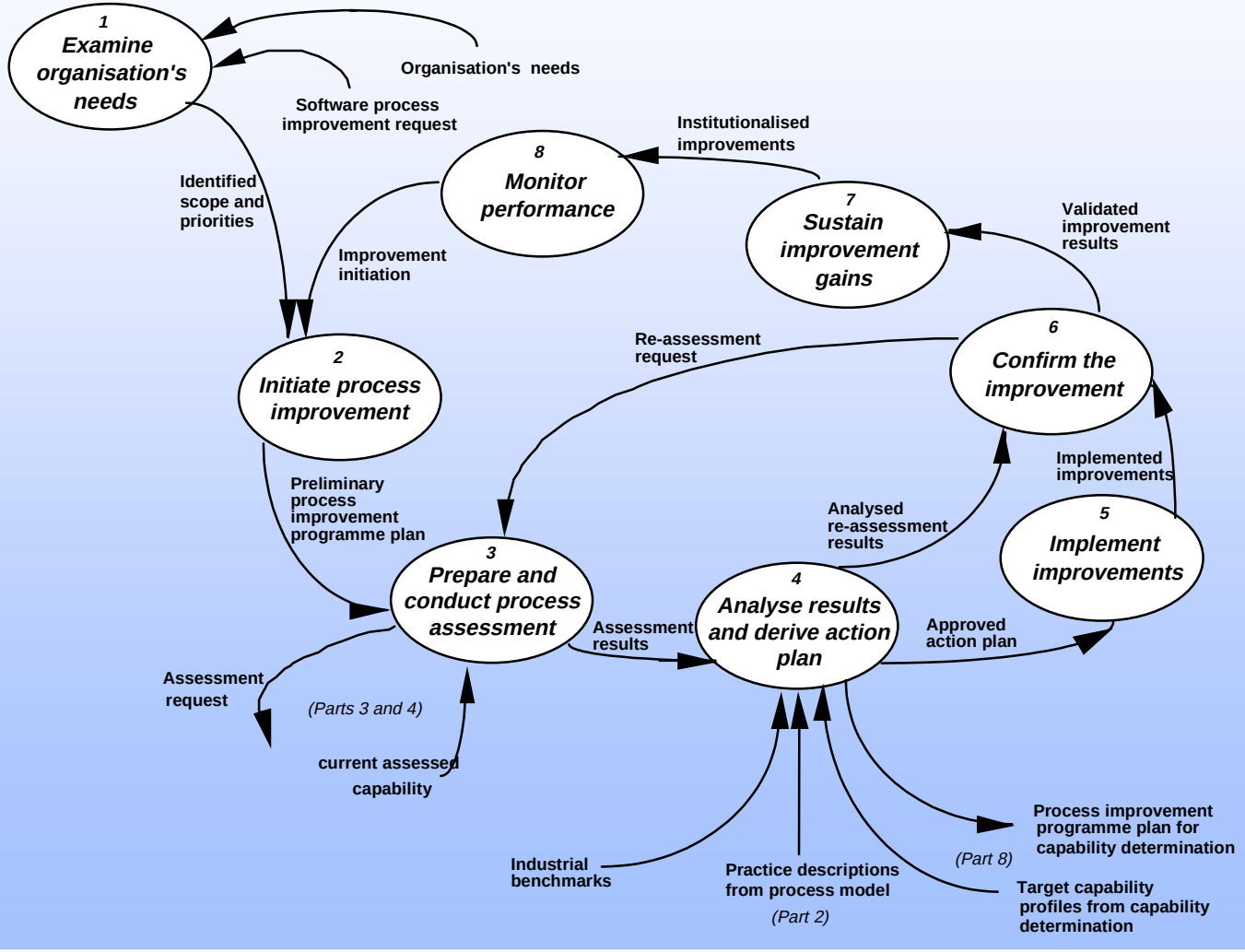


1996 Process Improvement

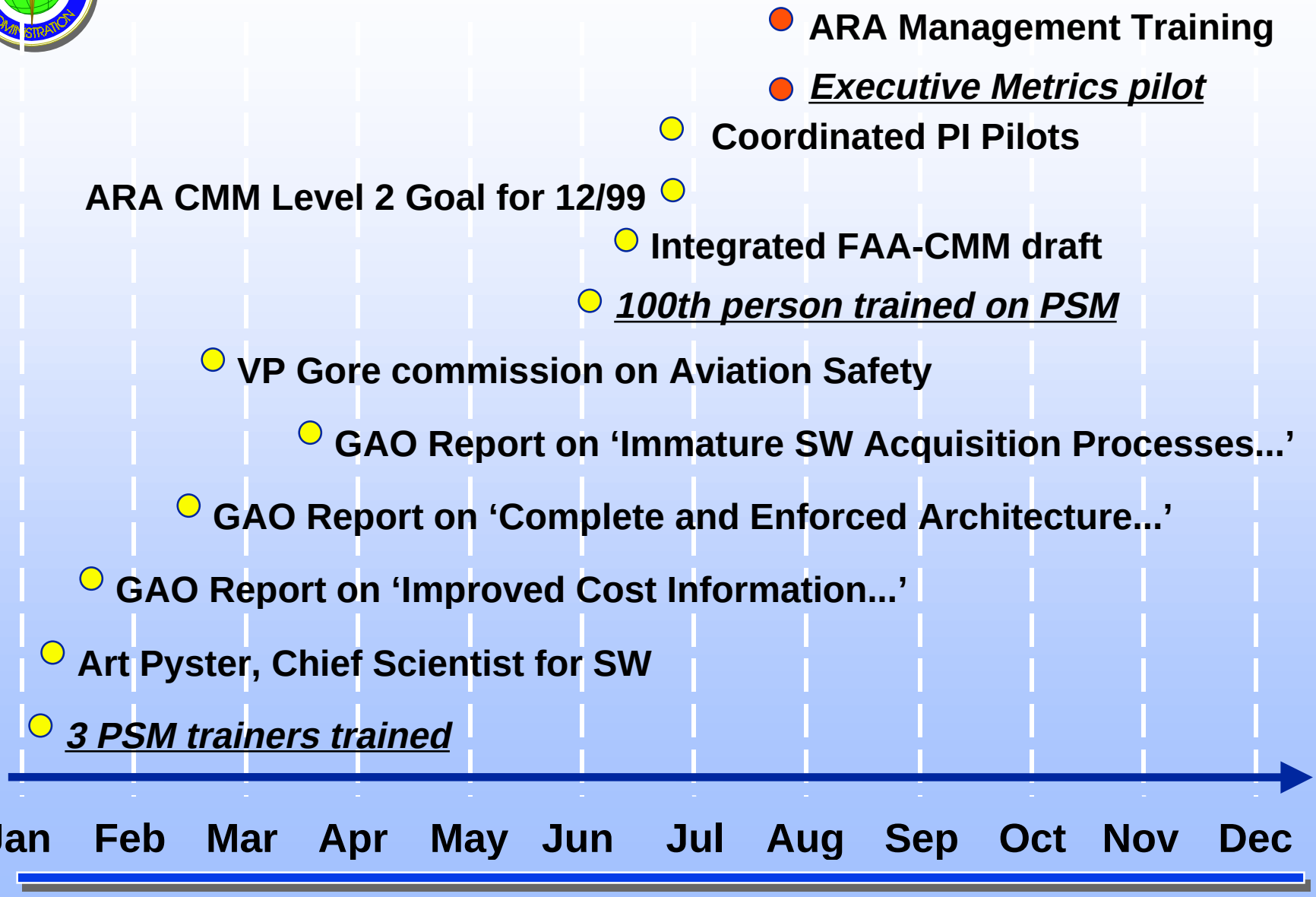


FAA PI Program - 5 year strategy

[source: adopted from SPICE]



1997 Process Improvement



Process Improvement Performance Goal

In support of FAA's performance goals in the area of productivity, ARA will:

Increase to FAA-CMM Level 2 (or equivalent) by December 1999, and to level 3 by December 2001, the process maturity of 75% of selected major software-intensive programs.

Prophesy is very hard, particularly when it involves the future.

Yogi Berra

Performance Will Be Measured By

- The percentage of selected major software-intensive programs that achieve Level 2 or higher status, as determined by independent assessment, and maintain that status, as determined by periodic independent reassessment.
- The percentage of selected major software-intensive programs that report improvements each year in the ARA Program Performance Metrics
- The percentage of staff on selected major software-intensive programs that report by survey that process improvements are increasing their efficiency and effectiveness.

Process Improvement Infrastructure

- Corporate
  - Software Engineering Executive Committee chaired by Associate Administrator for ARA
  - Corporate SEPG
    - chaired through Chief Scientist for SW Engineering
    - 10 directorates across 4 lines of business
    - 4 working groups: training, SCE use, integrating CMMs, **metrics**
  - Chief Scientist for Software Engineering provides “corporate” funds for process improvement
- Directorate
  - Directorate SEPGs
  - Process Action Teams target specific programs and specific process areas for improvement by July 1998
  - Targeted funds

Integrating the CMMs

The FAA-CMM will...

- Integrate SW-CMM, SA-CMM, and SE-CMM to provide a systems acquisition CMM tailored to the FAA business
- increase efficiency and effectiveness of FAA PI
- reduce process areas from 52 to 23
- minimize redundancy, overlapping needs and efforts through better coordination
- provide a single reference model for consistency, commonality, integration, assessments
- be consistent with FAA Acquisition Management System
- follow CMMI guidelines from the SEI

Domain Aspect of the FAA-CMM

FAA-CMM Process Area	*Systems Engineering SE-CMM Process Area*	*Software Acquisition SA-CMM Key Process Area*	*Software Engineering SW-CMM Key Process Area*
	Life Cycle or Engineering Processes		
PA01 Needs	Understand Customer Needs & Expectations	-	-
PA02 Requirements	Derive & Allocate Requirements	Requirements Development & Management	Requirements Management *(*SW Product Engineering)*
PA03 Architecture	Evolve System Architecture	-	*(*SW Product Engineering)*
PA04 Alternatives	Analyze Candidate Solutions	-	-
PA05 Outsourcing	Coordinate with Suppliers	Solicitation	SW Subcontract Management
PA06 Development/ maintenance	-	-	SW Product Engineering
PA07 Integration	Integrate System	-	
PA08 System Test and Evaluation	Verify &Validate System	Evaluation	
PA09 Transition	-	Transition to Support	-
PA10 Product Evolution	Manage Product Line Evolution	-	-
	Management or Project Processes		
PA11 Project Management	Plan Technical Effort Monitor & Control Technical Effort	SW Acquisisition Planning Project Management Project Performance Management	SW Project Planning SW Project Tracking and Oversight Integrated SW Management
PA12 Contract Management	*(* Coordinate with Suppliers)*	Contract Tracking and Oversight Contract Performance Management	SW Subcontract Management
PA13 Risk Management	Manage Risk	Acquisition Risk Management	*(*Integrated SW Management)*
PA14 Coordination	Integrate Disciplines		Intergroup Coordination

Domain Aspect of the FAA-CMM

FAA-CMM Process Area	***Systems Engineering SE-CMM Process Area***	***Software Acquisition SA-CMM Key Process Area***	***Software Engineering SW-CMM Key Process Area***
Supporting Processes (not lifecycle phase dependent)			
PA15 Quality Assurance & Management	Ensure Quality	*(*Contract Perf. Mgmt)*	SW Quality Assurance
PA16 Configuration Management	Manage Configurations	*(*Transition to Support)*	SW Configuration Management
PA17 Peer Review	Level 3 Common Features	*(*Evaluation)*	Peer Reviews
PA18 Measurement	Level 4 Common Features	Quantitative Process Management Quantitative Acquisition Management	Quantitative Process Management SW Quality Management
PA19 Prevention	Level 5 Common Features	-	Defect Prevention
Organizational Processes			
PA20 Organization Process Definition	Define Organization's Systems Engineering Process	Process Definition and Maintenance	Organization Process Focus Organization Process Definition
PA21 Organization Process Improvement	Improve Organization's Systems Engineering Process	Continuous Process Improvement	Process Change Management
PA22 Training	Provide Ongoing Skills & Knowledge	Training Program	Training Program
PA23 Innovation	Manage Systems Engineering Support Environment	Acquisition Innovation Management	Technology Change Management

FAA-CMM : Generic Practices

Level 1: Performed Informally

- Perform the process

Level 2: Planned & Tracked

- Establish policy
- Allocate resources
- Assign Responsibility
- Ensure Training
- Document the process
- Plan the process
- Use repeatable process
- Do CM
- Assess process compliance
- Verify work products
- ***Measure process***
- Review status
- Take corrective action
- Coordinate within project

FAA-CMM : Generic Practices

Level 3: Well Defined

- Standardize the process
- Use defined process
- Perform peer review
- Use well-defined data
- Coordinate with affected groups

Level 4: Quantitatively Controlled

- Establish quality goals
- Determine process capability
- Use process capability

Level 5: Continuously Improving

- Establish process effectiveness goals
- Continuously improve the standard process
- Perform causal analysis
- Eliminate defect causes
- Continuously improve the process

Managers should only expect what they inspect.

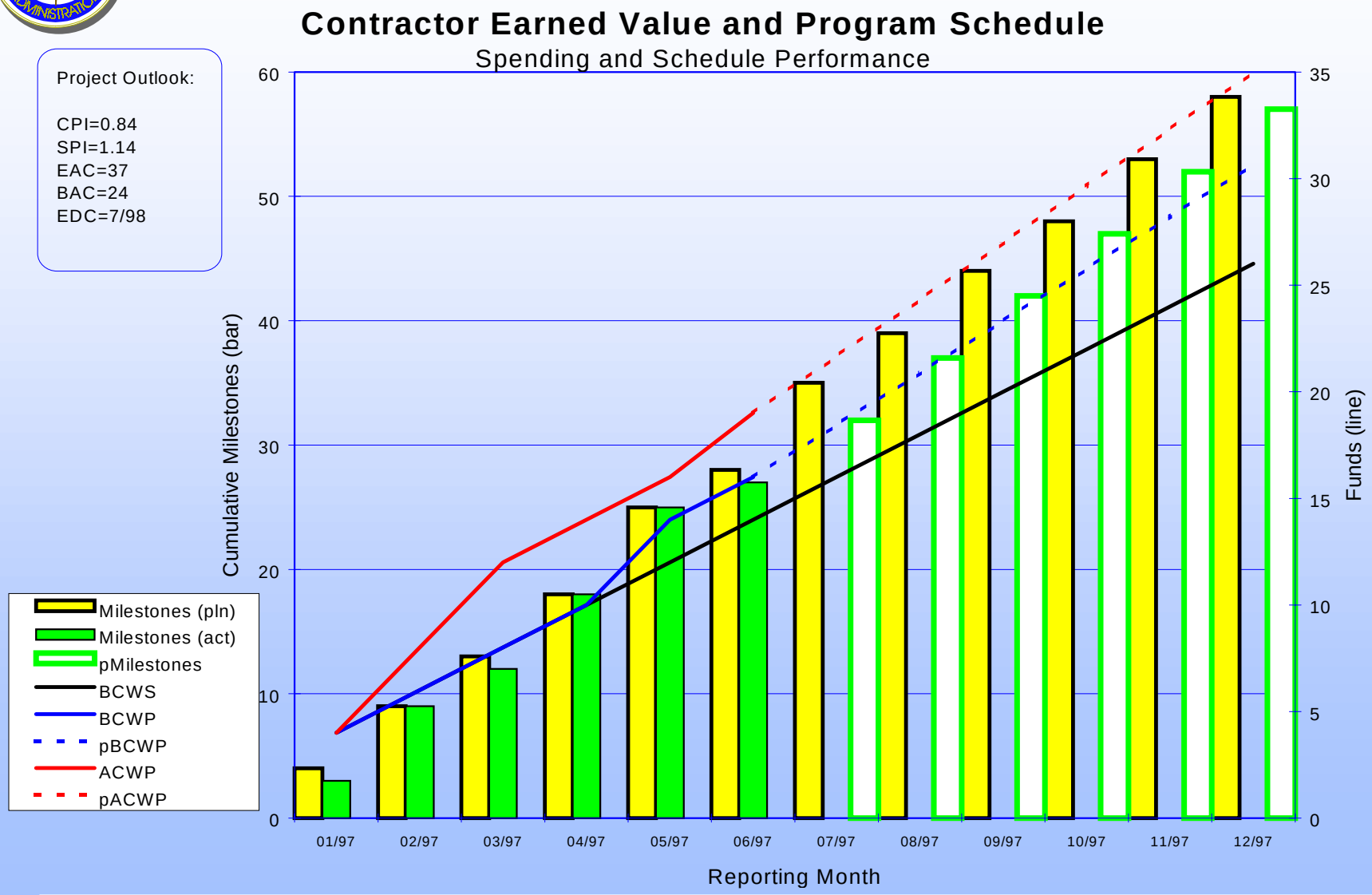
Executive Program Metrics

- Requested by George Donohue for all major programs to provide better barometer of program health than he currently has available
- As FAA Acquisition Executive, Donohue must understand status of all major programs and provide guidance to correct significant problems
- FAA Administrator required to report to Congress baseline breeches > 10%
- Piloting on 5 programs began July 1997

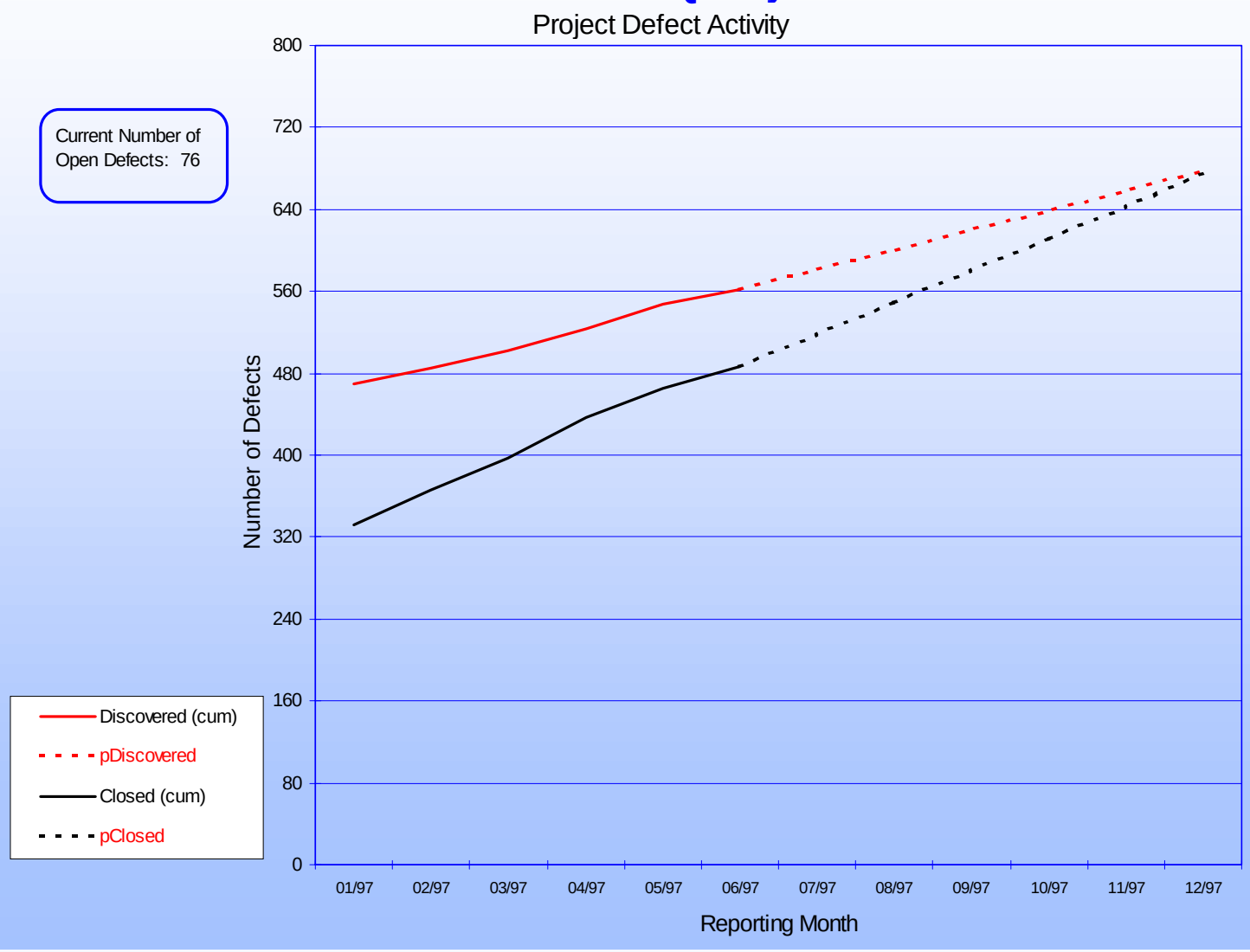
Executive Program Metrics

- Earned Value & Schedule
- Requirements Stability
- Product Quality
- Software Progress
- Document Cycle Time
- Cost/Benefit
- Technical Performance

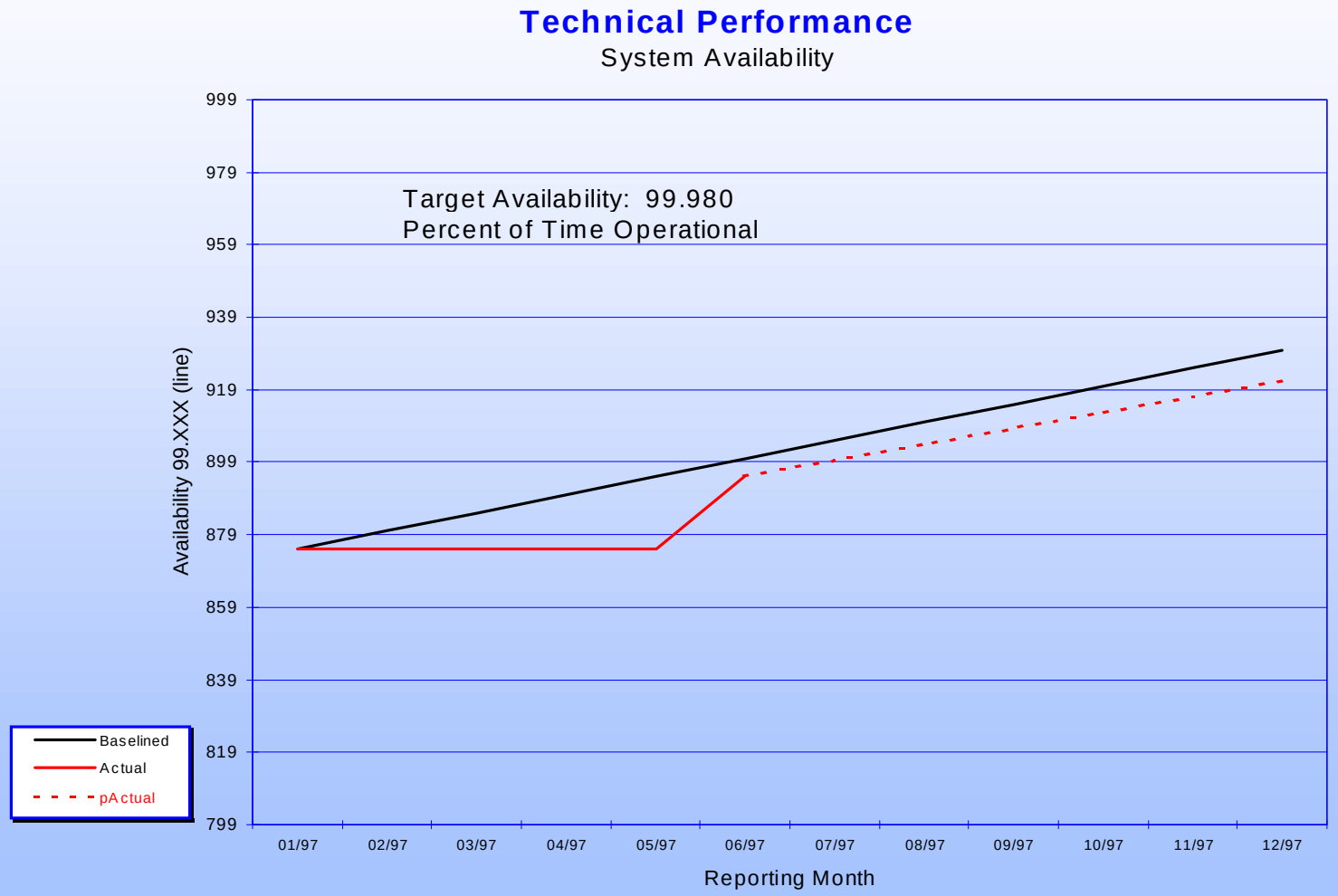
Contractor Earned Value and Program Schedule



Product Quality



Technical Performance



Summary

- FAA has a tremendous challenge
- FAA changing its paradigm
- Changes being piloted (PI projects, executive metrics) before broad application
- Committed to achieving level 2 by 12/99 and level 3 by 12/01
- Pace of process improvement activities accelerating rapidly
- Executive commitment key to progress
- Measurement is key - using PSM

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We are all faced with great opportunities ... brilliantly disguised as impossible situations.