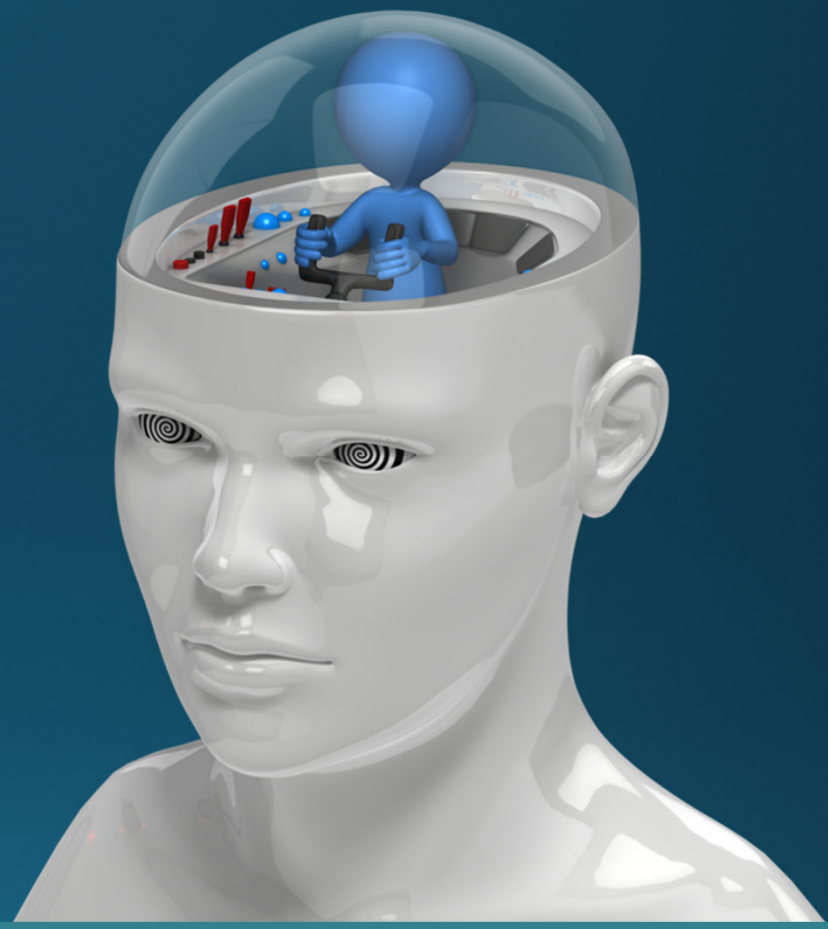
AUTHORS: Carla Hackworth, PhD.
Carol Manning, PhD.
Crystal Rowley, M.A.

FAA CAMI Human Factors Research Division (AAM-500)

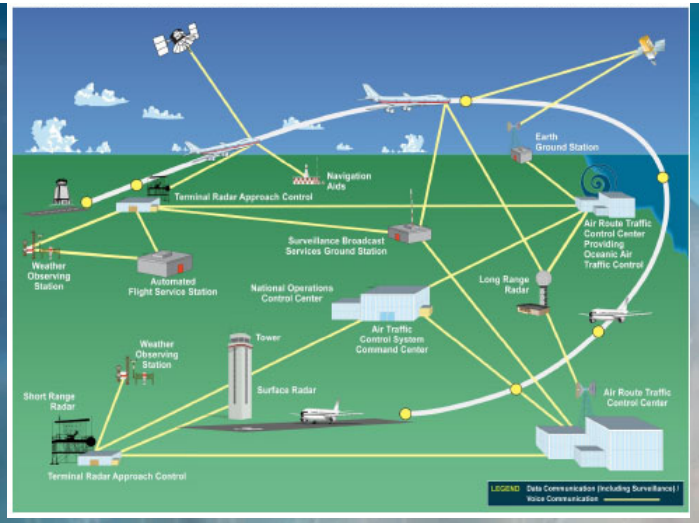


HUMAN FACTORS IN ACTION: Verification and Validation

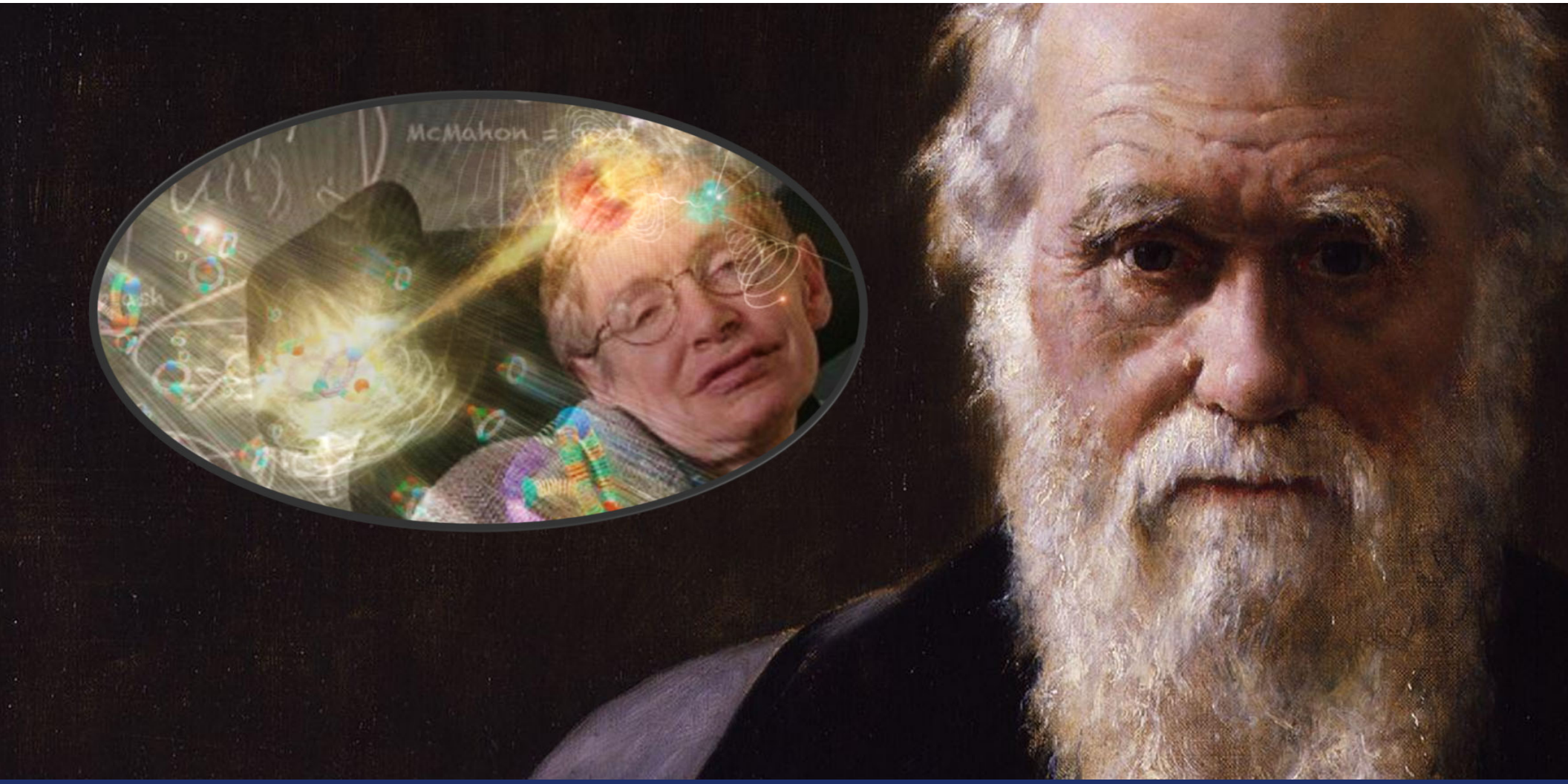
September 13-14, 2017

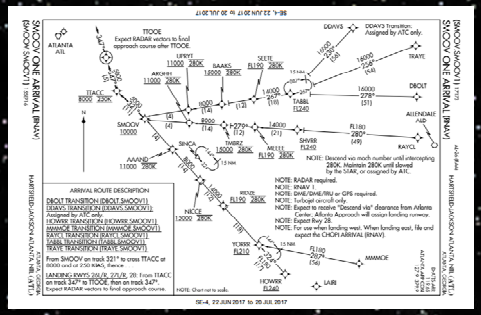
Civil Aerospace Medical Institute (CAMI)

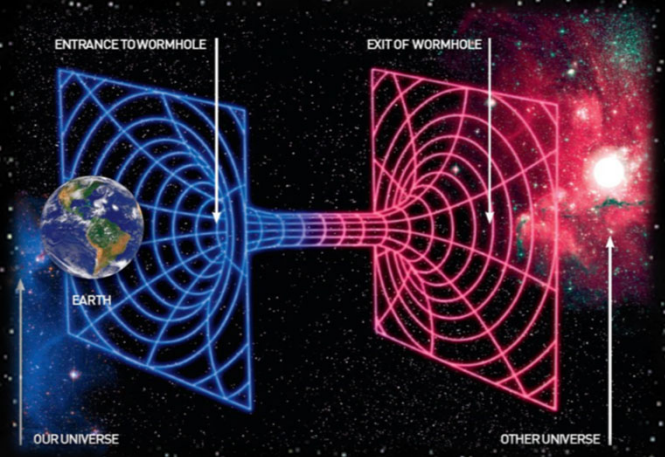
Complexity Consciousness



Verification & Validation


McMahon

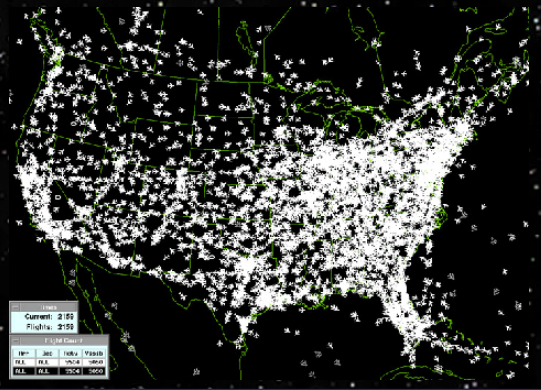




"Life is really simple, but we insist on making it complicated."

— Confucius

"Over 42K commercial flights per day supporting 10.6 million jobs. The FAA serves the transportation community through 520 air traffic control towers, 157 TRACONs, 21 en route centers (two CERAPS), 7,400 radar, weather, surveillance and communications facilities, housing more than 76, 000 pieces of equipment, and with 3 million lines of operational code under configuration control across dozens of automation systems, ..and 14,000 air traffic controllers, and 4,700 technicians." J. Eck (May, 2017)

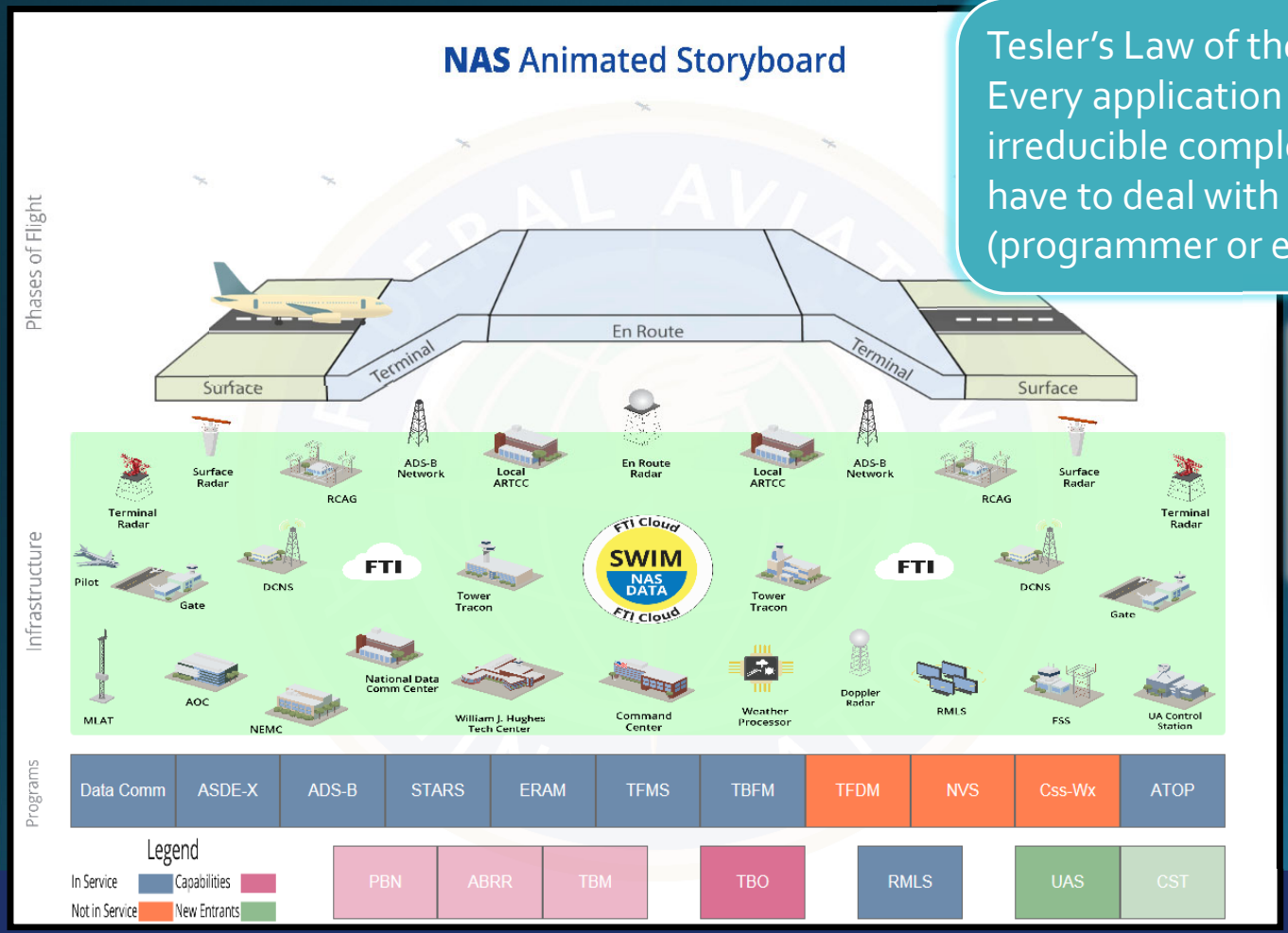


“The most powerful words in English are 'Tell me a story’…” - Pat Conroy

“The answer is always in the entire story, not a piece of it.” - Jim Harrison

“It takes a thousand voices to tell a single story.” - Native American saying

System of Systems

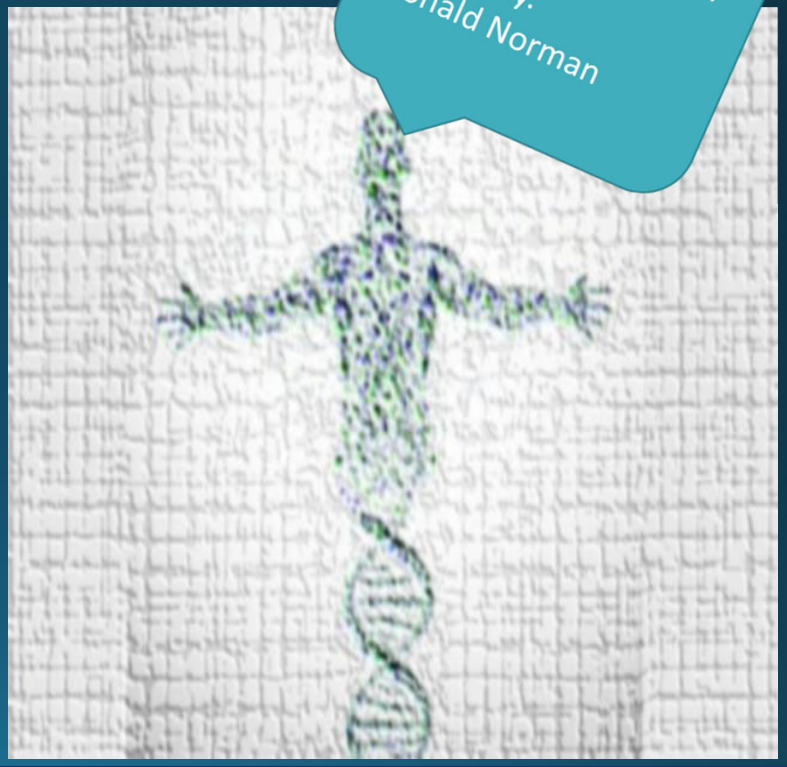


Tesler's Law of the Conservation of Complexity
Every application has an inherent amount of irreducible complexity. The only question is who will have to deal with it, the user or the developer (programmer or engineer). (Tesler and Saffer, 2007)

What system is embedded within the NextGen system?

Humans as a System

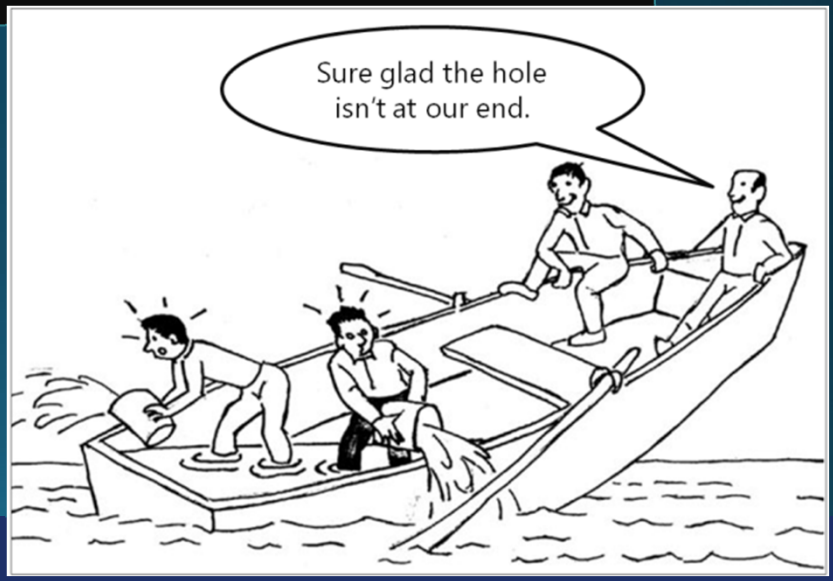
- Humans have a lifecycle, performance operating characteristics, failure modes, patterns of behavior influenced by context, and their own organic make-up and history.
- Humans add a layer of complexity to the system.



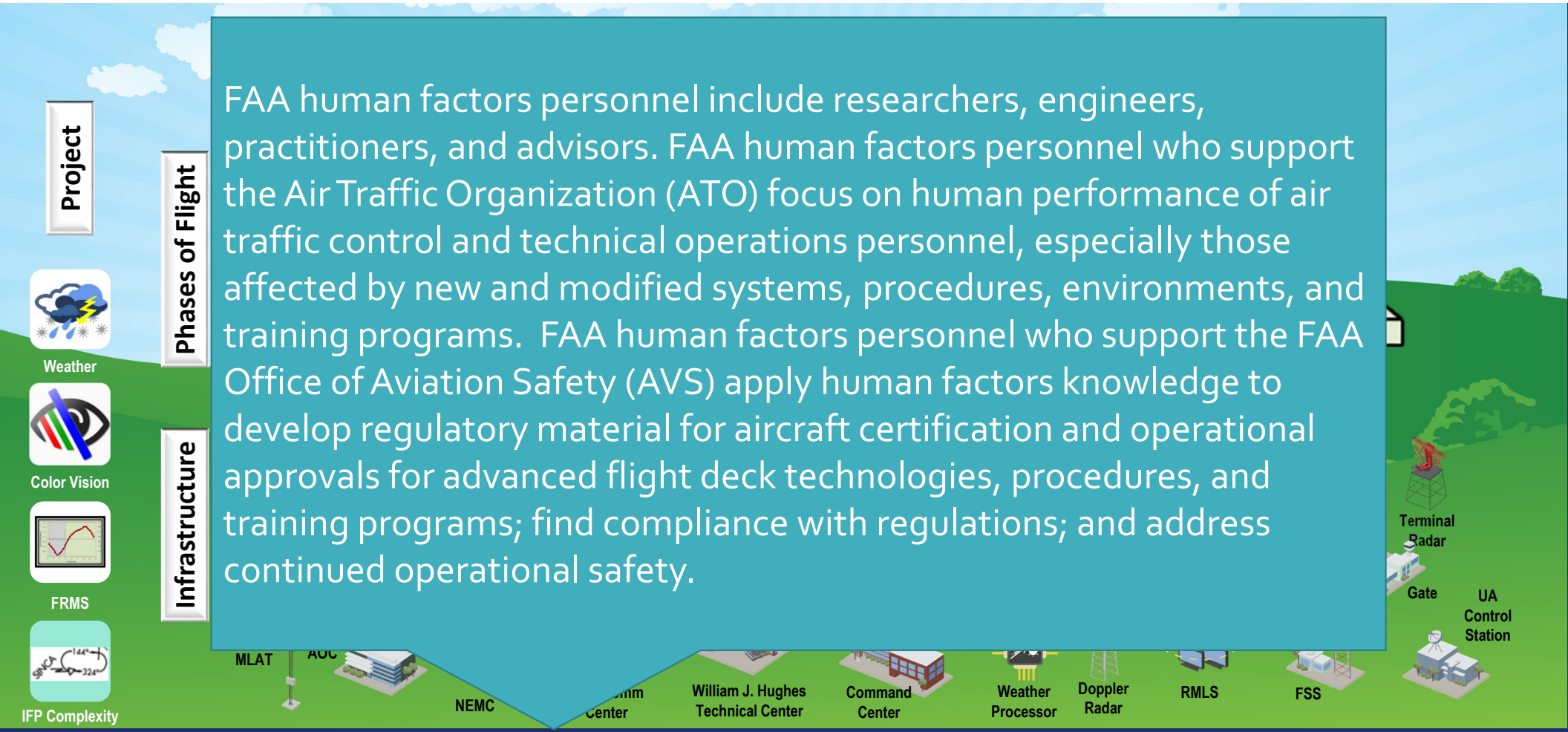
Human Factors

This requires an integrated system-of-systems approach that considers the complex interactions among people, technology, procedures, and organizations rather than just a system-by-system approach that considers each element in isolation.

"Human factors means a multidisciplinary field that generates and compiles information about human capabilities and limitations and applies it to design, development, and evaluation of equipment, systems, facilities, procedures, jobs, environments, staffing, organizations, and personnel management for safe, efficient, and effective human performance, including people's use of technology."



FAA Human Factors Policy 9550.8
HF-STD-001B HUMAN FACTORS DESIGN STANDARD
HF-STD-004a HUMAN FACTORS ENGINEERING REQUIREMENTS
FAA-HF-STD-002 "Baseline requirements for color use in air traffic control displays" (April 2007) - http://www.tc.faa.gov/its/worldpac/standards/faa-hf-std-002.pdf



FAA human factors personnel include researchers, engineers, practitioners, and advisors. FAA human factors personnel who support the Air Traffic Organization (ATO) focus on human performance of air traffic control and technical operations personnel, especially those affected by new and modified systems, procedures, environments, and training programs. FAA human factors personnel who support the FAA Office of Aviation Safety (AVS) apply human factors knowledge to develop regulatory material for aircraft certification and operational approvals for advanced flight deck technologies, procedures, and training programs; find compliance with regulations; and address continued operational safety.

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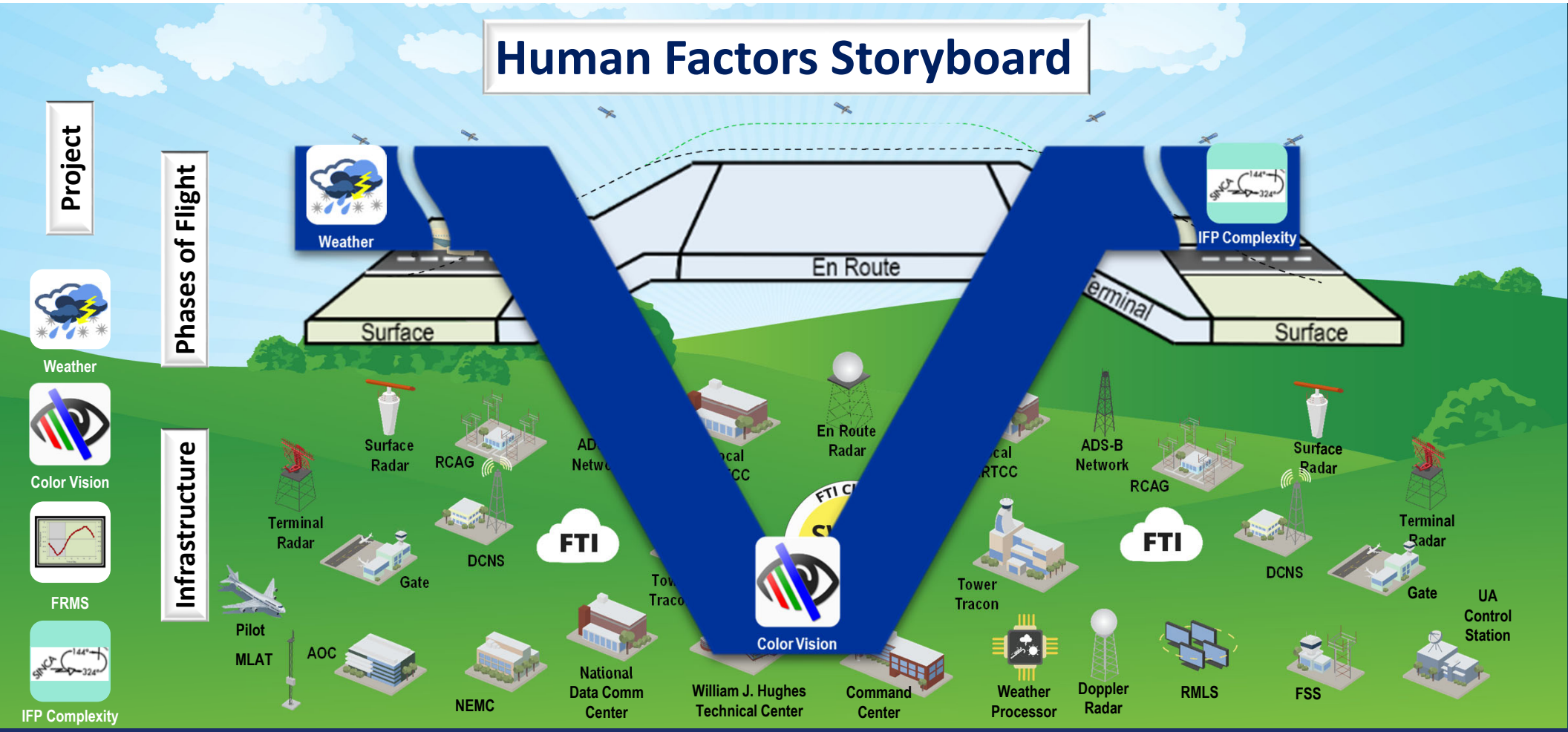
Human Factors Storyboard



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Weather Camera Project

Alaska WCAM portal is designed specifically for use by the public and is intended to facilitate pilot preflight planning and inflight decision making.

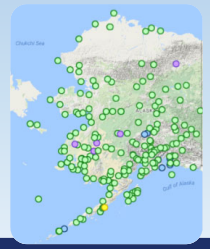
It provides a single source for pilots to access camera images combined with other necessary aviation data sets and eliminates the need to traverse numerous websites to obtain piecemeal flight planning data.

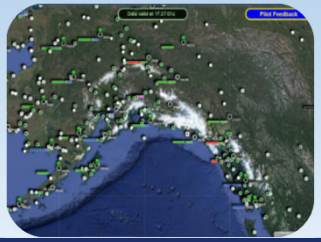
Research Question(s):

1. What is the optimal (in terms "Go no-Go" decision) presentation format and information flow for weather preflight briefing?
2. What are the most important weather-related factors impacting the "Go no-Go" decision during preflight?
3. What are the most important weather-related factors impacting the inflight decisions for rerouting due to adverse weather?

http://avcamsplus.faa.gov/

http://avcams.faa.gov received more than 200 million hits.

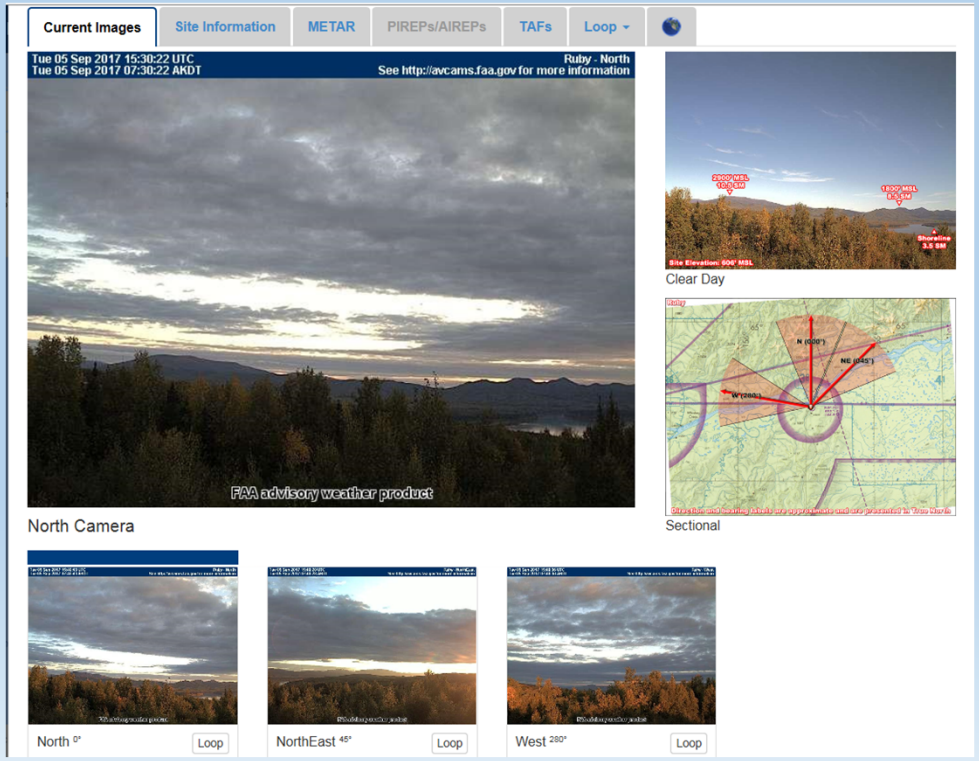




Human factors research improved usability in preflight and inflight decision making.

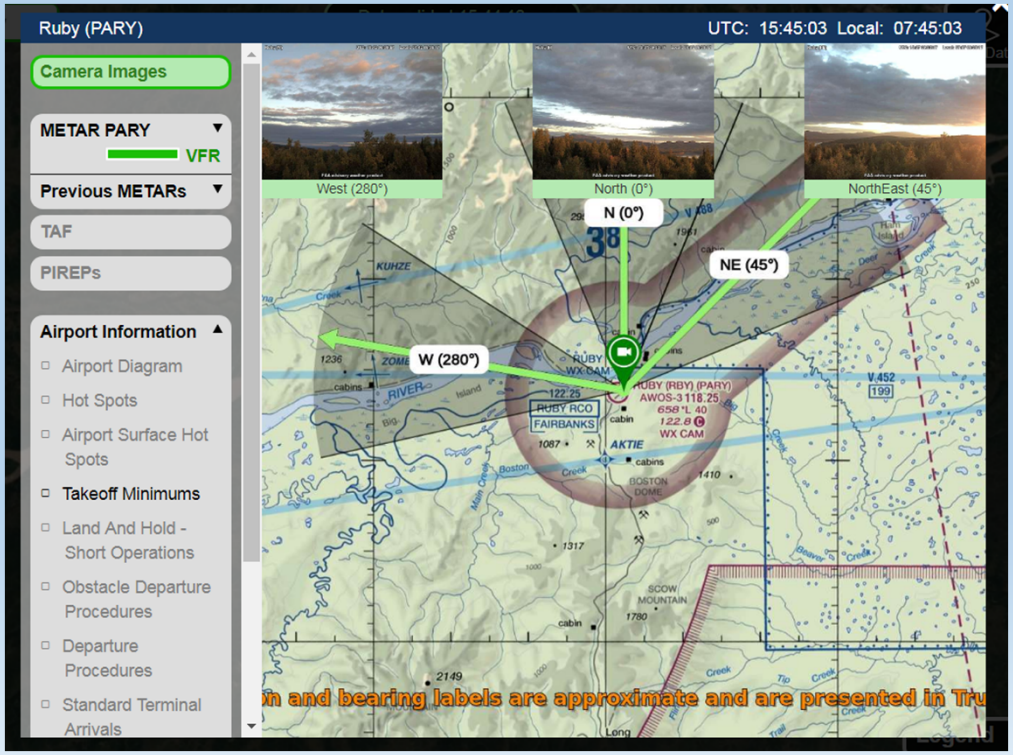
Old Ruby

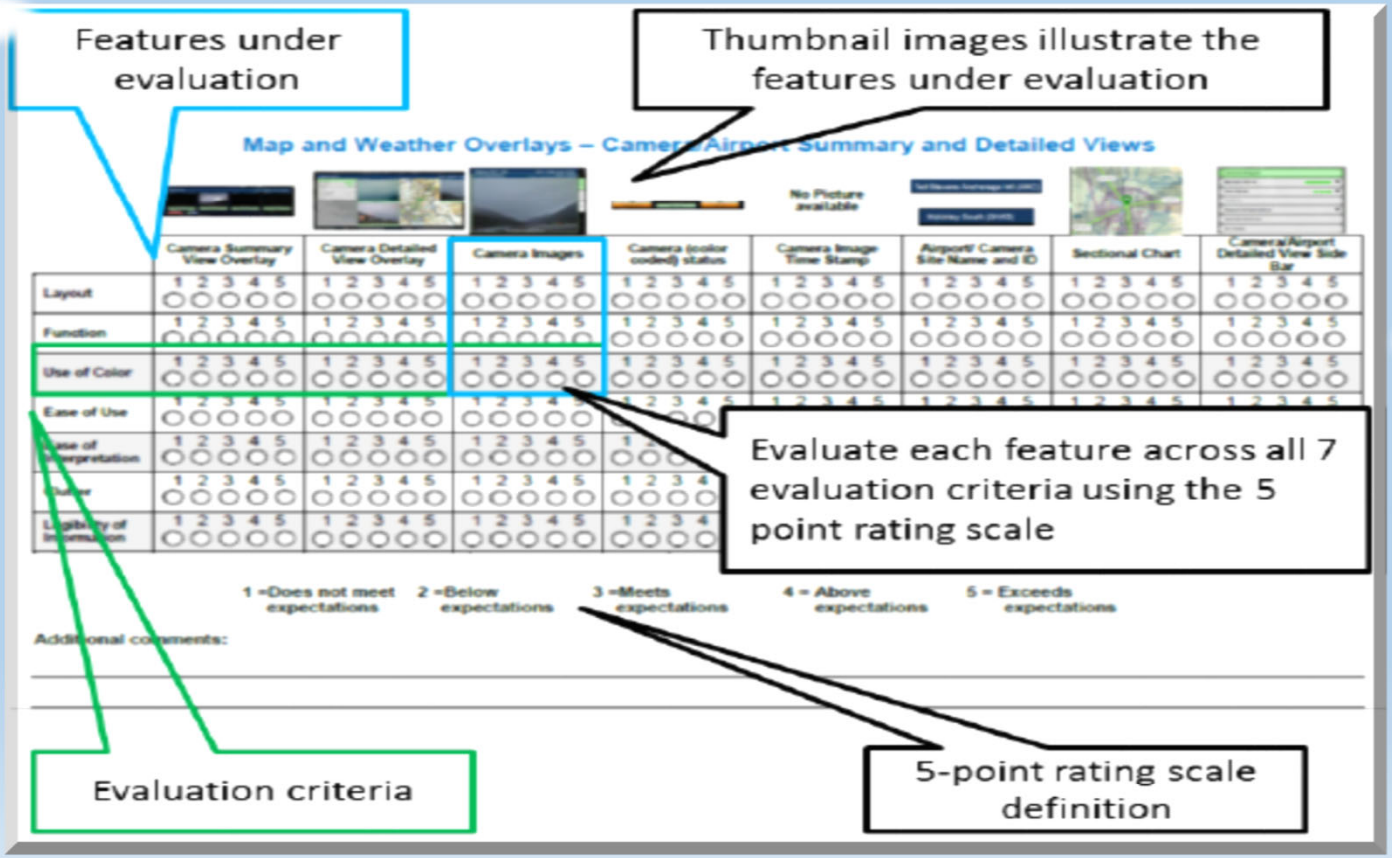
http://avcams.faa.gov

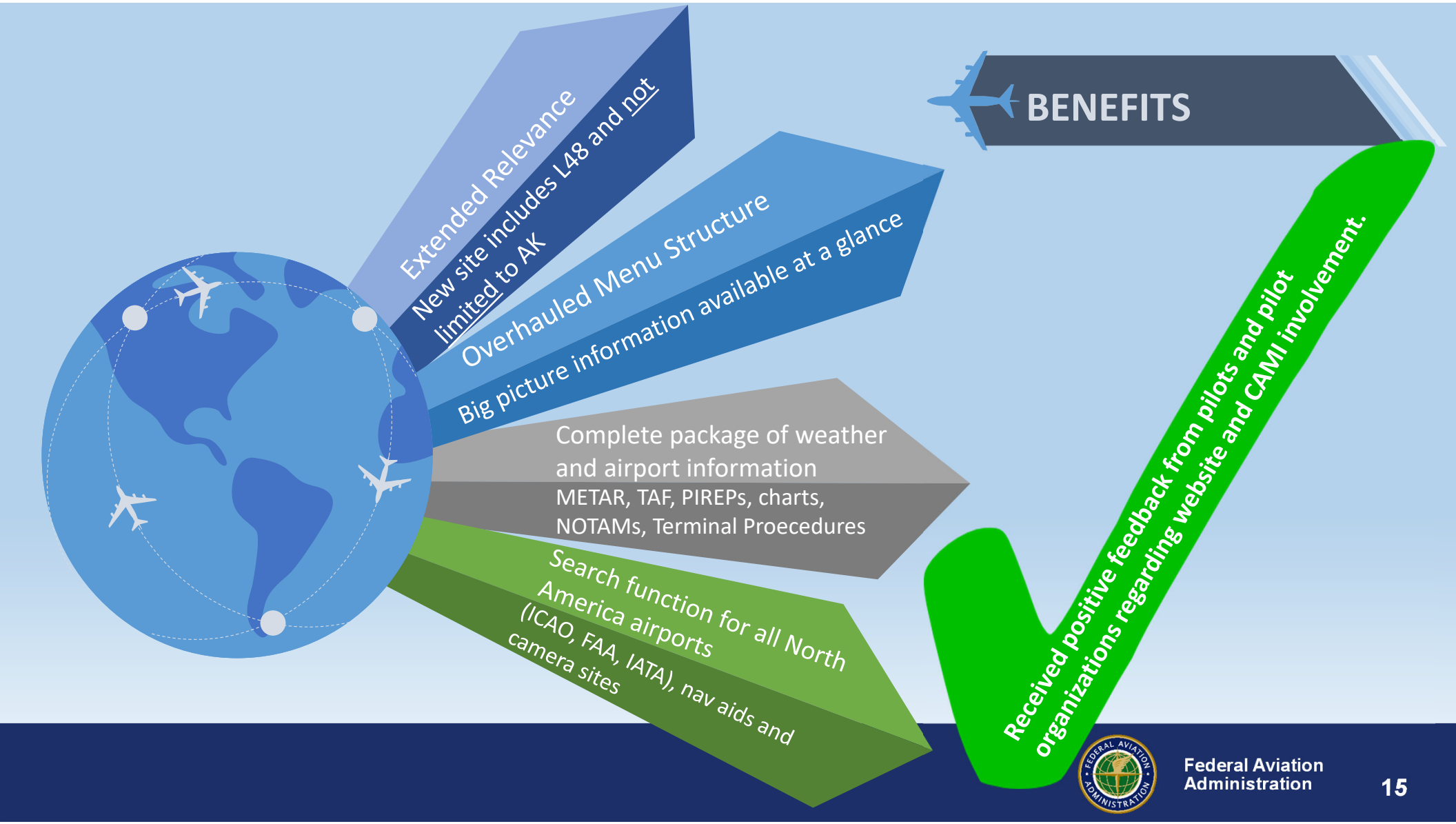


New Ruby

http://avcamsplus.faa.gov/



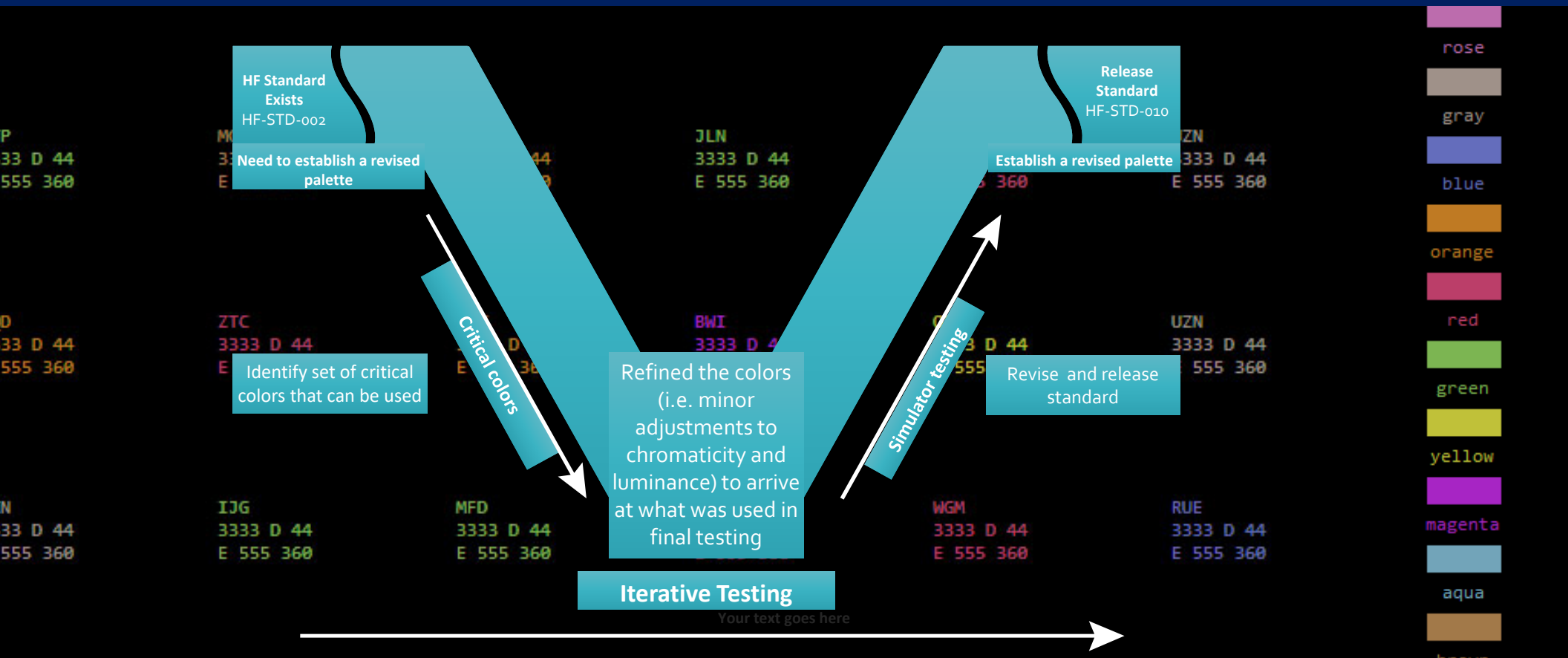

Features under evaluation
Thumbnail images illustrate the features under evaluation
Map and Weather Overlays – Camera/Airport Summary and Detailed Views
No Picture available
Camera Summary View Overlay
Camera Detailed View Overlay
Camera Images
Camera (color coded) status
Camera Image Time Stamp
Airport/ Camera Site Name and ID
Sectional Chart
Camera/Airport Detailed View Side Bar
Layout
Function
Use of Color
Ease of Use
Clutter
1 2 3 4 5
Evaluate each feature across all 7 evaluation criteria using the 5 point rating scale
1 =Does not meet expectations
2 =Below expectations
3 =Meets expectations
4 = Above expectations
5 = Exceeds expectations
Additional comments:
Evaluation criteria
5-point rating scale definition


BENEFITS
Extended Relevance
New site includes L48 and not limited to AK
Overhauled Menu Structure
Big picture information available at a glance
Complete package of weather and airport information
METAR, TAF, PIREPs, charts, NOTAMs, Terminal Proecedures
Search function for all North America airports (ICAO, FAA, IATA), nav aids and camera sites
Received positive feedback from pilots and pilot organizations regarding website and CAMI involvement.

Color Vision

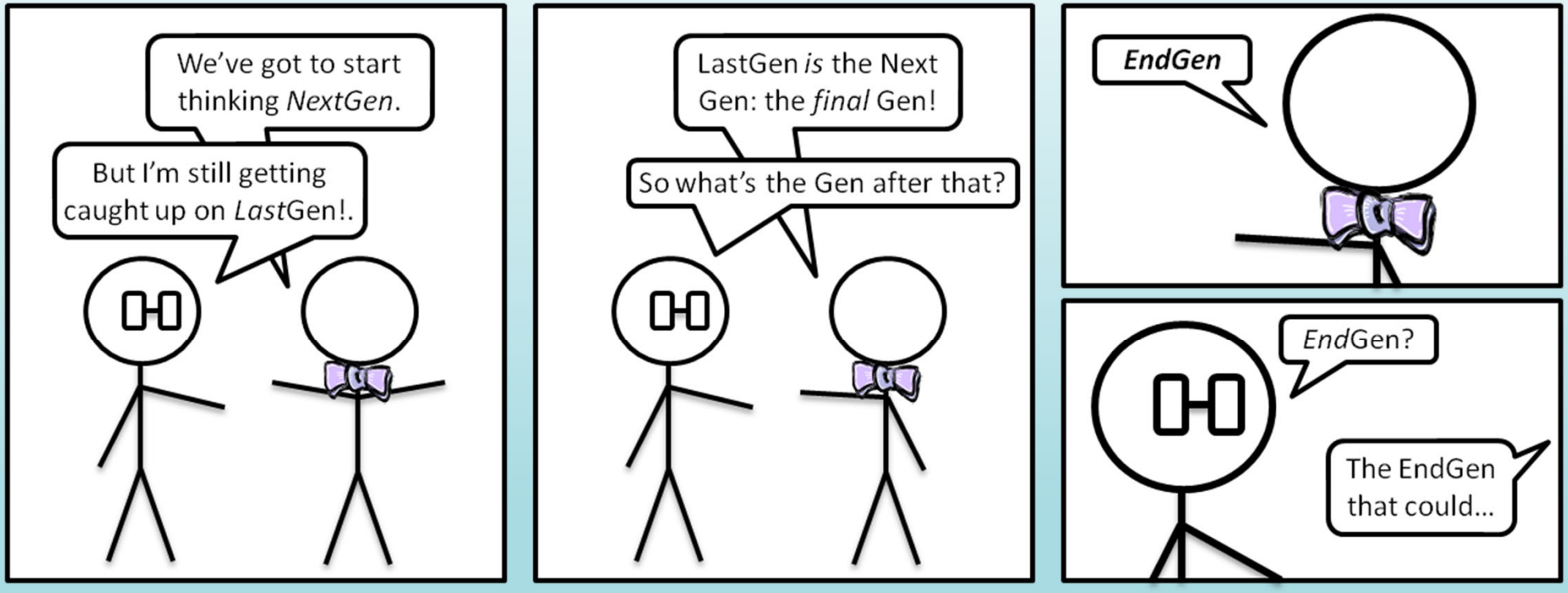
- Develop a color palette that will be usable for Normal Color Vision individuals as well as those with Color Vision Deficients currently in the ATCS workforce.
- To ensure that the study participants accurately represent the ATCSs with CVDs now working, we have tested all participants using the ATCOV (air traffic controller practical color vision test) that uses the colors found in STARS, ARTS, ERAM, and Ocean21 systems.
- The goal of the study is to increase the number of usable colors within a standardized color palette from which system developers can choose colors for additional tasks/functions.

Color Vision Systems Engineering Diagram



FAA HF-STD-010 (*Color Use in Air Traffic Control Systems*) is a new color standard that will replace HF-STD-002 (*Baseline Requirements for Color Use in Air Traffic Control Displays*).

NextGen


We've got to start thinking *NextGen*.
But I'm still getting caught up on *Last*Gen!.
LastGen *is* the Next Gen: the *final* Gen!
So what's the Gen after that?
EndGen
*End*Gen?
The EndGen that could...

NextGen HF

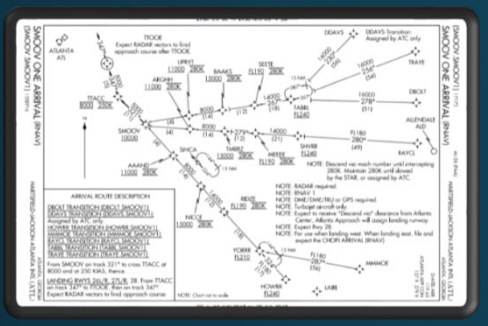
- FAA has accomplished significant progress regarding NextGen. The storyboard highlights the many systems and capabilities that are key to success.
- Performance Based Navigation (PBN) is central to many benefits and is available at all phases of flight. FAA has published over 9,000 PBN procedures and routes. Area Navigation (RNAV) and Required Navigation Performance (RNP) underlie PBN.
- Published navigation charts convey the performance requirements to pilots.
- As of April 2017, the FAA had published 6,954 RNAV and 393 RNP approaches.
- These procedures are necessary but can add additional complexity for pilots. The PARC/CAST Flight Deck Automation Working Group found that complex and unfamiliar procedures can present a challenge.

http://www.faa.gov/nextgen/update/progress_and_plans/pbn/

PBN NAS Navigation Strategy 2016

Instrument Flight Procedure Subjective Complexity

Divya Chandra, Ph.D. and Rebecca Markunas, Ph.D. (2017) Volpe



Purpose

Understand subjective complexity for line pilots
Interviewed 45 pilots that reviewed and briefed IFPs to each other. 2 SIDs, 2 STARs, 2 IAPs

Method

Individual and group review; discussion asked features that make an IFP difficult, pilot training recommendations, feedback for designers

Created summary file from notes both observations and information during discussion. Categorized into topic areas

Recommendations

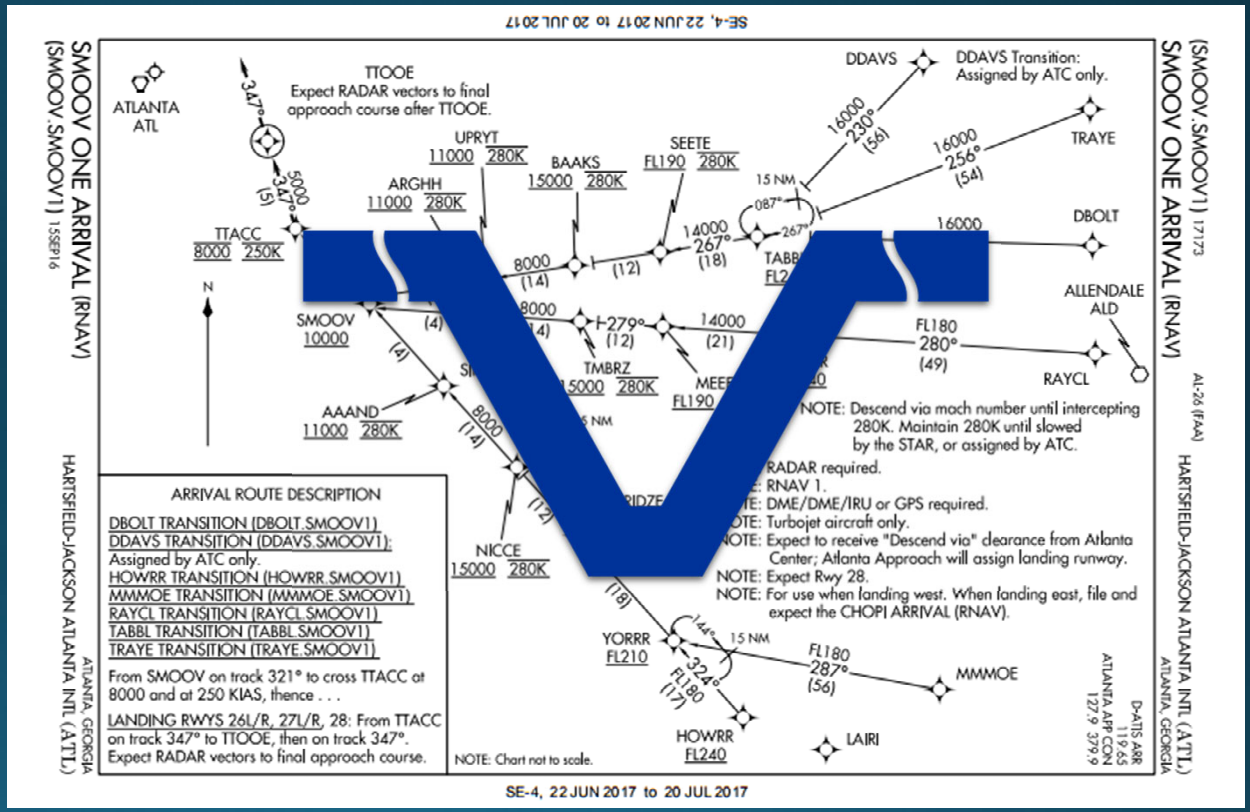
Minimize flight path constraints and transitions; energy paths should be smooth between adjoining IFPs; memorable waypoint names, design for normal not best case, educate designers and controllers on aircraft equipment variation and flight deck tasks, increase range of when runway changes are not allowed

–"Planning and flexibility are competing values. With planning , humans can accomplish complex and tightly coupled tasks extremely well, but accommodating change can break all those complex sequences in disastrous ways." (Tom Chidester, PhD)

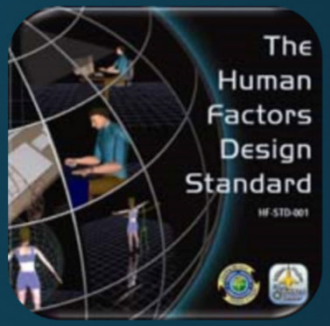
http://ntl.bts.gov/lib/62000/62100/62196/IFP_Subjective_Complexity_Report_Final_072517.pdf

Can procedures that have current amendments without full benefits, benefit from reviewing the recommendations?

Can we employ the complexity criteria prior to new procedures being implemented?



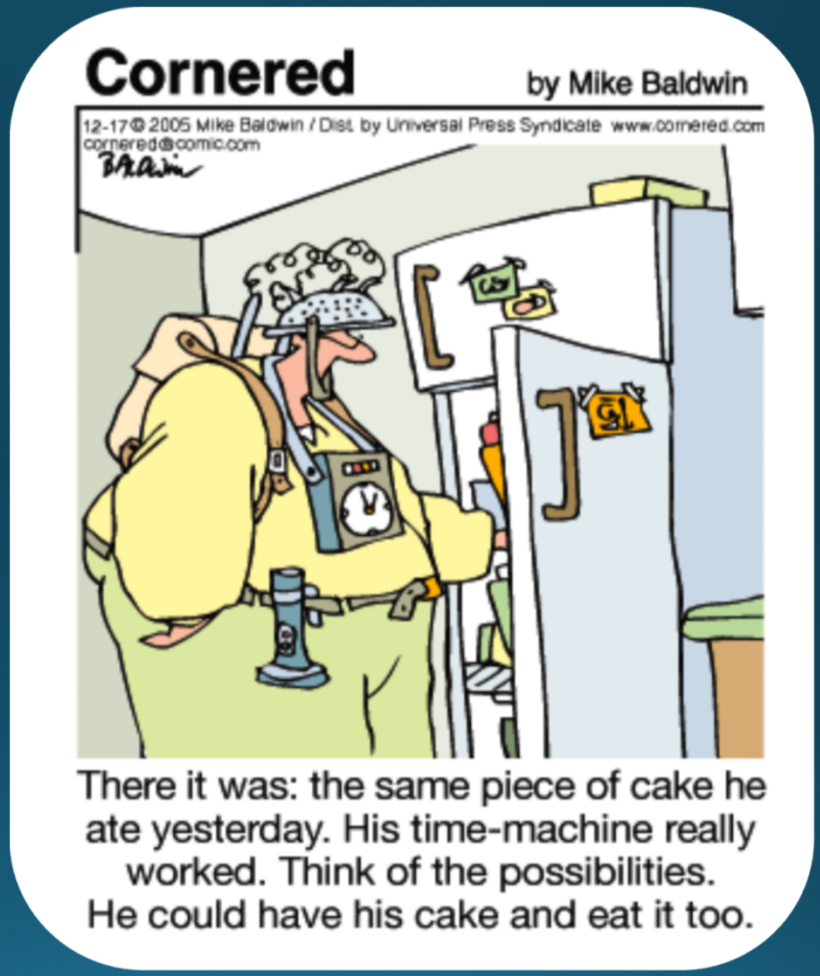
Conclusions



- **Human Factors research** is an integral part of verification and validation and key to improvement and success.
  - Early involvement is key for efficiency and controlling costs.
- Humans are fundamental to achieving complexity consciousness of NextGen.
  - **Operator/user education**
    - **Shared understanding and implications**
      - **Operator, planner, and strategist**

"We must design for the way people behave not for how we would wish them to behave." (D. Norman, 2011)

Questions?


Cornered
by Mike Baldwin
12-17 © 2005 Mike Baldwin / Dist. by Universal Press Syndicate www.cornered.com
cornered@comic.com
There it was: the same piece of cake he ate yesterday. His time-machine really worked. Think of the possibilities. He could have his cake and eat it too.