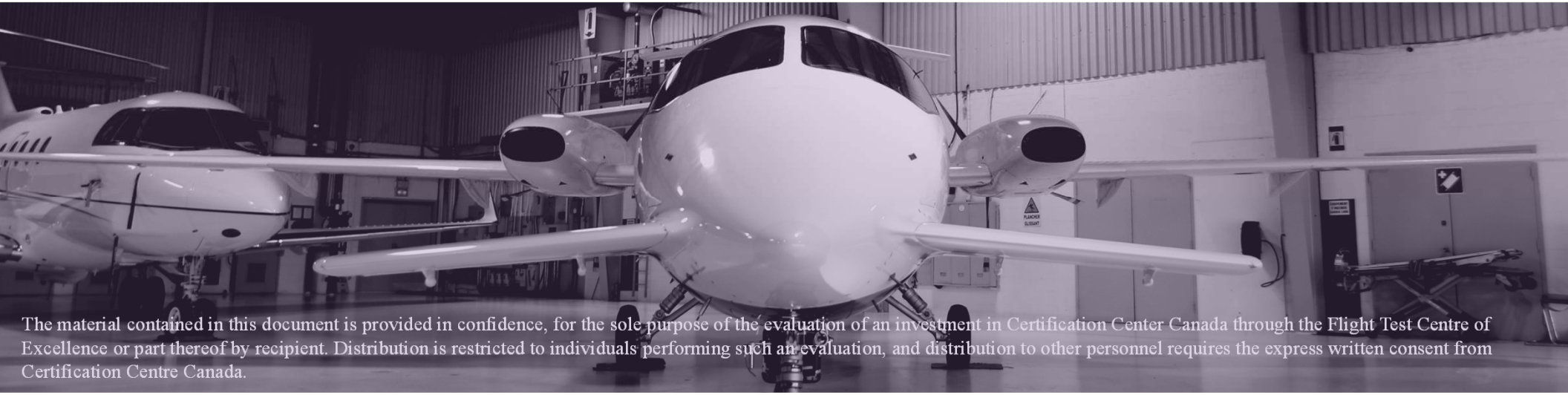
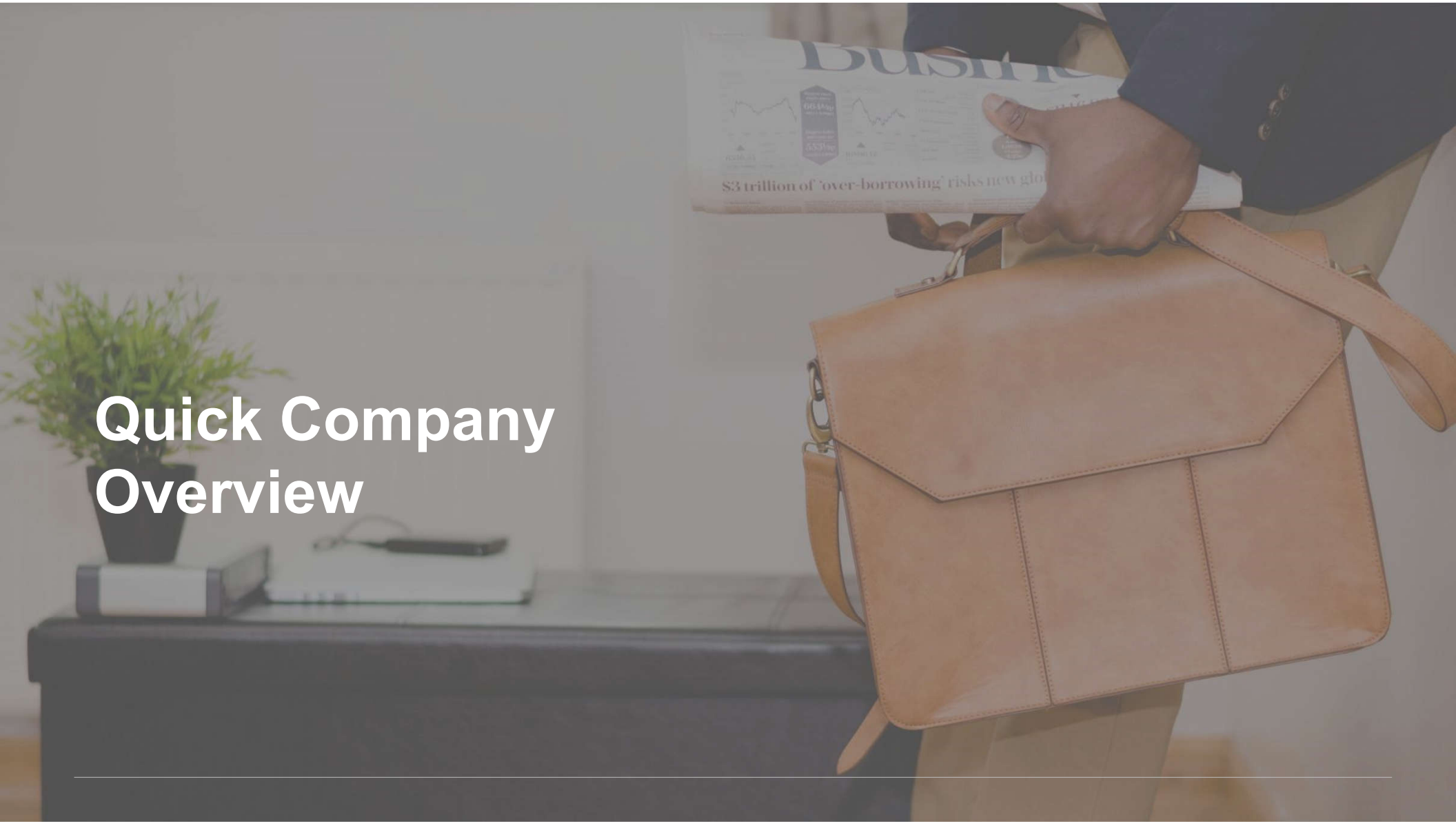
marinvent CORPORATION

APPROVED SYNTHESIS APPROVED

Synthesis Overview

IASS 2020





Quick Company Overview

Marinvent Background

Privately-held Canadian Corp.

Organically funded business since 1983

Two distinct revenue streams serving two different sets of customers

Research and Development, IP generation and IP exploitation

Certification-related services of all kinds.

Stellar track record of success (Many awards)

+50 successful certification programs with TCCA and FAA

CGP and AS9100

marinvent CORPORATION

Management Team

DR. JOHN MARIS
President & Owner

MR. PHIL COLE
Vice President Business Development

MR. SAM GRAINGER
Vice President Operations

Awards

Canadian American Business Achievement Award
Awarded for leading a joint enterprise demonstrating strong business growth, remarkable innovation, noteworthy contributions to local communities and the capacity to provide their partners with a global advantage

Canadian Aeronautics & Space Institute: Trans Canada (McKee) Trophy
Canada's oldest and most prestigious aeronautical trophy awarded to Marinvent for the Canadian whose achievements were most outstanding in promoting aviation in Canada

Aviation Week & Space Technology Laureate
Awarded for "..helping to transition from paper in the cockpit to a digital flight deck."

Canadian Business Aviation Association Industry Award
Outstanding contribution to aviation

Aerospace Association of Quebec (AQA) Prix de l'Entreprise
Aerospace company of the year

Canadian Business Aviation Association Industry Award
Awarded for the safety gains achieved through human factors enhancements, systems engineering and flight test services.

Create the Future Award
APM product winner

New Zealand Ministry of Defense Award of Excellence to Industry
Marinvent singled out as one of the two most valuable contractors from a pool of more than 800 contractors for contributions to C-130 LEP and P-3K capital programs

AIAC James C Floyd Award
Aerospace company of the year

C2-MTL Annual Aerospace Award
Marinvent's work on unmanned aerial systems flight test and evaluation with its Piaggio Avanti project singled out as aerospace innovation of the year

NASA
Small Business Subcontractor of the Year (TASAR)

NASA
LaRC 2014 Group Achievement Award

Canadian Defense Executive of the Year
Dr. John Maris

Canadian Aviation Hall of Fame
Dr. Maris Inducted

Canadian Defense Review
Canadian Top 50 Defense Companies 2015 - 2020

Need for Synthesis® Tools Suite

Ever increasing complexity of projects with external regulations / requirements / acceptance criteria - **COMPLIANCE**

- Constantly changing
- Currently Ad-Hoc tools
- Not integrated
- Lots of paper
- Difficult to status, manage, predict, optimize
- Almost impossible to re-use data

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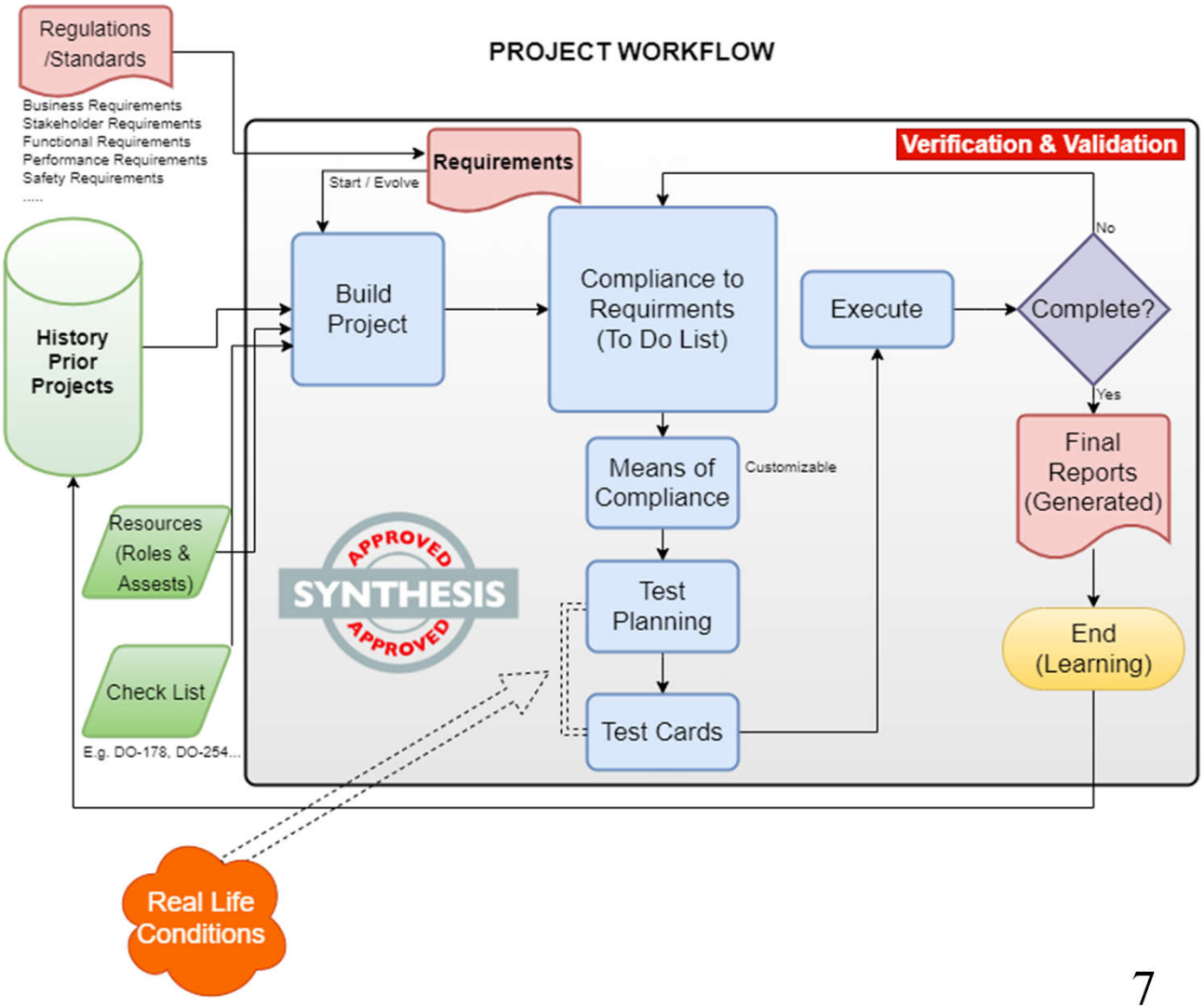
Project lifecycle

- Value increases over time
- Link Teams / Information
- Unifies distributed teams (Supply chain)
- Built for working level
- Provides transparency to Management
- Optimizes execution
- Out-of-box functionality
- "What if" capability
- Standardization



Definitions

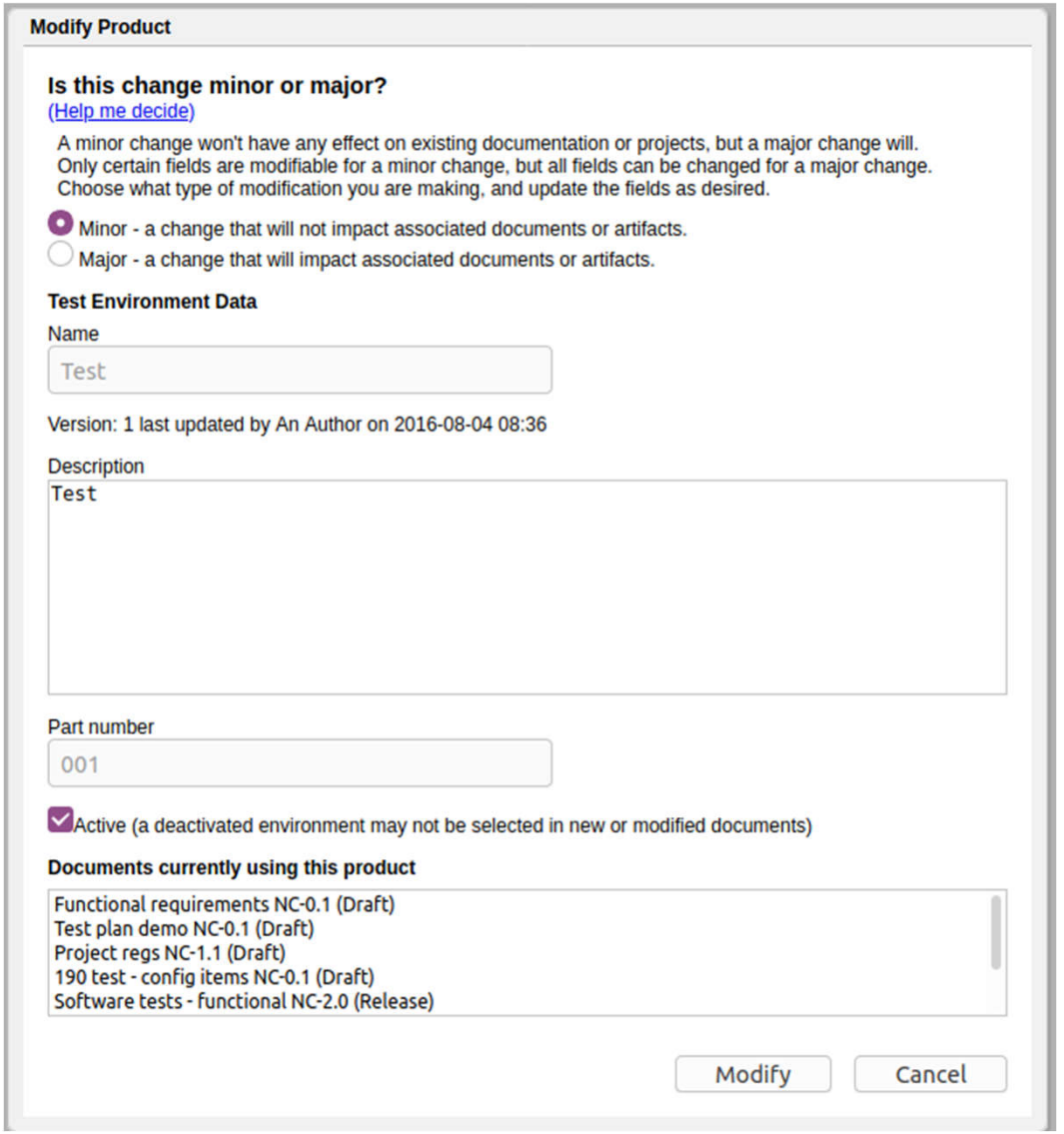
- Product – the end result of a project (a flight release, new release of PoH / aircraft operations with new gear, “certification” of hardware, software, etc.)
- Test environment / equipment, such as an aircraft, simulator, test rig / harness, test bench, etc.
- Users – who is involved on a project (stakeholders, QTP, FTE, FTA, etc.)
- Suppliers – groups of users from different units, companies, stakeholders, who need might need IP separation, of organization
- Test parameters – used to build simple and complex test plans and test cases

Building a Project – Starting Out (big picture)

- A project manager (or user with appropriate permissions) creates a new project when a contract is received and assigns users
- The project manager creates at least one product and test environment for the project
- The project starts with the creation of a requirements document, consisting of contract requirements, which is then reviewed and approved in Synthesis
- A second requirements document is then created which comprises the estimate (schedule cost, etc.), which is also reviewed and approved in Synthesis
- The object of the project is to demonstrate compliance with these two, and any other requirements documents

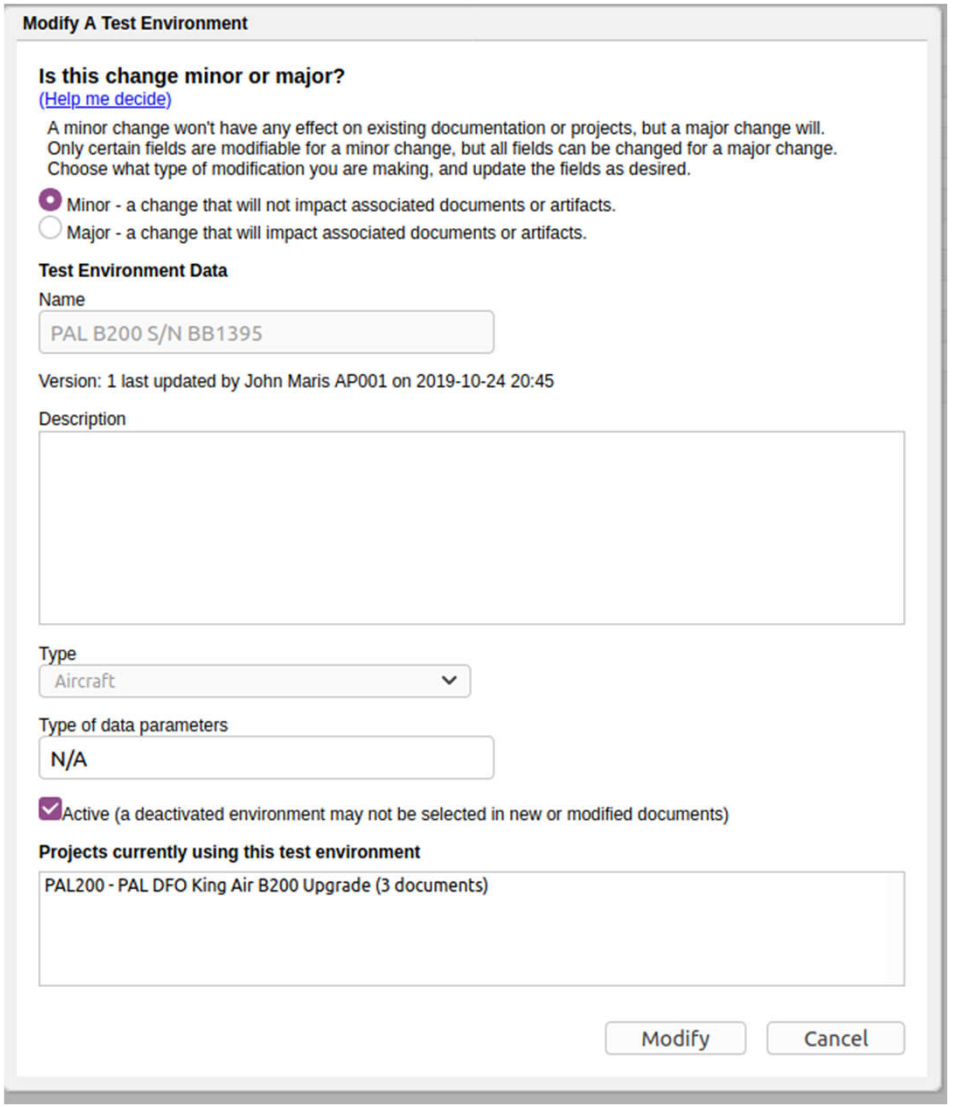
Products

- Versioned - minor & major changes tracked (automatic CM)
- Describes a goal / target in a project
- All project data attached to a product it belongs to
- Changes to a product can drive changes in documents
  - for example, a major change in a product can force related documents to be revised and re-approved.



Test Environment

- Versioned - minor & major changes tracked (automatic CM)
- Describes a test environment, such as an aircraft, sim, bench, desktop PC (anywhere a test needs to take place)
- All project test plan data (tests) are attached to a target test environment testing will occur in (e.g.: target aircraft, system, etc.)
- Changes to a test environment can drive changes in documents
  - for example, a major change in an environment can force related documents to be revised and re-approved to ensure they are still applicable and correct for any changes made to the test environment.

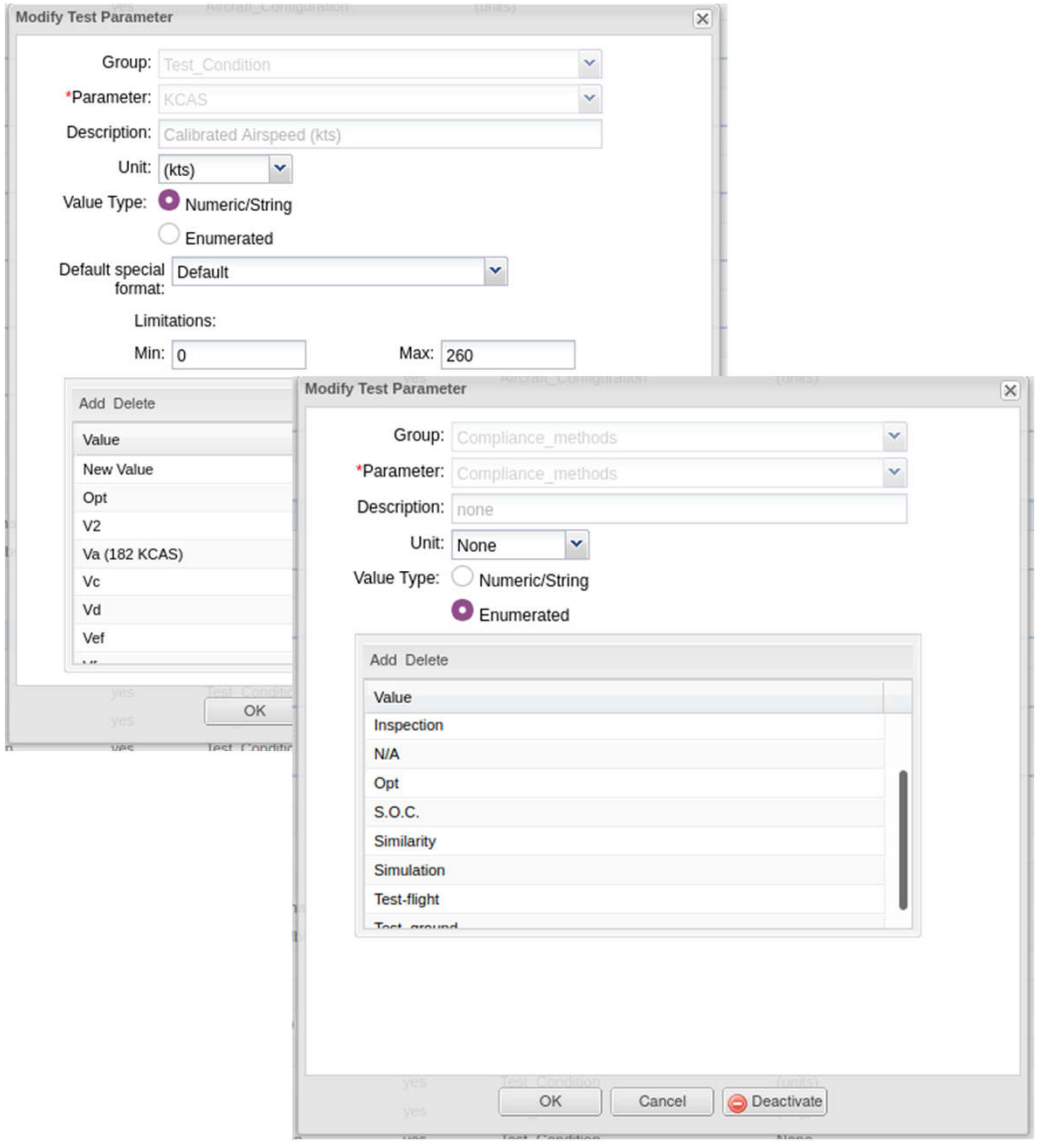


Users / Suppliers

- Build-in basic roles – author, reviewer, approver, observer, project manager, etc.
- Includes approval for differing safety / risk levels in tests (no risk, low, medium, high, very high)
- Supports integration with LDAP, MS ActiveDirectory back-ends or database users

Test Parameter

- Describes an input or output for a test
- Configured for a project
- Ensures consistency across all tests and between test plan authors
- Can be any type of data with formatting and optional minimum and maximum limits
- Can define conditions for a test, and/or data to be collected / recorded when executing a test
- Configurable field from free-form entry, to restricted “pick” list



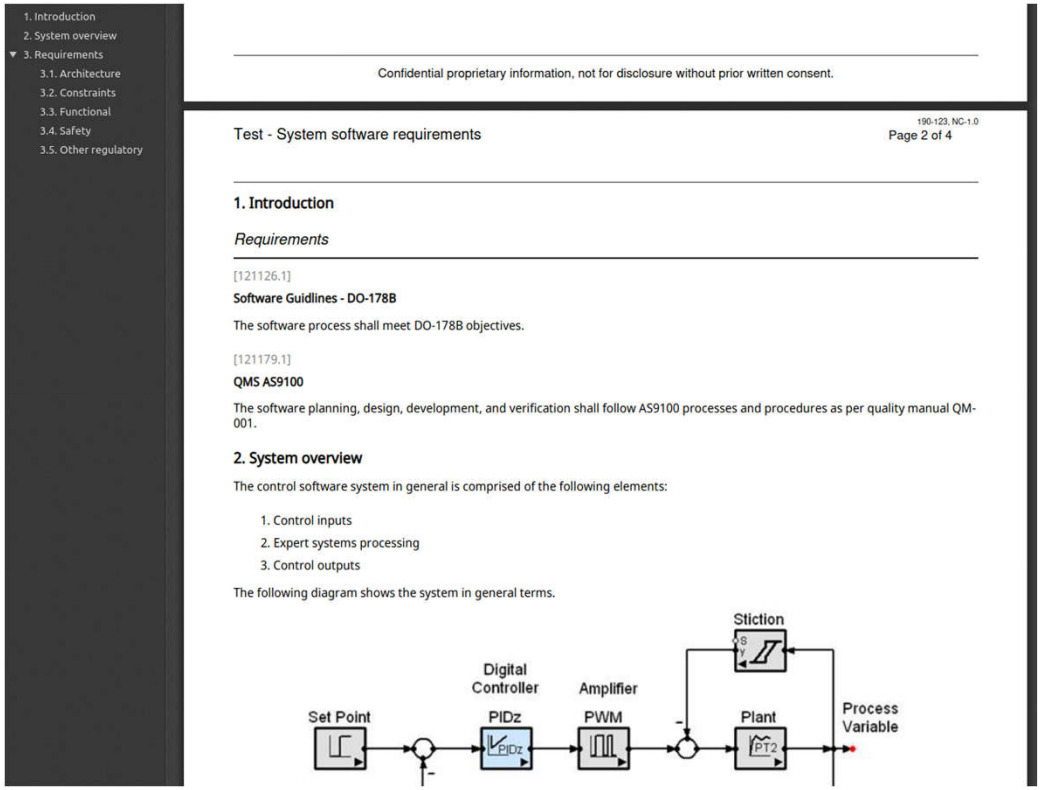
Building a Project – Next Steps

- All Synthesis projects are requirements driven
- Requirements can be anything that needs to be achieved, from contract requirements, functional, constraints, etc.
- Either the project manager can create documents and assign them to users, or individual users with author permissions can create documents
- Documents can also be general reports, memos, analysis documents and so on.

Documents

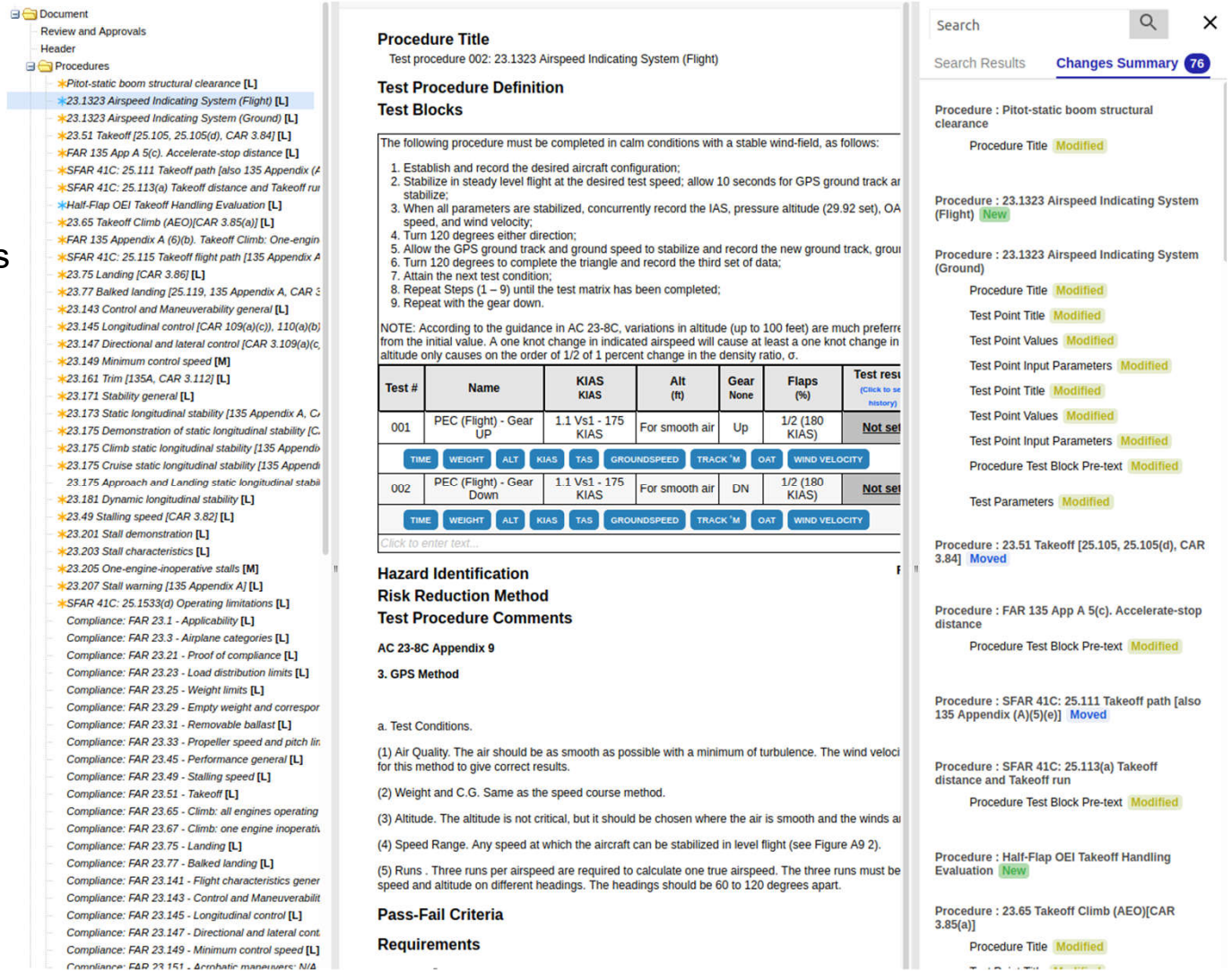
- Hierarchical, data-driven, documents (outlined numbering)
- Allows engineers to enter the data, and not worry about the layout
- Auto-generated indexes, headers, footers (including security markings, e.g.: built-in Top Secret, Secret, Protected, ITAR/Controlled Goods Restricted, Unclassified, and customizable)

- Automatic draft watermarks
- Revision history and automatic configuration manage and history
- PDF output
- Built-in dictionary (no data sent offsite)



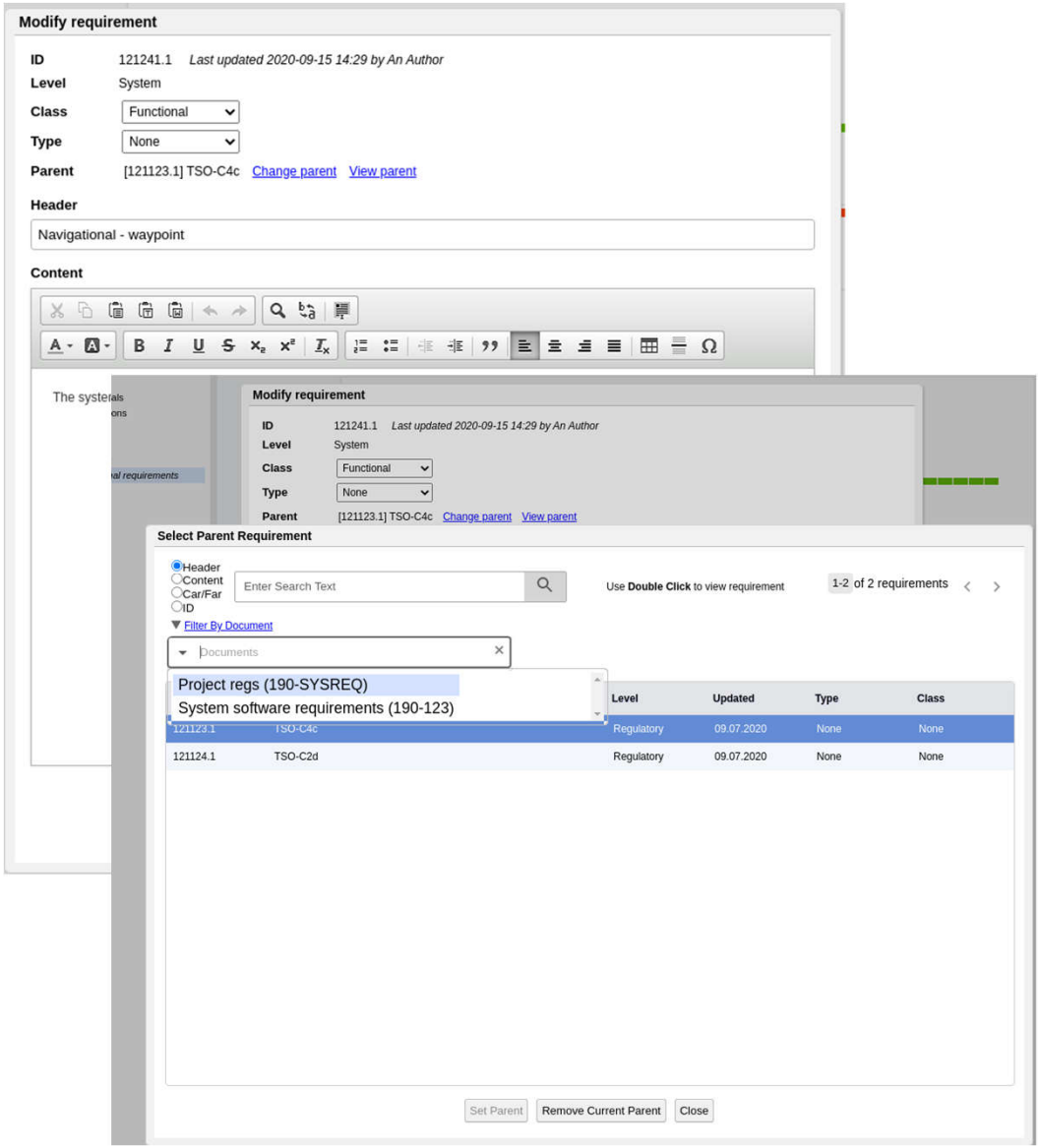
Documents

- Live change tracking, including outdated requirements and requirements with outdated parents
- Modification / differencing of all document data, such as section text, requirements, test points
- Search for any text in any data (requirement, CAR/FAR, sections, test points, etc.)



Requirements

- Hierarchical requirements with configurable levels (default levels in order are Contract, Regulatory, System, Subsystem, Design)
- Parent-child relationships between levels
- Support for CSV import
- CAR/FAR regulatory fields (fully searchable)
- Configuration managed and versioned
- Labeling (safety, functional, constraint, etc.)

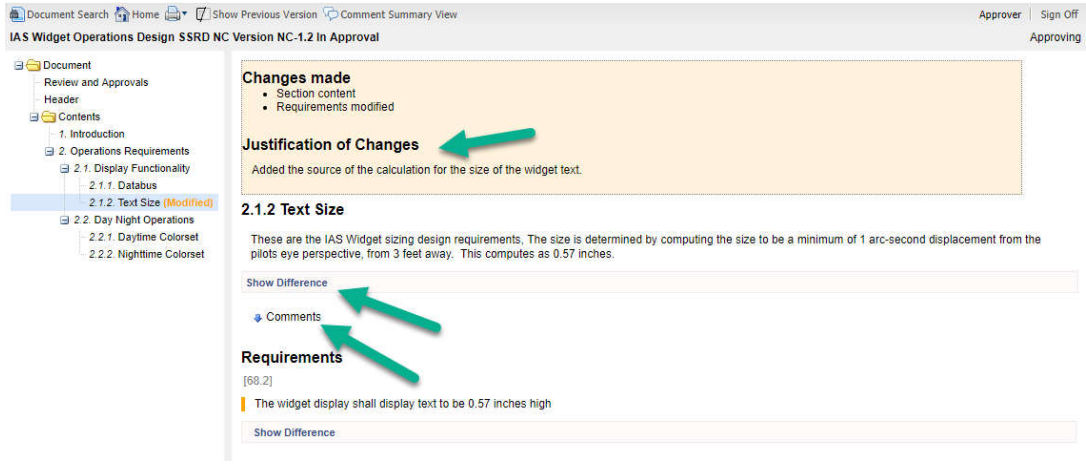


Document Life-Cycle

- All documents share the same life-cycle
- A document by the author, or an author is assigned (and can be re-assigned any time) by someone else
- Content is written (memo, analysis, requirements, tests, etc.)
- Users are assigned for review or approval
- Reviews can occur as many times as necessary (or not at all),
- Approval is required to release a document and allow its data to be linked to other data in Synthesis

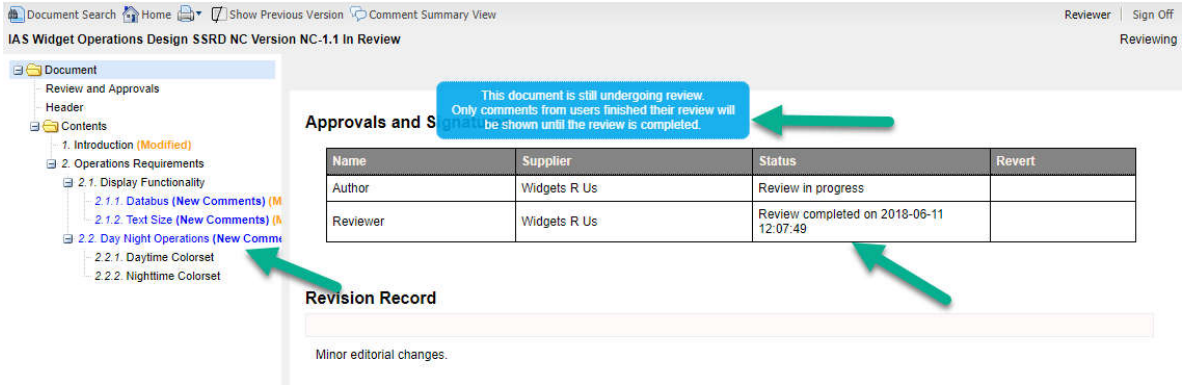
Documents Life-Cycle

- Changes made to documents must be justified by the document author, so reviewers know the scope and context of the changes
- Any changed data can be compared to its previous version



Documents Review / Approval

- Notification is automatically sent for users assigned to review or approve
- Comments are managed, captured, and dispositioned inline
- Modifications and comments are shown to allow other users to understand what has changed and other user comments

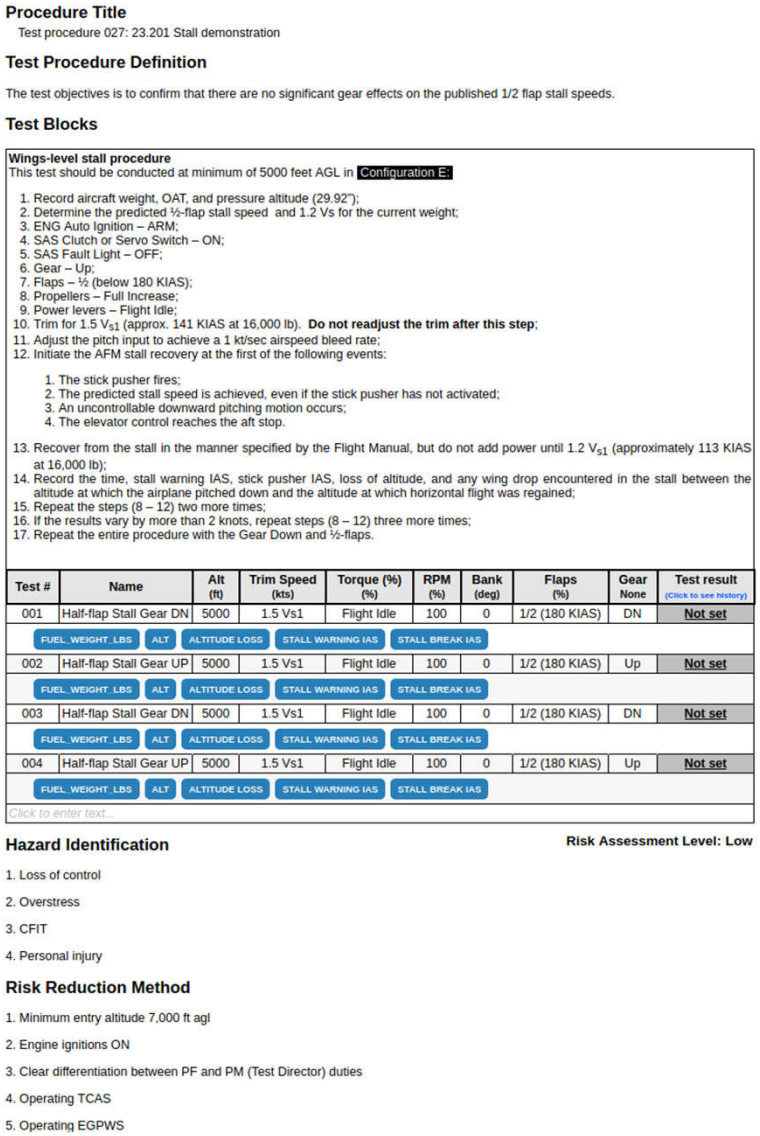


Building a Project – Verification

- Test plans (which are also documents) need to be created to define test procedures
- Each requirement specified must be tested
- Synthesis considers a requirement to be completed when all requirements and tests linked to it have been passed
- When all requirements in a project are complete, the project is complete
- The simplest project may have requirements, which are linked to a single test which is then passed.
- More complex projects can have multiple levels of requirements, linked together, and linked to tests

Test Plans

- Template-based test plans
- Test procedure templates with definition, hazard identification & mitigation, pass fail criteria, link to requirement
- Test points can be manipulated quickly by an author to construct simple (pass/fail) to very complex tests with multiple configurations, conditions, and recorded data.
- Risk level and mitigations is carried with the test point to ensure safety throughout



Procedure Title

Test procedure 027: 23.201 Stall demonstration

Test Procedure Definition

The test objectives is to confirm that there are no significant gear effects on the published 1/2 flap stall speeds.

Test Blocks

Wings-level stall procedure
This test should be conducted at minimum of 5000 feet AGL in Configuration E:

1. Record aircraft weight, OAT, and pressure altitude (29.92");
2. Determine the predicted ½-flap stall speed and 1.2 Vs for the current weight;
3. ENG Auto Ignition – ARM;
4. SAS Clutch or Servo Switch – ON;
5. SAS Fault Light – OFF;
6. Gear – Up;
7. Flaps – ½ (below 180 KIAS);
8. Propellers – Full Increase;
9. Power levers – Flight Idle;
10. Trim for 1.5 V_{S1} (approx. 141 KIAS at 16,000 lb). **Do not readjust the trim after this step**;
11. Adjust the pitch input to achieve a 1 kt/sec airspeed bleed rate;
12. Initiate the AFM stall recovery at the first of the following events:
    1. The stick pusher fires;
    2. The predicted stall speed is achieved, even if the stick pusher has not activated;
    3. An uncontrollable downward pitching motion occurs;
    4. The elevator control reaches the aft stop.
13. Recover from the stall in the manner specified by the Flight Manual, but do not add power until 1.2 V_{S1} (approximately 113 KIAS at 16,000 lb);
14. Record the time, stall warning IAS, stick pusher IAS, loss of altitude, and any wing drop encountered in the stall between the altitude at which the airplane pitched down and the altitude at which horizontal flight was regained;
15. Repeat the steps (8 – 12) two more times;
16. If the results vary by more than 2 knots, repeat steps (8 – 12) three more times;
17. Repeat the entire procedure with the Gear Down and ½-flaps.

Test #	Name	Alt (ft)	Trim Speed (kts)	Torque (%) (%)	RPM (%)	Bank (deg)	Flaps (%)	Gear None	Test result (Click to see history)
001	Half-flap Stall Gear DN	5000	1.5 Vs1	Flight Idle	100	0	1/2 (180 KIAS)	DN	Not set
	FUEL_WEIGHT_LBS ALT ALTITUDE LOSS STALL WARNING IAS STALL BREAK IAS								
002	Half-flap Stall Gear UP	5000	1.5 Vs1	Flight Idle	100	0	1/2 (180 KIAS)	Up	Not set
	FUEL_WEIGHT_LBS ALT ALTITUDE LOSS STALL WARNING IAS STALL BREAK IAS								
003	Half-flap Stall Gear DN	5000	1.5 Vs1	Flight Idle	100	0	1/2 (180 KIAS)	DN	Not set
	FUEL_WEIGHT_LBS ALT ALTITUDE LOSS STALL WARNING IAS STALL BREAK IAS								
004	Half-flap Stall Gear UP	5000	1.5 Vs1	Flight Idle	100	0	1/2 (180 KIAS)	Up	Not set
	FUEL_WEIGHT_LBS ALT ALTITUDE LOSS STALL WARNING IAS STALL BREAK IAS								

Click to enter text...

Hazard Identification — **Risk Assessment Level: Low**

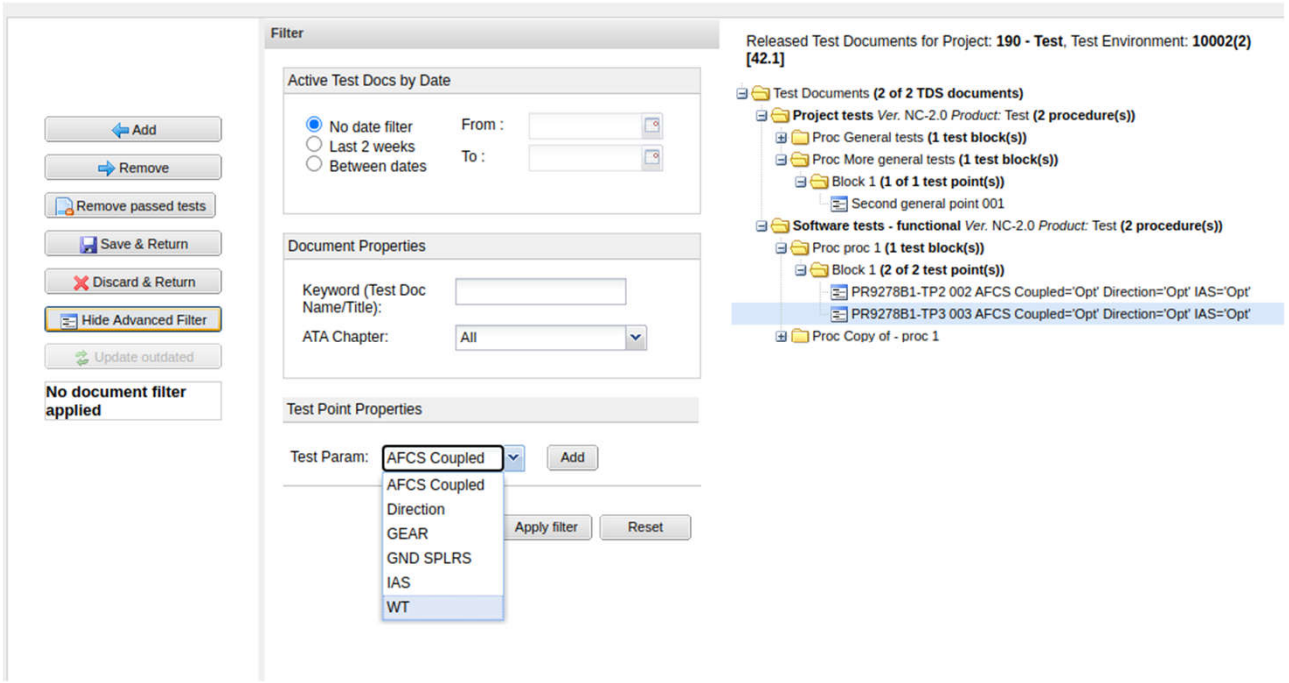
1. Loss of control
2. Overstress
3. CFIT
4. Personal injury

Risk Reduction Method

1. Minimum entry altitude 7,000 ft agl
2. Engine ignitions ON
3. Clear differentiation between PF and PM (Test Director) duties
4. Operating TCAS
5. Operating EGPWS

Test Cards

- All tests defined in a test plan are tested on a test card
- Test cards allow on-the-fly batches of tests to be run (e.g.: A flight test, bench test, “desktop” testing)
- Test cards auto-filter by test environment and product, and only offer users test points that can be tested together in the same environment
- Test points can also be filtered by <u>any</u> test parameter value



Test Cards

- Test cards can be completed in PDF forms on a laptop or tablet
- Completed test card PDFs can be uploaded, and Synthesis will automatically extract test data and statuses and add the PDF to the test card
- Test status can be also be completed in Synthesis directly
- Test results are shown directly in test plans as they are completed, including snags and test plan report details

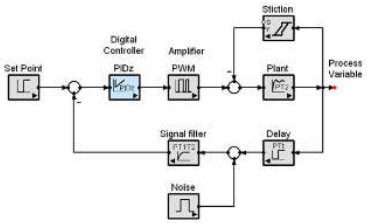
# (Seq.)	Name	AFCS Coupled	Direction	IAS	Status
001	PR9278B1-TP1	Opt	Right	500	Exec: Pass

Time: 2020-09-15 14:17:12.0 **Execution Time:** Start: 00:45:00 End: 00:50:00

Direction IAS

Data Comment:

Result Comment:



See above image for details.

# (Seq.)	Name	AFCS Coupled	Direction	IAS	Status
002	PR9278B1-TP2	Opt	Opt	Opt	Not Exec

AFCS Coupled Direction IAS

New test data:

Start time End time

Collected data

AFCS Coupled

Direction

IAS

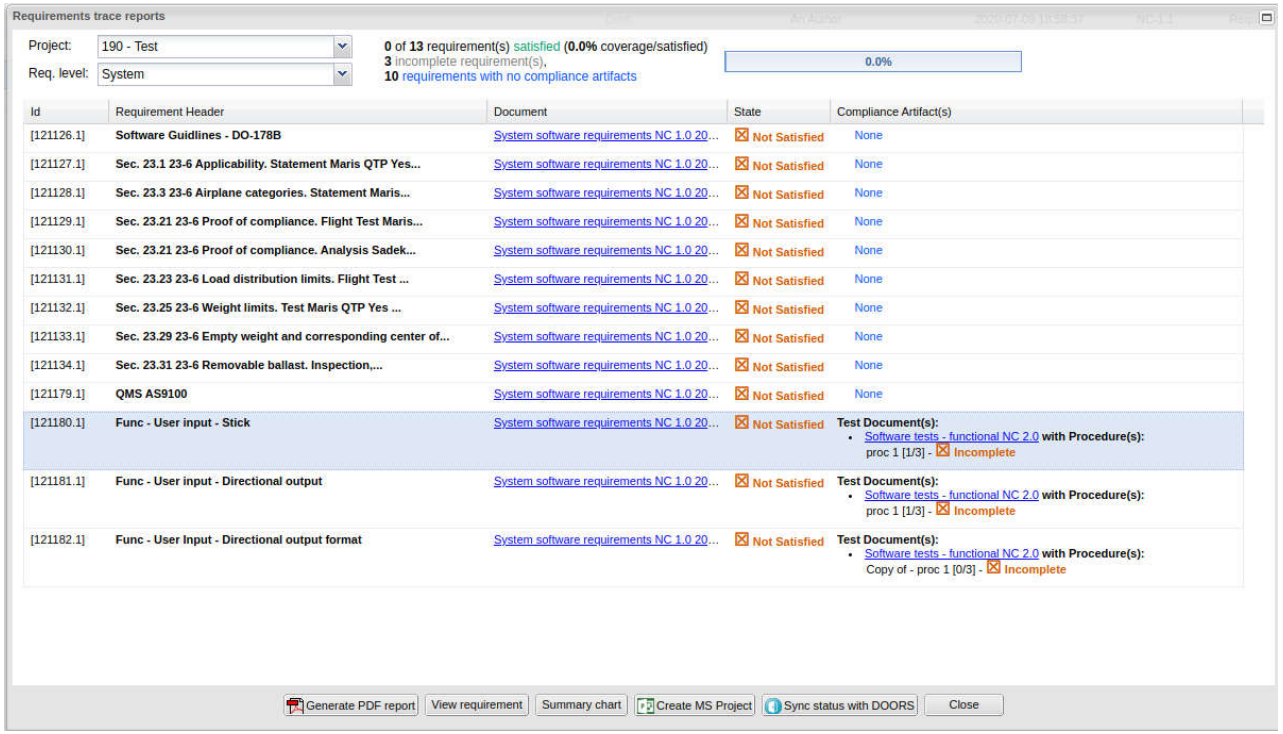
Set status now?

Result

Comment

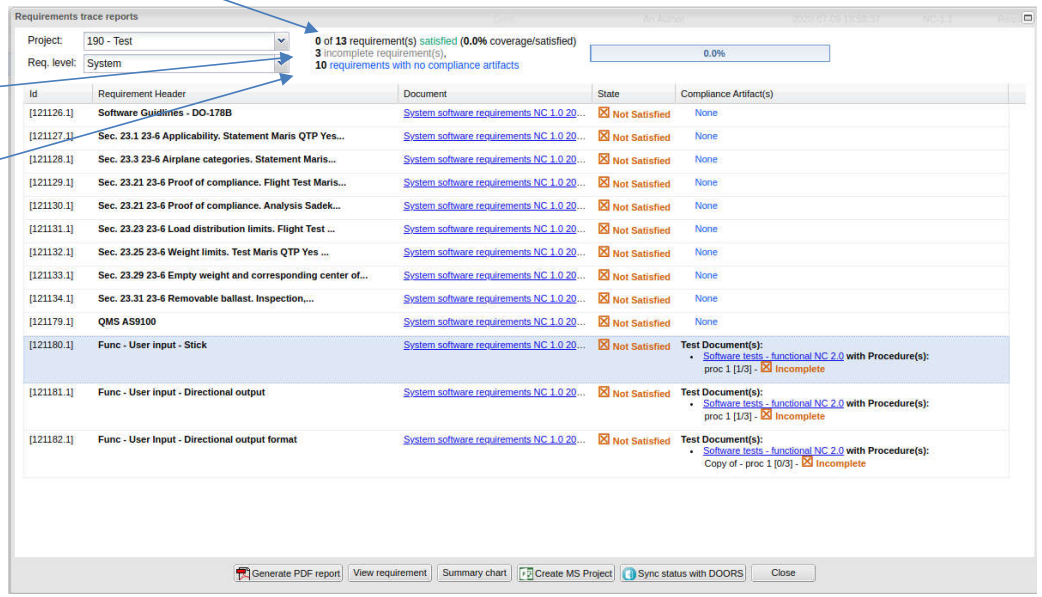
Tracking Progress

- The main source of tracking data in Synthesis is the project status page
- This allows users to see requirements, what each requirement is linked to
- The report can be used to navigate to requirements and test documentation



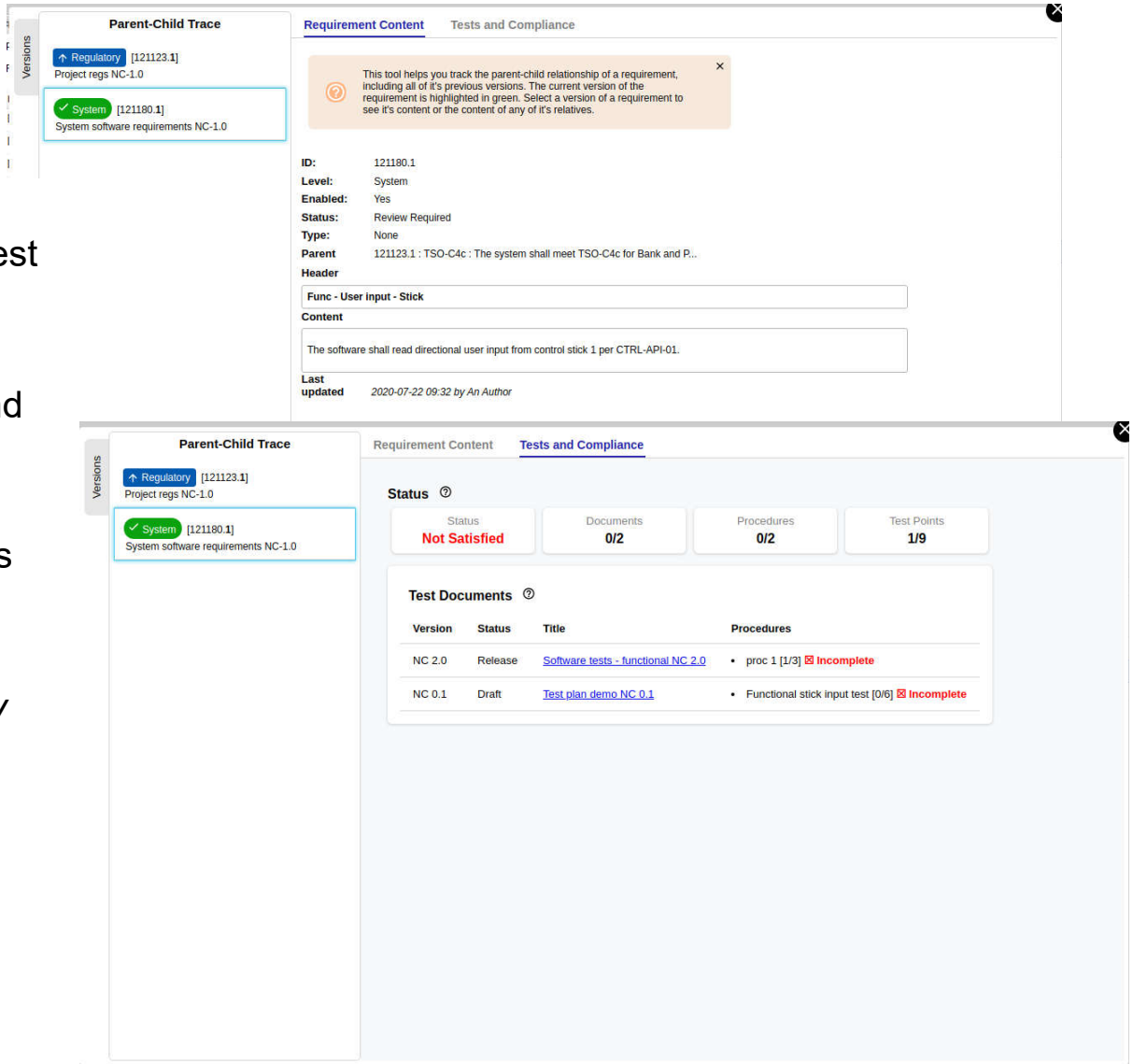
Tracking Progress (cont'd)

- "0 of 13 requirements coverage/satisfied …" - How many of the total number of requirements has been satisfied by having all related tests completed for it.
- "3 incomplete requirements" – number of requirements that have some data associated, but the data has not been completed (e.g.: testing not complete)
- "10 requirements with no compliance artifacts" – the number of requirements which do not have any link to either a requirement or a test/test procedure.
- Left hand column is the requirement number, and version (number.version), then header (clicking on the requirement shows the trace dialog)
- Middle column shows the document the requirement is contained in, clicking the link will navigate to that document
- Last column shows any child requirements, and/or tests linked to the requirement. Clicking on the links will navigate to the requirement or test document



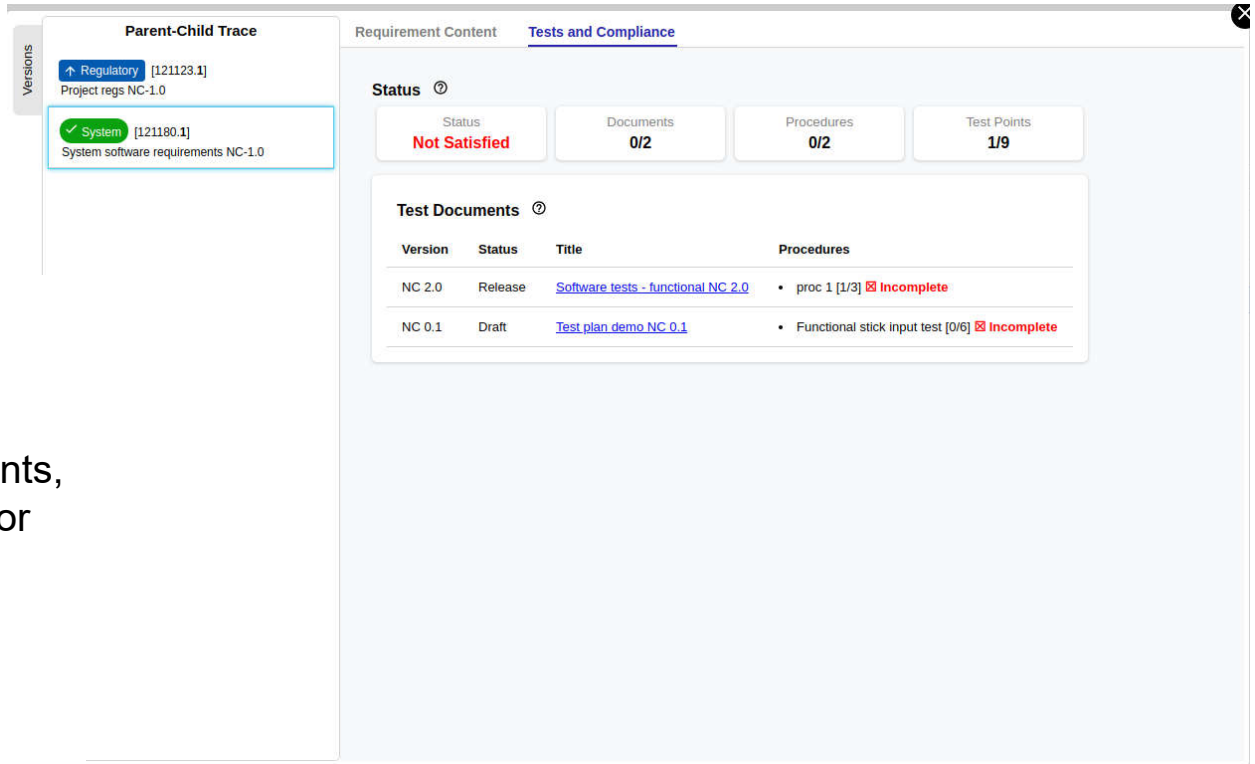
Reporting

- Any requirement can be clicked on in the project status, document (requirement or test plan), and test card to see its status
- Compliance data is also available (tests and other requirements)
- Versioning and history of the requirement is also listed
- This also allows what-if analysis: *If I modify this requirement, what is the impact?*



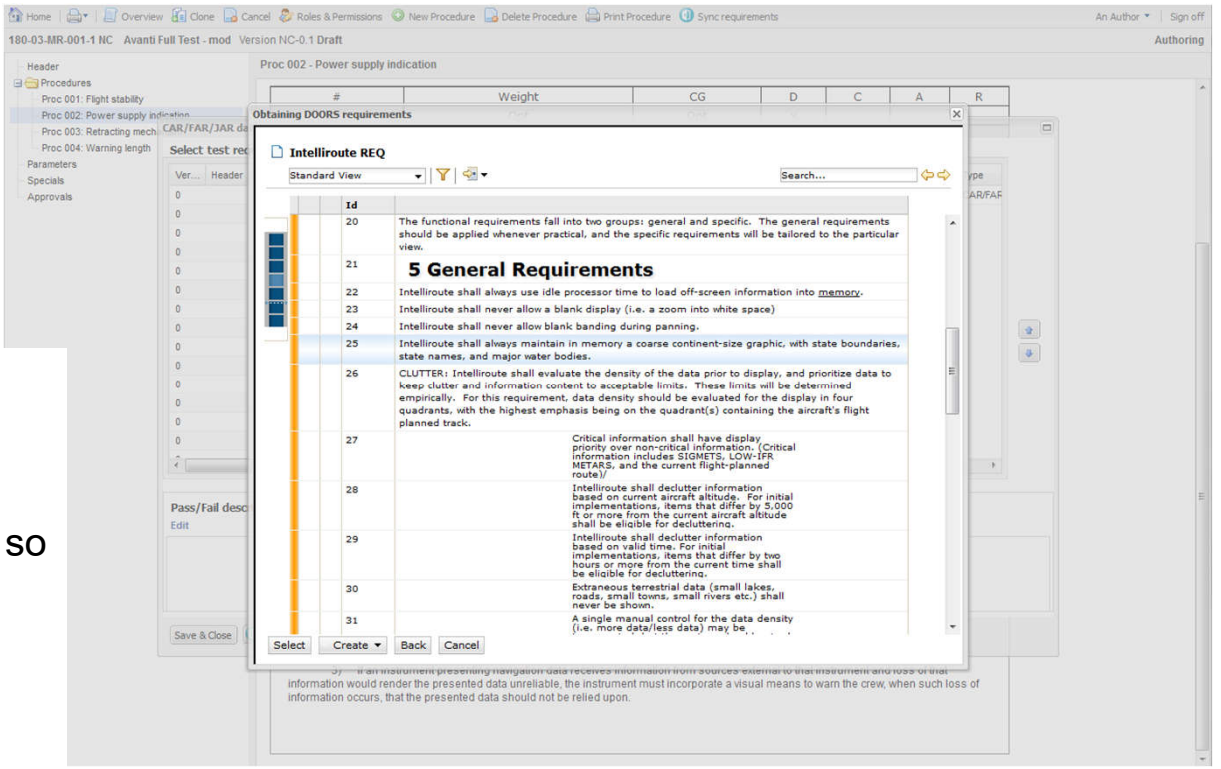
New Projects

- New projects can clone data (or even an entire project) from an existing project
- This means similar project data, requirements, and tests can be leveraged easily with minor modifications for new projects
- Continuing a project is also possible – baseline (snapshot) a project, then change requirements, and update any effected data. Previous history is <u>always</u> saved in Synthesis.



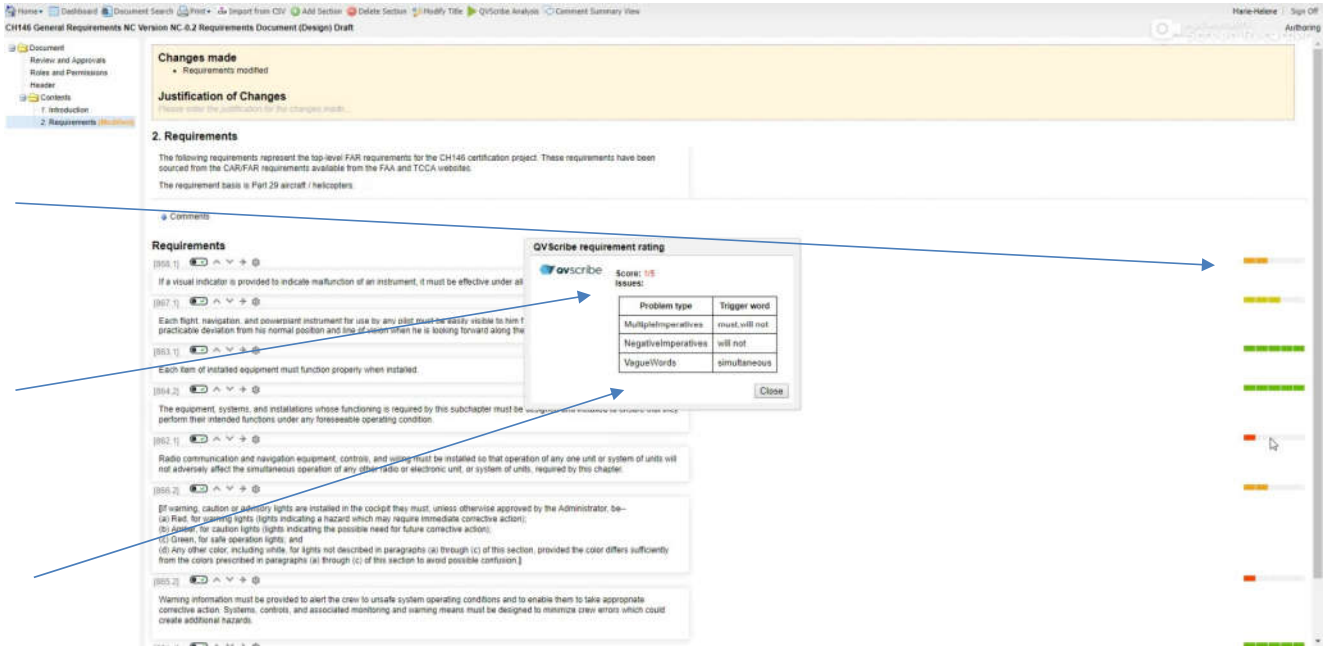
Requirements Import From DOORS (et al)

- Requirements can be directly imported and synched with DOORS (or other software)
- Requirements are referenced from DOORS so integrity is maintained
- All requirements, versions and updates are stored and linked



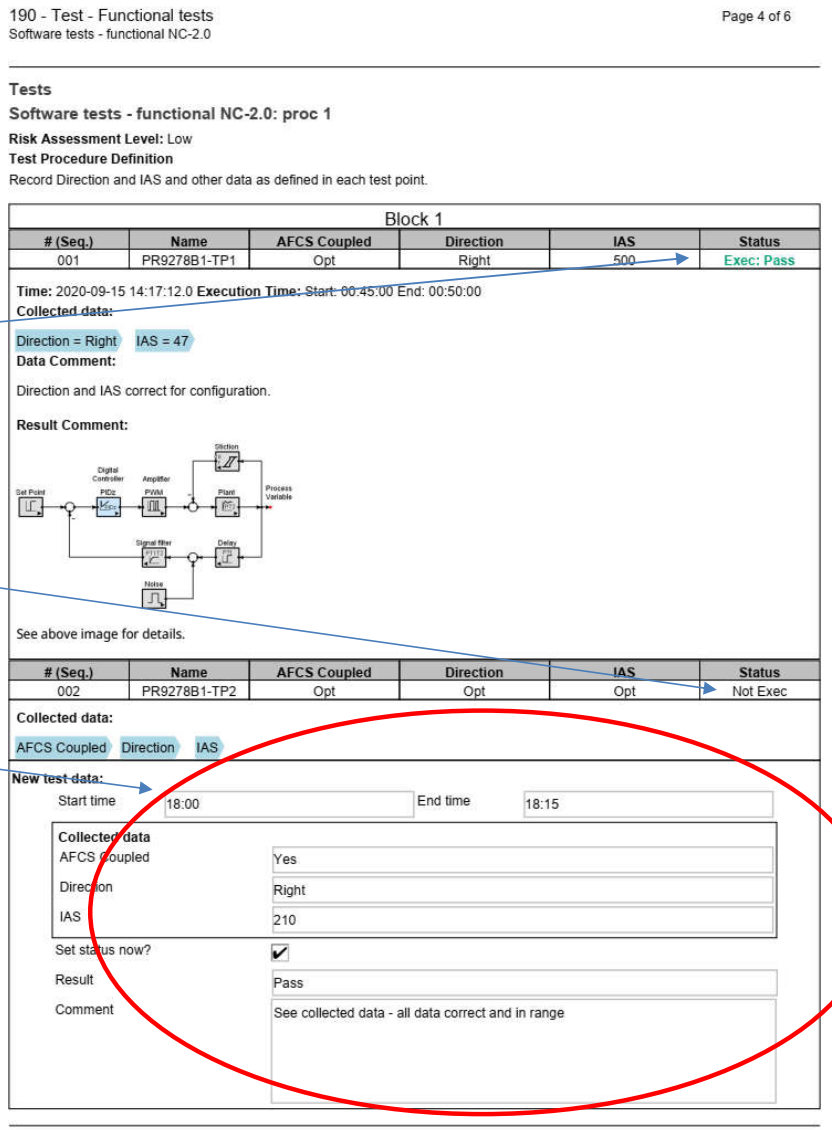
Requirements Analysis (Optional)

- All requirements are analyzed for strength of accuracy/ambiguity
- Accuracy check highlights the problem with the language used
- Solutions are offered and require user acceptance and input



Example: Test Pdf. For Inputs

- 001 Test has been passed and is locked.
- 002 Test is open “Not Exec”
- All fields can be input directly into the pdf. and record.
- Test is uploaded once connection is re-established



190 - Test - Functional tests
Software tests - functional NC-2.0

Tests

Software tests - functional NC-2.0: proc 1

Risk Assessment Level: Low

Test Procedure Definition

Record Direction and IAS and other data as defined in each test point.

Block 1

# (Seq.)	Name	AFCS Coupled	Direction	IAS	Status
001	PR9278B1-TP1	Opt	Right	500	Exec: Pass

Time: 2020-09-15 14:17:12.0 **Execution Time:** Start: 00:45:00 End: 00:50:00

Collected data:

Direction = Right | IAS = 47

Data Comment:

Direction and IAS correct for configuration.

Result Comment:

See above image for details.

# (Seq.)	Name	AFCS Coupled	Direction	IAS	Status
002	PR9278B1-TP2	Opt	Opt	Opt	Not Exec

Collected data:

AFCS Coupled | Direction | IAS

New test data:

Start time: 18:00 End time: 18:15

Collected data

AFCS Coupled	Yes
Direction	Right
IAS	210

Set status now? ✔

Result: Pass

Comment: See collected data - all data correct and in range

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Ever increasing complexity of projects with external regulations / requirements / acceptance criteria - **COMPLIANCE**

- Constantly changing
- Currently Ad-Hoc tools
- Not integrated
- Lots of paper
- Difficult to status, manage, predict, optimize
- Almost impossible to re-use data

marinvent CORPORATION

50 Rabastalière est, suite 23, Saint-Bruno QC
J3V 2A5, CANADA,
Tel: (1) 450-441-6464, Fax: (1) 450-441-2411

MR. ALISTAIR CHAPMAN
Marketing Director
Alistair.chapman@marinvent.com