

Human System Integration (HSI) Application to the National Airspace System (NAS) Enterprise Architecture (EA)

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Agenda

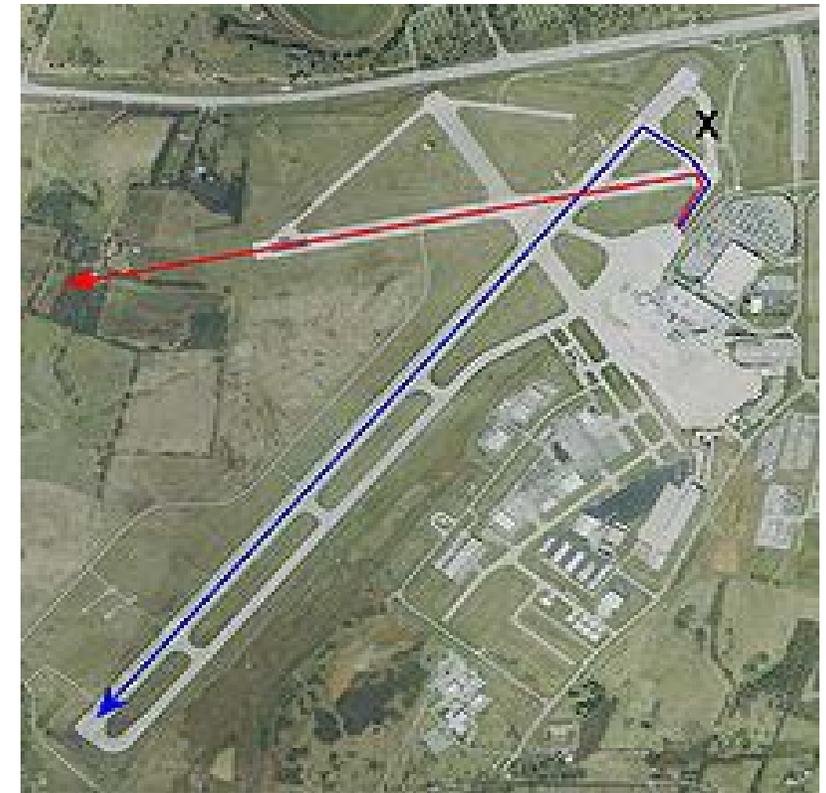
- About the FAA
 - National Airspace System (NAS)
 - HSI in FAA
 - HSI in NAS Enterprise Architecture (EA) and Next Generation Air Transportation System (NextGen)
- About the HSI Roadmap
 - Objectives
 - Approach
 - Description
 - Benefits
- Lessons Learned



FAA: Safety and Capacity (Linked to HSI)



Photo by Jon Ross, FAA



Blue Grass Airport, Lexington, Kentucky

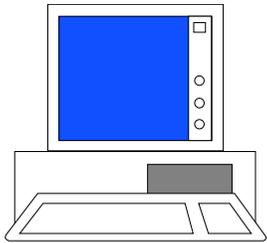
August 27, 2006

FAA Mission: To provide the safest, most efficient aerospace system in the world.

The FAA oversees about 55,000 flights and millions of air traffic control operations every day. It manages operations in hundreds of facilities such as air traffic control towers. It oversees 5,000 public use airports, certificates of over 5,000 air operators, 700,000 active pilots, 1,500 approved manufacturers, 90,000 flight instructors, 10,000 designees, and 320,000 aircraft.

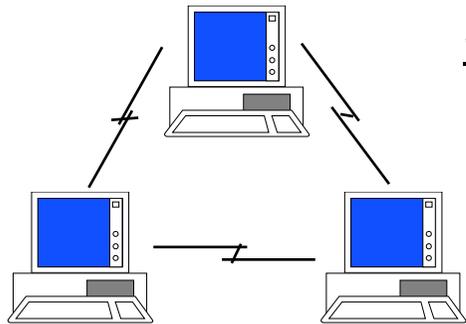


HSI Objectives: Safety and Effectiveness (Circa 1990)



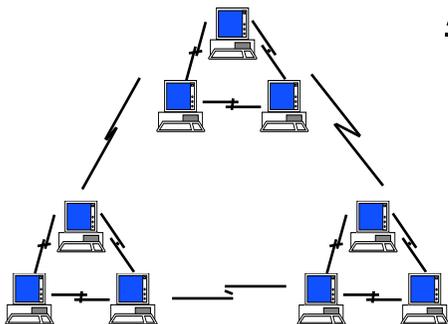
Products that accommodate human interfaces:

- Detailed displays & controls
- Screen layout and design
- User inputs & commands; information processing
- Physical and cognitive demands
- Product usability



Systems that accommodate human-system interfaces:

- Workstation ergonomics
- Decision aiding; training & procedure development
- Individual workload; job design
- Product-product compatibility
- System usability



A system of systems that accommodates multi-system human requirements:

- Organizational structures; staffing levels
- Communication; coordination; team workload & performance
- Training strategies and resource requirements
- System-system compatibility with human-in-the-loop
- National Airspace System (NAS) usability



HSI in the FAA: Some Milestones

Continuous infrastructure development: Tool availability, technical capability, people, funding...

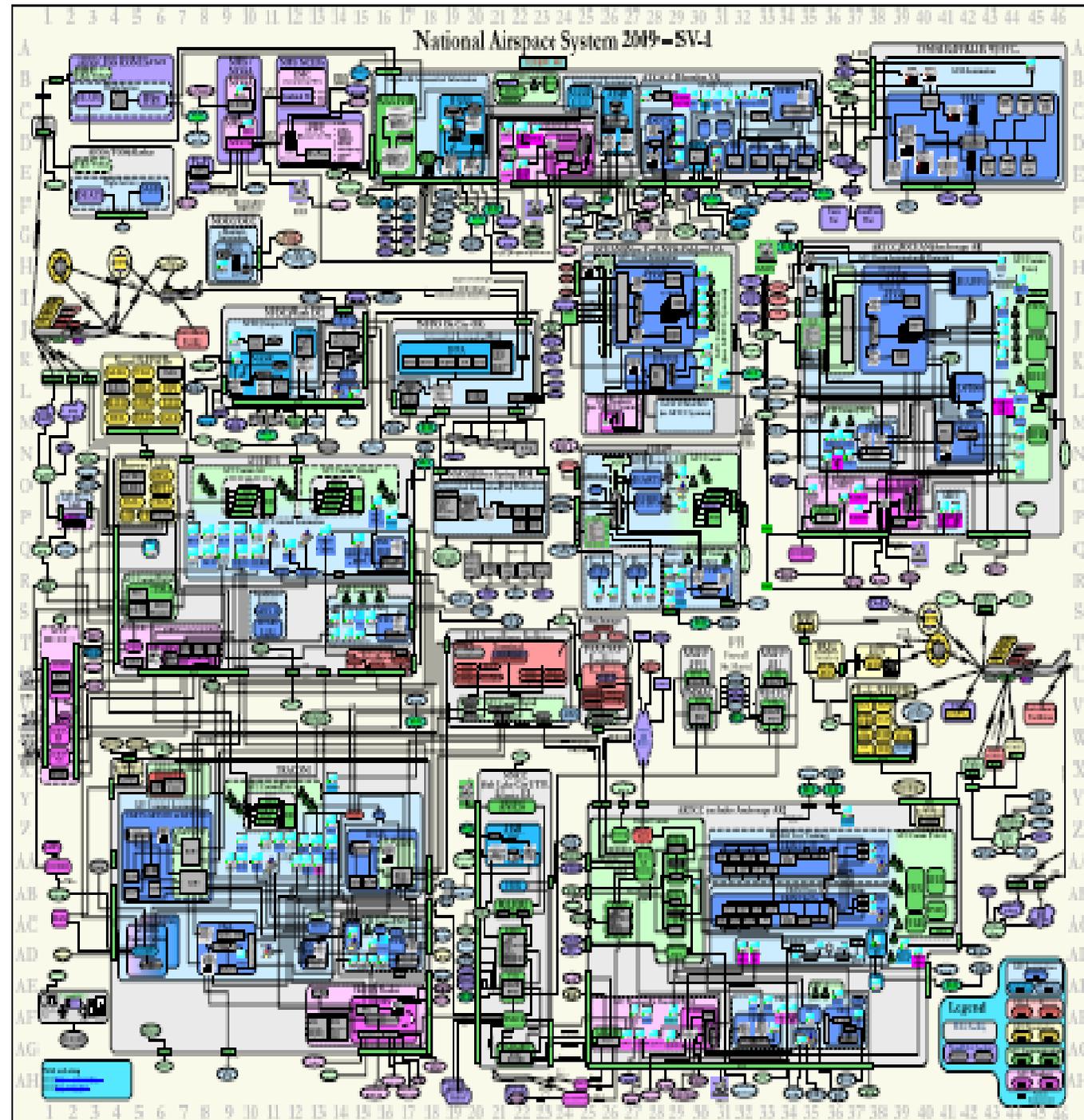
- 1988: Aviation Safety Research Act (PL 100-591)
- 1991: FAA Human Factors R,E&D Office
- 1992: Human Factors Laboratory
- 1993: FAA Human Factors Policy and Guidelines
- 1995: National Plan for Civil Aviation Human Factors
- 1996: Human Factors Design Guide
- 1997: FAA Human Factors Acquisition Job Aid
- 2003: Human Factors Design Standard
- 2005: Human Factors Awareness Course (on-line)
- 2008: HSI Roadmap for NAS Enterprise Architecture
- 2010: Human Factors Portfolio



Applying HSI in the FAA

HSI in FAA, Similar to DoD

- Supports command and control operations: Air Traffic Control (e.g., airports, towers, centers)
- Focuses on acquisition programs in a well-defined Acquisition Management System policy and processes (e.g., requirements, analysis, design, development, test)
- Scope is broad (e.g., similar HSI domains)
- Similar HSI objectives, tool, processes
- Challenges in implementation and institutionalization (e.g., business case, performance requirements, safety)



“NAS Simplified”

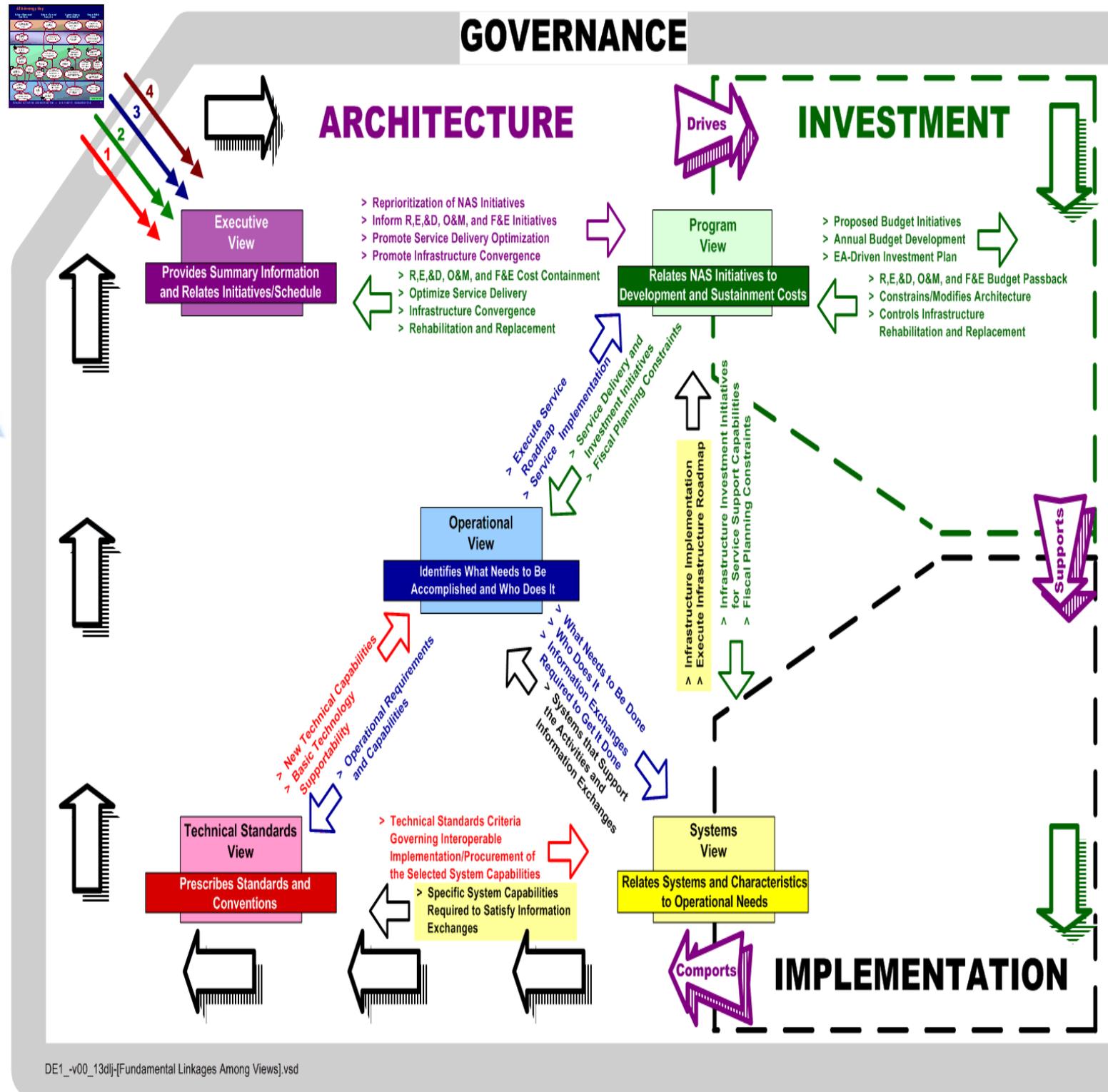


NAS Enterprise Architecture Views

Key Components

- **Parallel in structure to DoDAF**
 - System Views (yellow)
 - Operational Views (blue)
 - Technical Views (red)
- **Augmented with Executive and Programmatic Views**
- **Includes Service Roadmaps: Planned Operational Developments**
- **Infrastructure Roadmaps: Paths to achieving future NAS – Next Generation Air Transportation System (NextGen)**

On line: <https://nasea.faa.gov/>



HSI NAS EA Challenges

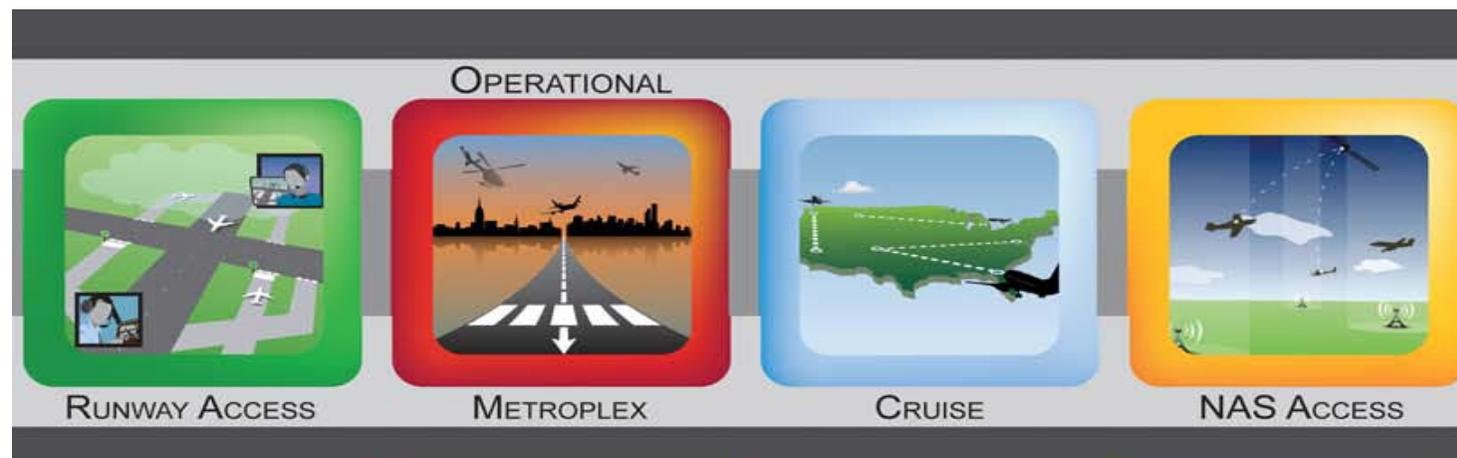
- HSI domain integration/trade-offs
- System-centric planning and development decisions
- Understated individual, team, and organizational roles
- Inadequately specified human performance metrics, targets, and standards



HSI Roadmap Objectives

Objectives of the HSI Roadmap participation in the NAS Enterprise Architecture (EA) activities:

- Influence the NAS EA development and its artifacts (e.g., Operational Views) from a "people" perspective.
- Support the conduct of human factor research and engineering for NAS EA/NextGen developments.
- Enhance the coordination of impacts on the development of FAA's workforce and workforce environment.



Current HSI Roadmap Approach

- Focused on People (1 of 14 Infrastructure Roadmaps)
- Defined by sub-capabilities: Workforce and Work Environment
- Built from an Operational Improvement based, bottom up assessment of research and development (R&D) requirements, especially related to:
 - ATC & Tech Ops (Controller Efficiency)
 - Flight Deck (Air-Ground Integration & Delegated-Separation)
 - Other NextGen human factors activities
 - Near-, Mid-, Long-Term
 - FAA, non-FAA
 - Domestic, International
- Represented with HSI perspective:
 - Roles, responsibilities, procedures
 - Safety, productivity, human-system performance (reliability)
 - Training, personnel selection, staffing and distribution
 - Information/display requirements
- Available at Human Factors Web Page: <https://www2.hf.faa.gov/HFPortalnew/>



Operational Improvement Impacts & Dependencies on NAS Actors

NextGen impact on people (e.g. who they are, what they do, and how they do it) is broad and deep.

Time Frame	OI Count for HF	Radar Controller	Local Controller	Pilots
Mid-term	37 of 45	16 (36%)	13 (29%)	16 (36%)
Far-term	36 of 39	22 (56%)	19 (49%)	22 (56%)
Total	73 of 84	38 (45%)	32 (38%)	38 (45%)

Some Major Issues:

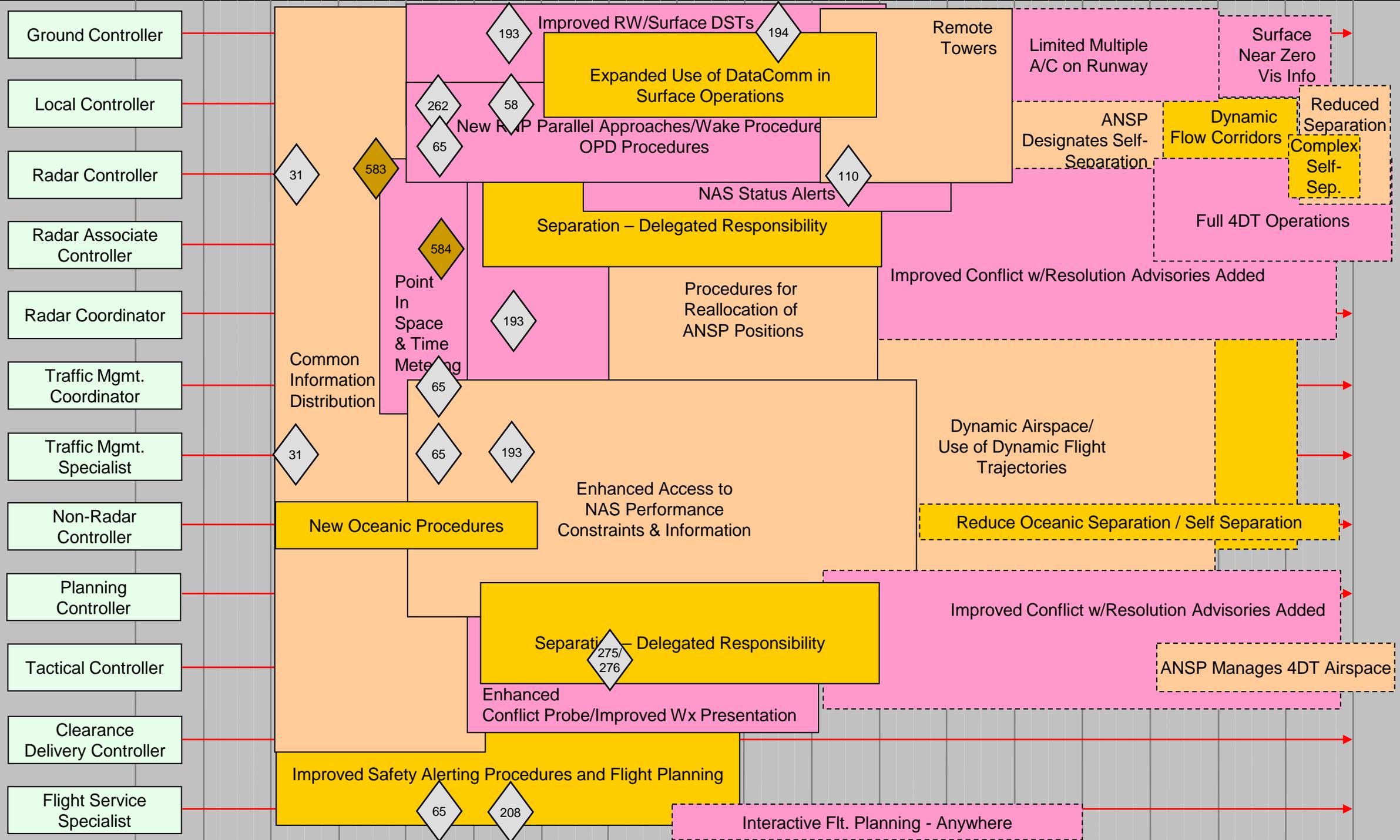
- Human-Automation Interaction: Allocation of human role; displays, controls, and procedures
- Controllers role changing (from vectoring to monitoring, responsibility sharing)
- Humans as sole backup (redundancy) to technology, reliance on automation
- Systems integration for multiple OIs
- Handling mixed equipage (aircraft)
- Complexity of aircraft priorities (e.g., WX, RNP equipped)



Human Systems Integration Roadmap (1 of 6)

CY 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025

Air Traffic



Notes:

- (1) The shaded boxes above are intended to reflect changes to the NAS workforce and work environment.
- (2) The shaded boxes above are intended to represent an earliest potential "implementation" of a capability.
- (3) Far Term representations on the HSI Roadmap (2018 – 2025) depicted in dotted-line boxes are included for planning purposes.
- (4) The actors represented in this roadmap are selected from NAS EA "mechanisms".

Work Environment Change in Automation
 Mixed Workforce/Work Environment Change
 Workforce Change in Role/Responsibility Change

Human Systems Integration Roadmap: Decision Points (1 of 2)

DP #	Target Date	High Priority	Domain	Name
31	2010	Y	Automation	Final invest for Post ERAM 3 WP
32	2011	Y	Automation	NextGen Staff tower Initial Investment Dec
58	2013	Y	Automation	Staff NextGen towers final invest
65	2012	N	Automation	Final invest decision of common information display (IDS) capability in En Route & Terminal
75	2014	Y	Automation	Approve En Route Automation NextGen mid-term WP- Initial Invest
83	2017	Y	Automation	Approve transition to NextGen far-term automation platform & display subsystem via converg
109	2010	N	Automation	Assess common IDS – En Route/Terminal
110	2018	Y	Automation	Final invest for TRACON NextGen automation platform & display subsystem via convergence
111	2015	Y	Automation	Approve reqmts for ERAM NextGen WP final invest
112	2011	N	Automation	Assess common Terminal/EnRoute R-side (hw/sw)
114	2011	N	Automation	Assessment for common display (e.g., H/W and S/W platforms) of electronic flight data for En Route and Terminal automation
118	2012	N	Automation	Research transition - integrated & baselined A/G concept
193	2013	N	Air-Ground	Policy decision-develop human/automation design principles to support NextGen infrastructure
194	2017	N	Air-Ground	Res. Trans.-incorporate results into future NextGen technology & human/auto, intensive ops
208	2013	Y	Automation	Flight Services Evolution Integrated Services and Capabilities Final Investment Decision
262	2012	N	Airspace & Procedures	Decision to implement Big Airspace at candidate sites
267	2017	N	Airspace & Procedures	Decision to proceed with High Altitude Generic Airspace
275	2014	Y	Automation	Approve Terminal Automation NextGen Mid-term Work Package Initial Investment Decision
276	2015	Y	Automation	Approve Terminal Automation NextGen Mid-term Work Package Final Investment Decision
356	2014	N	Automation	CATMT Work Package 4 Initial Investment Decision
361	2013	N	Automation	En Route Automation NextGen Mid-Term Work Package Investment Analysis Readiness Decision
363	2013	N	Automation	Terminal Automation NextGen Mid-Term Work Package Investment Analysis Readiness Decision



Benefits of HSI Roadmap

The HSI Roadmap serves to:

- Highlight and support the coordination of key workforce/work environment related decision points and activities
- Provide a consolidated view of NextGen impact upon the people operating and maintaining the NAS
- Enhance the efficient planning for workforce support activities and capabilities (e.g., human factors research, Human-In-The-Loop simulations, human engineering)
- Facilitate the planning of workforce development (e.g., training plans, selection plans, hiring plans)
- Support the creation and maintenance of required NAS EA Operational Views and artifacts



Lessons Learned

HSI in Enterprise Architecture Development:

- **Disadvantaged by:**
 - Lack of top down HSI specificity of EA performance objectives
 - Lack of precedence, unfamiliarity of EA participants with HSI
- **Facilitated by:**
 - Inventive approach
 - Extant HSI infrastructure
 - Legitimacy of official status as a part of the long-term architectural solution
 - Human performance baselines for “as is” architectural representations
- **Tends to:**
 - Break down barriers across HSI domains
 - Force an alternative (human) view of, and voice for, “to be” architecture
 - Provide a mechanism to explicitly highlight human and organizational role changes
 - Establish a means to coordinate and evaluate human performance across interdependent systems

