

UX Usability Methods for Enterprise/Expert Systems

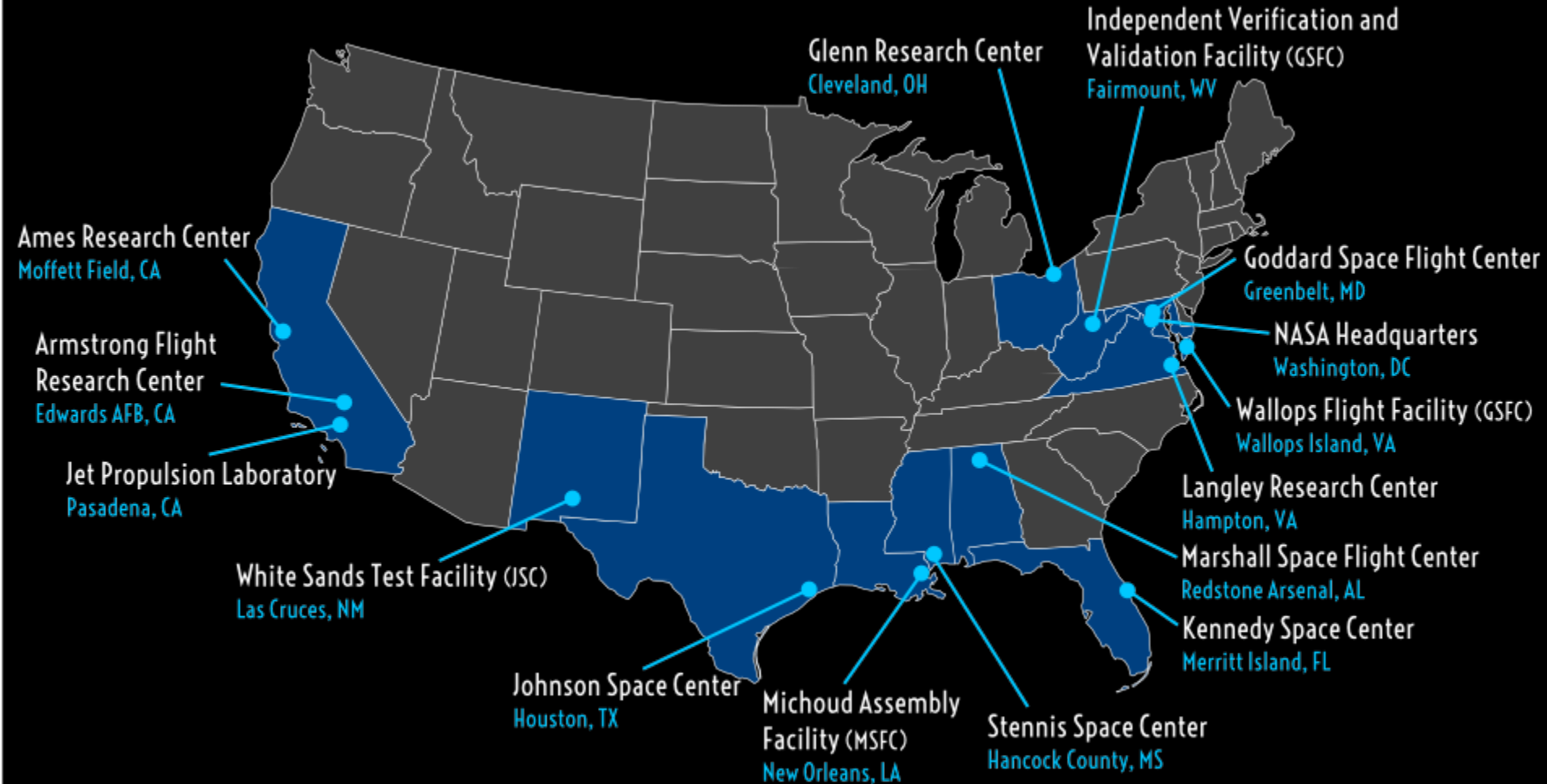
Matt Sharpe

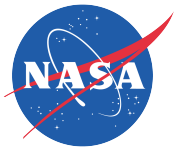
Matt Guibert

NASA Ames Research Center
Human Computer Interaction Group
October 2015



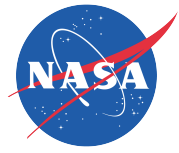
NASA Centers





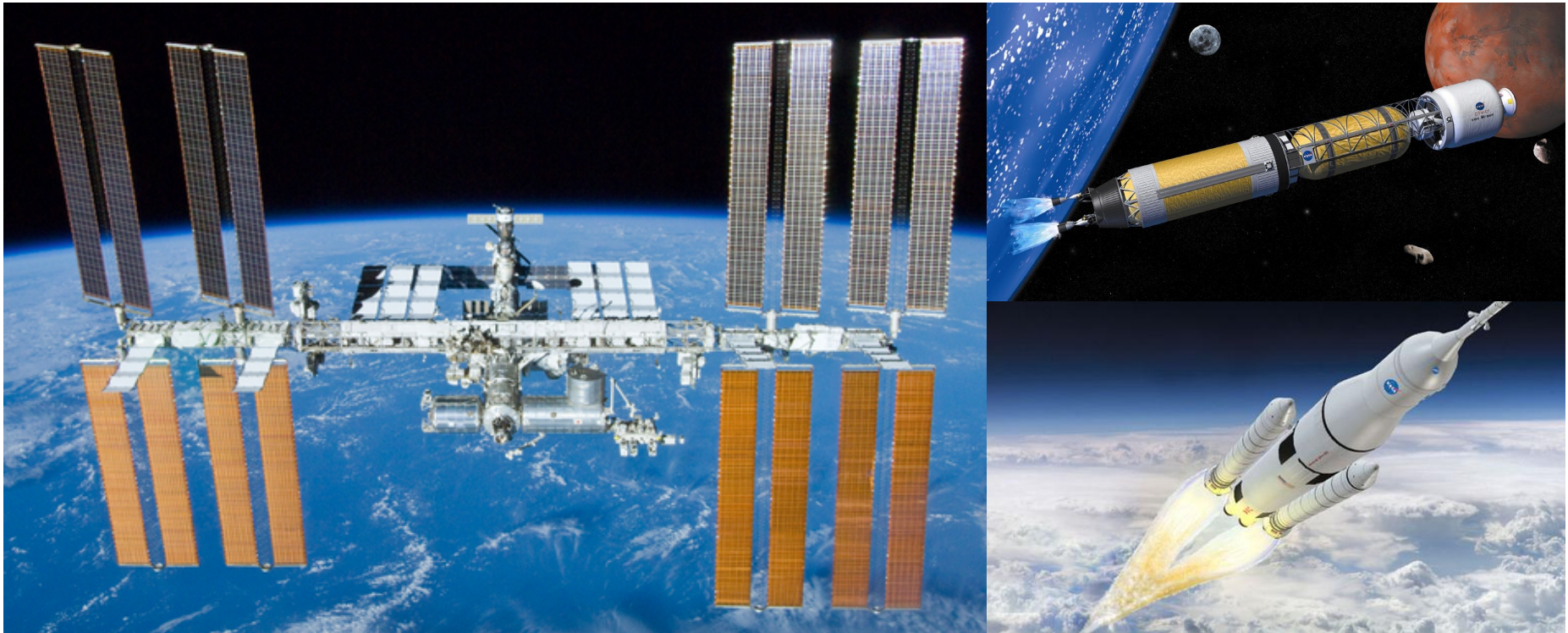
NASA Ames Research Center





The HCI Group

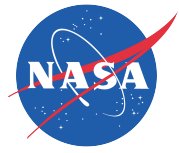
- We are an *applied* HCI group.
 - 18 production systems
 - 19 production integrations
- We build engineering data systems and integrations:
 - Web systems
 - Mobile applications
 - Data integrations





Expert Users





Representative System Example

Operations Task: find all analyses related to an anomaly.

Historical Process: With no search capabilities, analysts used prior knowledge/trial and error to browse through the available flight folders (48 total) to find when the affected hardware flew to ISS. Once the flight is found where the analysis is located, open each MS Word document in the folder and scan through to find the applicable analysis (one document in particular was 1719 pages long).

Operations estimated this process took ~3 days.

"Spent a lot of time collecting data, and spent little time analyzing it"

"Got a lot of data, but very little information"

"If the [legacy] system had the searching capability that the [new] system did, this would've taken a few hours"



HAZARD
CROSS-PROGRAM

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Search: enter keywords, record ID, etc.

Home | Charts | Advanced Search | Help | Signatures | Saved Searches | Whining | Prefs | Admin

Hazard
[Hazard] Record 5720 - INWORK
(MPCV-XXXX-001) Ignition of Flammable Atmospheres (edit)

Basic Information	Causes
Causes	CAUS1. Introduction of a Flammable Atmosphere
Controls	Causes ID: CAUS2 <input type="button" value="Delete"/>
Verifications	Cause Title: <input type="text" value="Arc / Spark Ignition Sources"/>
Supporting Information	Full Transfer: <input type="button" value="No"/>
Related Documents	Severity: <input type="button" value="Catastrophic"/> definitions
Approvals and Concurrences	Likelihood: <input type="button" value="Low"/> definitions
	Fault Tree Reference: <input type="text"/>
	Cause Description: <input type="text" value="The ignition/explosion of a flammable atmosphere in MPCV"/>
	Effect(s): <input type="text" value="Creation and subsequent ignition of a flammable atmosphere may cause catastrophic damage to vehicle structures, safety critical systems, damage to launch processing facilities, or injury"/>
	Likelihood Justification: <input type="text"/>
	<input type="button" value="Add CAUS3"/>

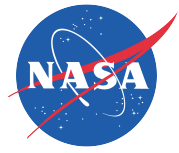
Related Controls:

1 CTRL2 <input type="button" value="Edit"/>
Design • EGSE hazard proofing
<input type="text"/> provided EGSE that is to be operated in locations where fire or explosion hazards may exist, as defined by <input type="text"/> Code, Article <input type="text"/> , are listed by a nationally recognized testing agency for use in that location in accordance with <input type="text"/> or are purged and pressurized in accordance with the requirements of <input type="text"/>
2 CTRL3 <input type="button" value="Edit"/>
Design • Prop Provisions for Electrical Grounding
The spacecraft design <input type="text"/> includes provisions for electrical grounding to the hazardous <input type="text"/> panel and associated Ground Systems-provided propellant loading equipment and facilities.
3 CTRL5 <input type="button" value="Edit"/>
Design • MGSE IAW 72506
<input type="text"/> provided EGSE electrical systems and their grounding / bonding complies with <input type="text"/> in accordance with <input type="text"/> Standard for the Design and Fabrication of Ground Support <input type="text"/>
4 CTRL7 <input type="button" value="Edit"/>
Hazard transfer • XFER to FLT- (Ignition sources)
No information listed

Add Controls – or – Reuse Controls

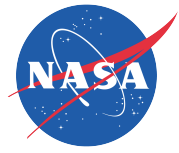
Created:2014-08-20 17:03 PDT by
Modified:2015-09-28 14:12 PDT (History)

Hazard PDF - Create Record Snapshot - XML - Transfers



System Benefits

- **Streamlined, consistent data entry** — provides in context training and help documentation for process compliance.
- **Structured searching** reduces search time and ensures that engineers find the *complete* set of records efficiently.
- **One consolidated system** reduce overhead/maintenance and ensures configuration control while providing a single entry point for Ops use.
- **Full change history** provides tracking of updates to individual aspects of a report (e.g. severity changed from moderate to catastrophic).
- **Complete version tracking** ensures that each version has the full analysis available in one place.
- **Robust security model** supports participation of International Partners, Universities, etc while protecting proprietary and ITAR data.



Representative Data Integration Example (1)

Historical Process

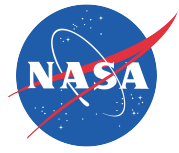
Part Number:	<input type="text"/>
◆ Part Name/Drawing Title:	<input type="text"/>
◆ Manufacturer:	<input type="text" value="..."/>

23% Completion

Current/Improved Process

VMDB Linkable Fields	
Part Number:	<input type="text" value="SED321XXX-XXX"/> linked
◆ Part Name/Drawing Title:	<input type="text" value="G-SUITS"/> linked
◆ Manufacturer:	<input type="text" value="NASA Contractor"/> linked

86% Completion



Representative Data Integration Example (2)

ESD Requirements

Program Requirements

Program Verifications

Assessment

	Program Requirements						Program Verifications						Assessment
	Req #	Requirement Title	Requirement Language	Requirement Rationale	Specified By	Allocated To	ID	Name	Effectivity	OBJECTIVE	SUCCESS CRITERIA	Verification Method	
18	R-6	Orion-CM Imagery	The LRE Descent Imaging Subsystem shall provide	Use recovery ship imaging assets to: provide optical data on post-	Landing and Recovery Element (LRE) EIT	Communication Systems (Comm) EIT	760		EFT-1	Review results of C3R verifications prior to operations.	Inspection complete	Inspection	sufficient for [REDACTED]
							7270	Orion EM-1		The LRE documentation will be inspected to verify that stabilized imaging assets are provided to [REDACTED]	Ensure imaging assets are provided that capture stabilized imaging of crew module, parachutes and forward bay cover.	Inspection	sufficient for [REDACTED]
19	R-6	Recovery Team Communication	The LRE CM Recovery team shall	Use recovery ship communication capability to: transmit	Landing and Recovery Element (LRE) EIT	CM Recovery Ship	763		EFT-1	C3R methods associated with Underway Test to verify requirements are satisfied.	Inspection complete	Inspection	Is [REDACTED] part of underway test? They are both involved [REDACTED] but no mention [REDACTED] here. If [REDACTED] piece covered, then this would be sufficient for [REDACTED]. Would want to see involvement of [REDACTED] in [REDACTED]
13	R-6					Command Control Communications and Range (C3R) IPT	###		EFT-1	[REDACTED] data to Mission Control Center at JSC. (during Underway Test)	JSC receives data	Demonstration	sufficient for [REDACTED]
14	R-6						###	01	EFT-1	[REDACTED] recovery ship communications capability. (during Underway Test)	JSC receives file	Demonstration	sufficient for [REDACTED]
15	R-6						###	02	EFT-1	[REDACTED] Provide recovery team with internet access during the underway test using the recovery ship communications capability. (during Underway Test)	The analysis shows that [REDACTED] provided is sufficient for [REDACTED]	Analysis	sufficient for [REDACTED]
16	R-6						###	03	EFT-1	[REDACTED] Provide [REDACTED] communications during underway test using the recovery ship communications and any [REDACTED]	The analysis shows that [REDACTED] team is sufficient for [REDACTED]	Analysis	sufficient for [REDACTED]
17	R-6						###	04	EFT-1	[REDACTED]	[REDACTED]	Analysis	sufficient for [REDACTED]
18	R-6						###		EFT-1	[REDACTED]	[REDACTED]	Inspection	sufficient for [REDACTED]
19	R-6	Video Uplink	The LRE Descent Imagery Subsystem	The [REDACTED] includes [REDACTED] footage from the [REDACTED]	Landing and	Communication Systems (Comm)	766		EFT-1	Review results [REDACTED]	Review complete	Inspection	Is the [REDACTED] demo different than [REDACTED] test? This is probably [REDACTED]



Trace powered by **Dig-IT** matthew.d.sharpe@nasa.gov

HOME REPORTS SEARCH **BROWSE** WORKSPACE

ESD	EVAT Assessment [8]	ESD Cradle Requirement [1]	ESD Cradle Requirement [1]
Assessment	Size R-2 Crew Size	GSDO Cradle DVO [438]	EVAT Assessment [1]
Requirement	R-16 Recovery R-6 Nominal Post-Landing Crew Recover,	GSDO Cradle Requirement [35]	GSDO Cradle Change Notice [2]
DRM	R-7 R-7, Post Landing Crew Survival	65 ESD R-11: Lift Capability	GSDO Cradle DVO [1]
show more	R-15_Assessment R-15 Launch Rate	84 Receipt of Flight Elements	GSDO Cradle Equipment [2]
GSDO	R-11_Assessment R-11 Lift Capability	89 Transportation of Flight Elements	GSDO Cradle Requirement [36]
SLS	R-12_Assessment R-12 Payload Dimensions	90 Offline Operations	
MPCV	R-20_Assessment R-20 Audio and Motion Imagery	91 Integrated Operations	
		92 Integrated Testing	
		93 Integrated Stack Transportation	
		94 Pad Operations and Launch	
		95 Ground Element Refurbishment	
		97 Post-Flight Processing	
		104 Design Life Duration	
		106 Launch Ready State	

65: ESD R-11: Lift Capability

Cradle ID: 65
Name: ESD R-11: Lift Capability

Frame: Requirement: The Architecture shall deliver a minimum of [redacted] payload for the Tactical capability and [redacted] for the Strategic capability to [redacted] degrees inclination, with a demonstrable evolution path to [redacted] metric tons.

CM Status: Baselined

Frame: Rationale: HEFT Design Reference Mission analysis indicates that launch vehicles in the [redacted] metric ton class are necessary to enable Strategic missions. The [redacted] metric ton Tactical requirement will provide the ability to [redacted] path and is called for as part of the [redacted] 2010. [redacted] lift capability allows the architecture to conduct mission types from the Strategic DRM set. As more challenging missions are needed, the launch vehicle lift capacity needs to support a [redacted] metric ton class. The launch system needs to consider this [redacted] metric ton capability throughout its design to ensure that this capability can be achieved.

Category: ReqType: Performance
Category: Authority: Programmatic
Key: PROG
Version/Draft: 01
Modified Date: 2014-07-30 20:49:09 UTC
Created Date: 2012-03-01 20:25:13 UTC
Security Classification: UNCLASSIFIED

GSDO Cradle

Assessment

R-11_Assessment

Assess?

Orig. ESD Trace

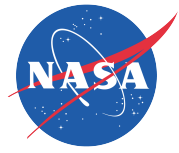
Assessment Result

Sufficient

created by | Nov 24 2014

ESD Assessment > R-11_Assessment > 65

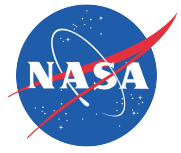
Curator: [Matt Guibert](#) | NASA Official: _____ | Trace v 1.8 r 997 master d89f159 | Dig-IT v 2.8 r 1236 master 15404f8 | Last Updated: Thu Sep 10 09:45:25 PDT 2015 | [Privacy Statement](#)



Integration Benefits

- **Structured searching** reduces search time and ensures that engineers find the *complete* set of records efficiently.
- **Improved efficiency in record creation** reduce overhead/maintenance in validation of information through baselining.
- **Automatically trigger notifications** provides notifications to individual aspects of a report.
- **Quick reference to integrated information** ensures that each reference goes to authoritative piece of information in other system.

Integrated question: If a failure occurs on a piece of hardware, what similar problems have occurred in the past?



Design Process and Methods



Affinity Diagrams

rating of DC

Managerial duties (dutys)

GMIP upkeep

Managers don't track day-to-day
DCMA mostly self-manages inspections
Actual DCMA proceedings obfuscated
Manager relies on QA & owner to review acceptance data

Manager review at CoFR Level
CoFR-Level review of GMIPs
GMIPs can be waived

GMIP maintenance + analysis
No long-term GMIP metrics
Periodic scrubs eliminate non-generalizable
Reduce oversight by reducing frequency of tasks

GMIPs must adapt to changing contexts
Needs to be flexible over project lifecycle
Conditions vary, Guidelines & Rules
Ability to add more GMIPs later
GMIP status changes during a project
Hard to schedule GMIPs due to safety doc revisions

Collaboration + Sharing + Caring

All parties share uniform QA plan
QA great for uniform methods amongst many
Have an explicit, available QA plan!

GMIPs as a collaborative process
Conversation between DCMA, Contractors, etc.
Trust based on competence
Each role has specific expertise to contribute
Project should always get final say DCMA gets bossed around

Informational isolation
Don't centralize all knowledge internally!
Lack of communication between projects

Structured data concerns

Ways to organic feed GMIP
Sort by:
oCR
See GMIPs by Part/Serial number
Group by work site
Milestone

No real data tracking (i.e. Not capturing structured data)
Not associating with oCR (only routing decisions)

Process Product Vendors
Loss of life is focus of risk
Tailoring # of GMIPs based on Risk level (from list)

Vendors using DCMA in lieu of internal QA
Some vendors can't be trusted to handle QA
Contractors rely on DCMA for QA

Objective risk factors
Reference Plans, FMEAs, & knowledge of vendor to identify risk
ESD Scorecard as Risk Identifier
of issues found by DCMA as factor
Look at criticality of item to determine time
Prioritize inspections based on maturity
Production Δs



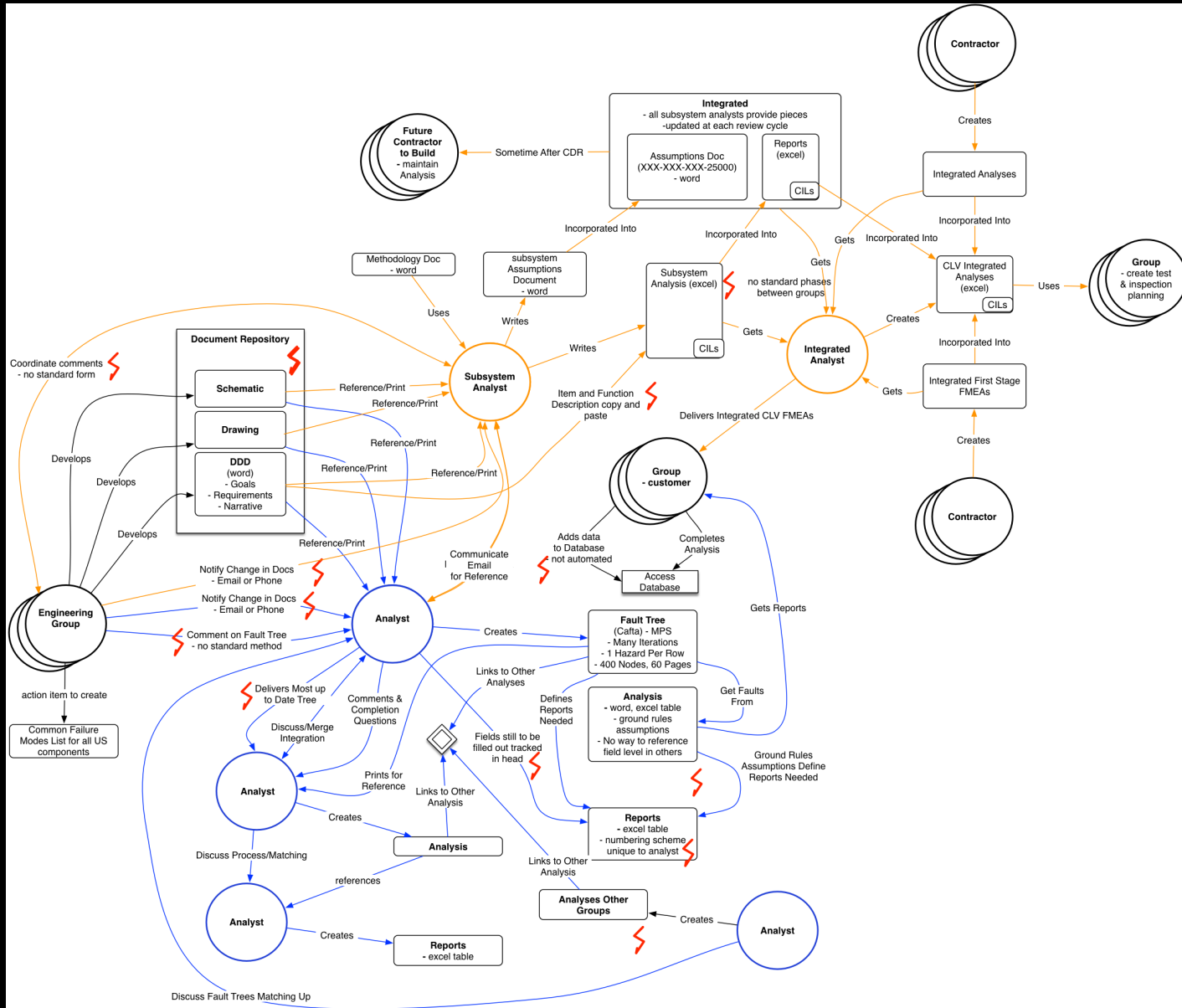
via NASA ([Flickr 9773268932](https://www.flickr.com/photos/nasa/9773268932/))

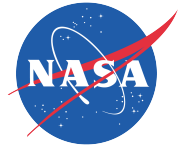
Contextual Inquiry





Models





Wireframing/Storyboards

1

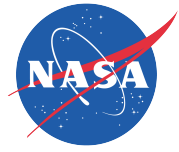
2

3

4

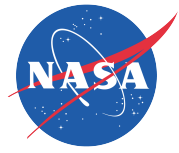
5

6



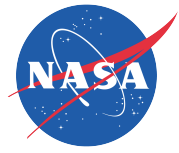
Wireframing/Storyboards

And we always use *real* data.



Usability Testing

- Informal, no usability lab.
- Scenarios need to be detailed and incredibly accurate



~~Personas~~

Typical persona:

- *"Angelline is a safety engineer who loves books about the beach."*
- *"Bob is a flight controller who watches a movie every Saturday."*



Web Analytics and A/B Testing

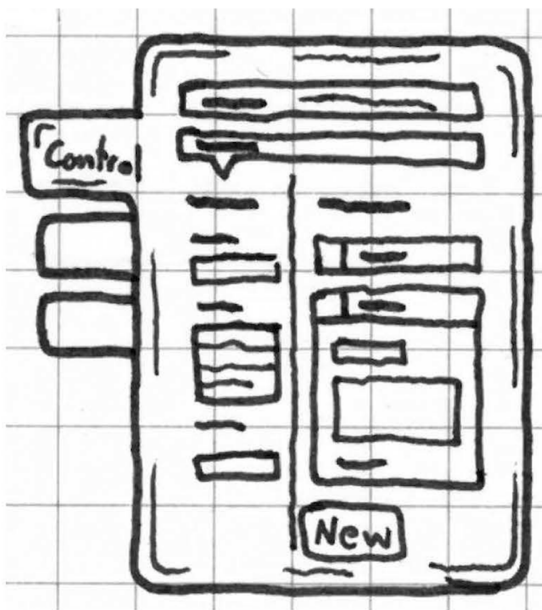




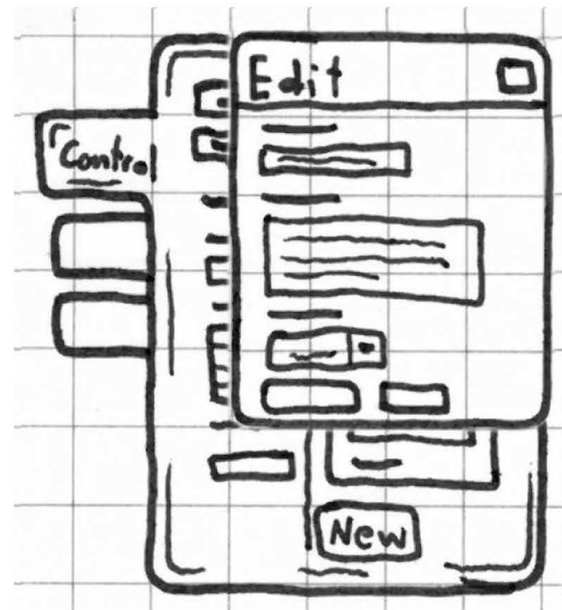
Speed Dating

Status Transition and Control

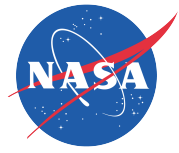
Have you ever had another author edit a cause that you had previously baselined?



Changes to the Cause record are indicated visually. You can also view the old and new versions

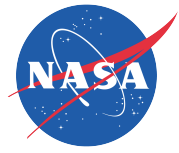


Changes to the Cause record are indicated visually. You can also view the old and new versions



Other Methods

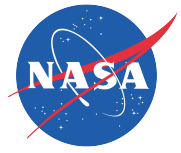
- ~~Heuristic Evaluation~~
- ~~Fitts Law Modeling~~
- ~~Surveys~~



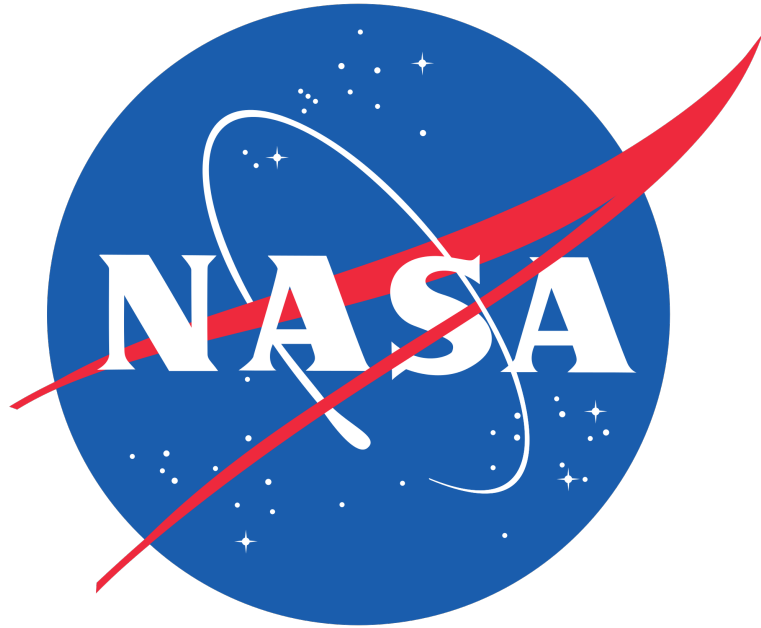
Design(er) thoughts

Our designers:

- Write the initial test case
- Are first to run the test case
- Often double as software testers



Technology should conform to the process, and never a process to technology.



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