

MATLAB EXPO

 FRANCE

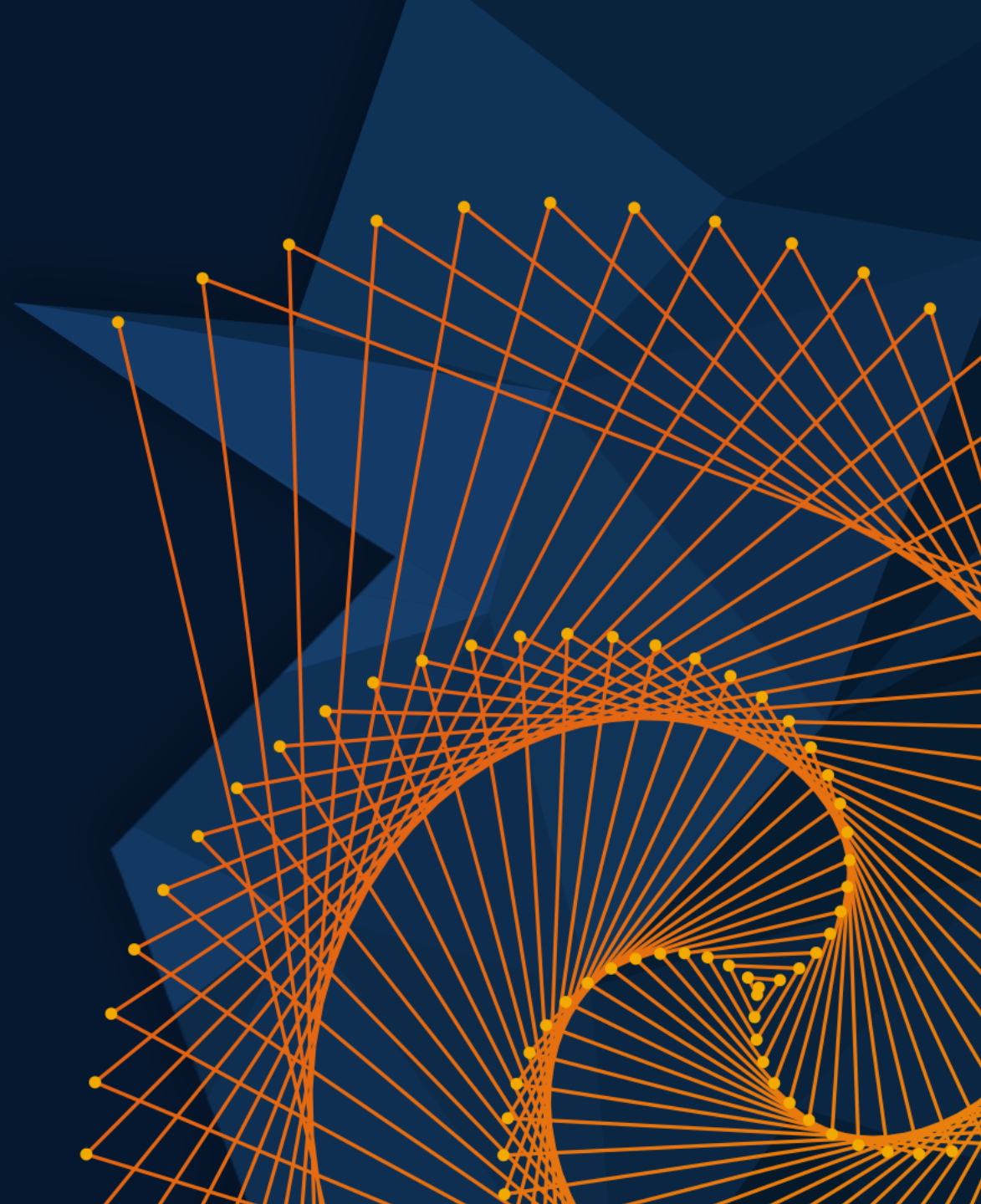
8 octobre 2024 | Paris

**Usine logicielle, industrialisez vos
développements avec MATLAB et
Simulink**

Michelle Valente, MathWorks

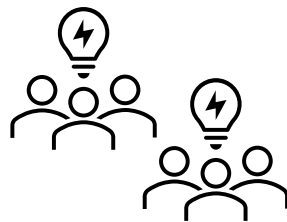
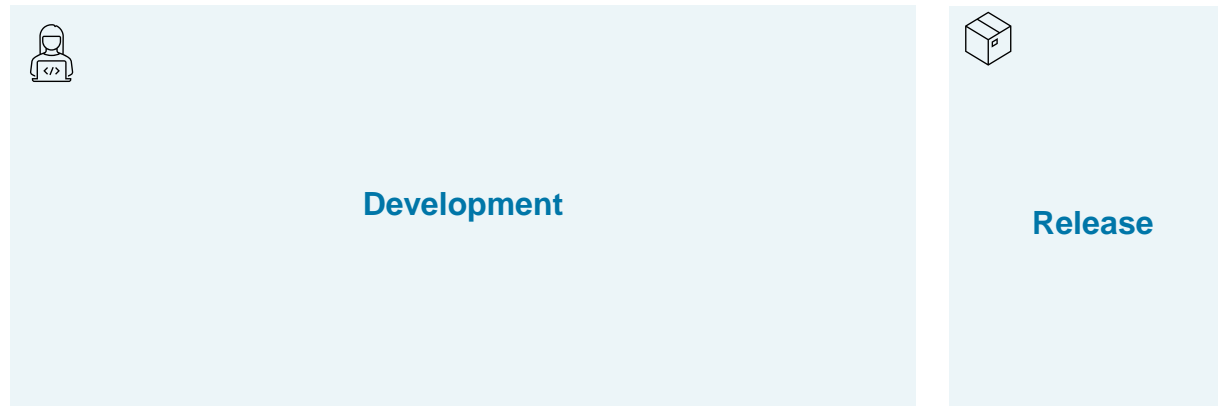


Maxime François, MathWorks

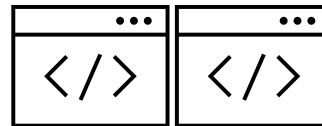


Traditional Software Development

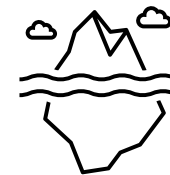
Challenges Without a Software Factory



Fragmented
Processes



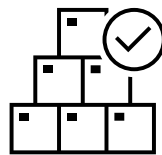
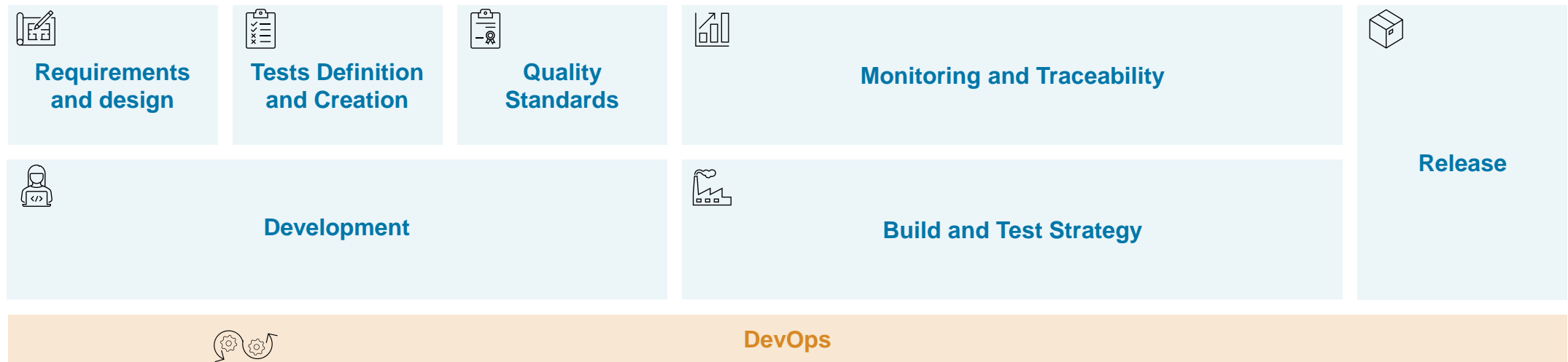
Limited
Reusability



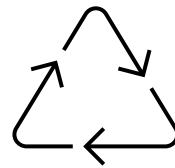
Higher
Error Risk

Software Factory

An approach to create software applications based on manufacturing principles



Standardization



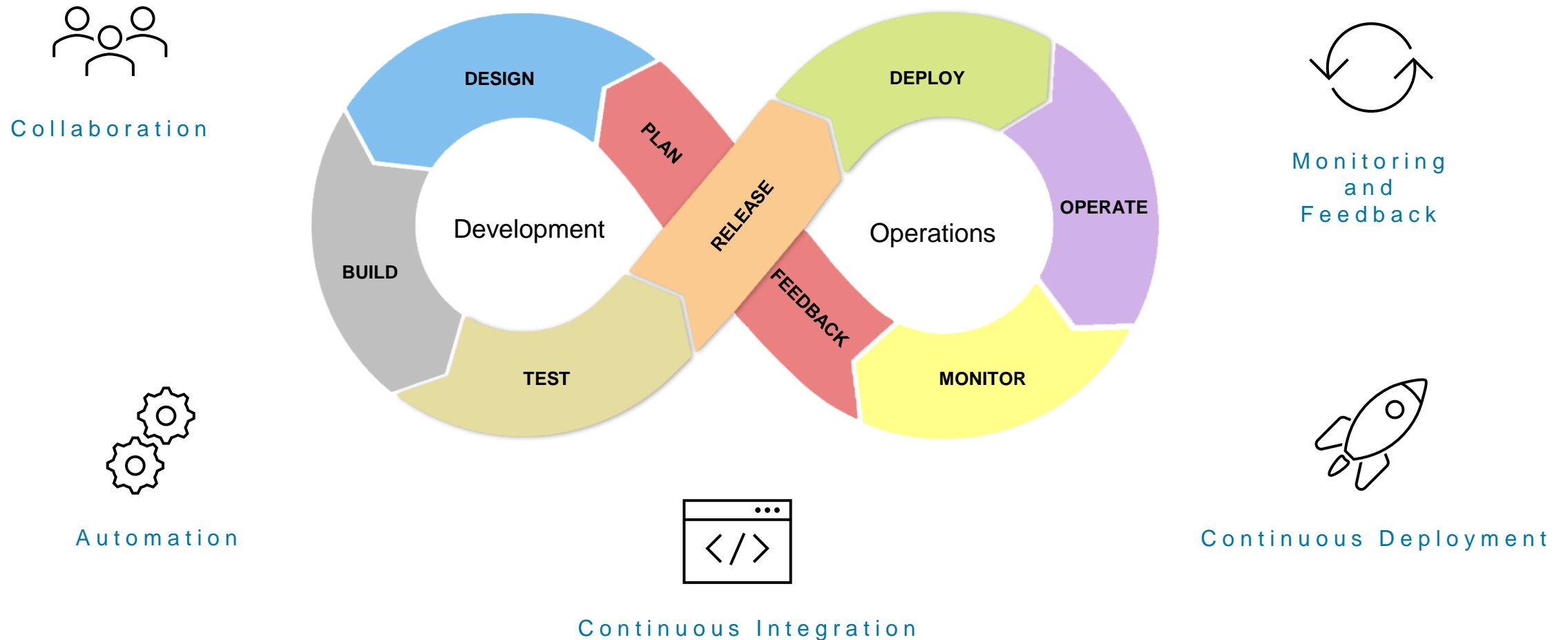
Reusability



Quality

What is DevOps?

Unifying development and operations with continuous collaboration and automation



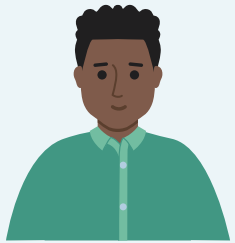
Project Context

Advanced Air Mobility: The future of air transportation



Reference project: startup developing drones for air mobility systems

Project team



Project
Manager

Oversees project
scope and
timeline



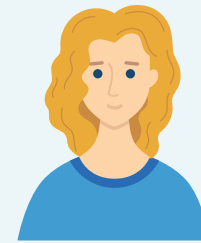
DevOps
Engineer

Manages CI/CD
and
automation



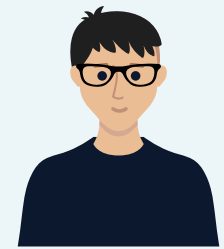
Phys Mod
Engineer

Develops drone
models and
simulations



Control
Engineer

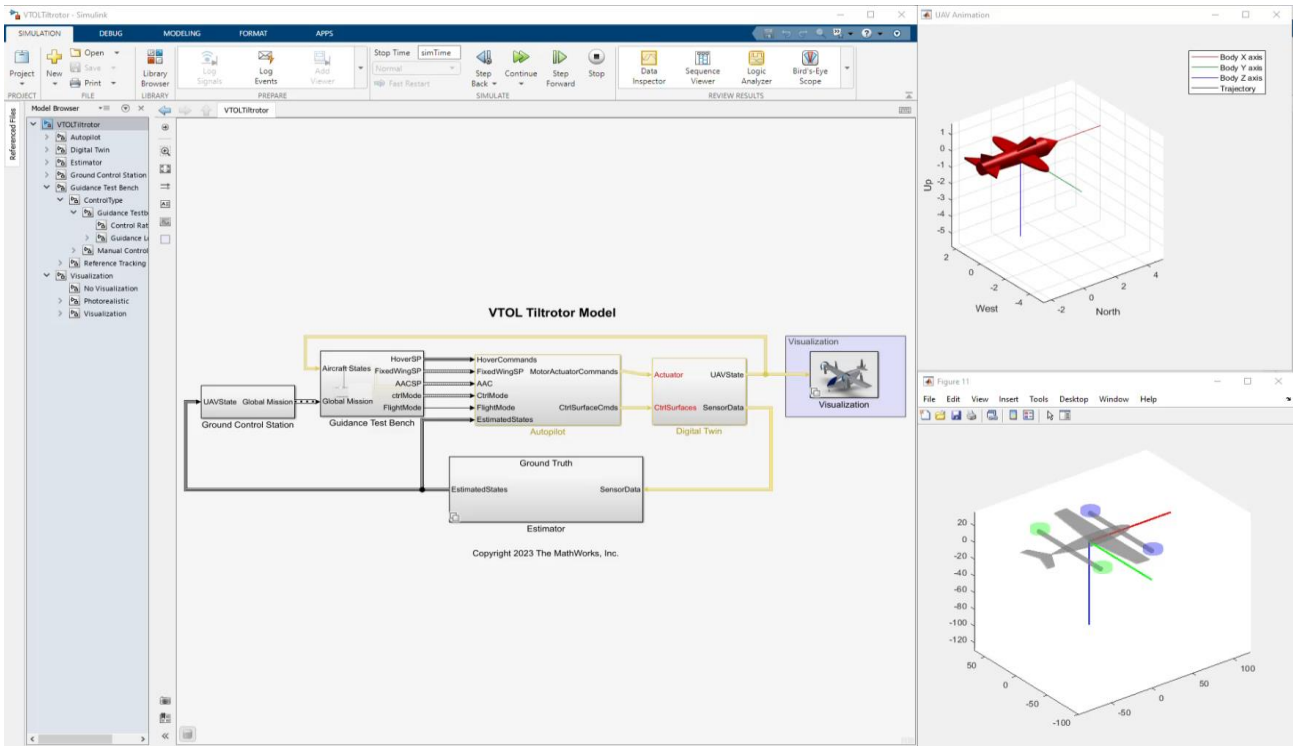
Designs
and tunes
controllers



Test
Engineer

Validates
system
performance

Current Project Status

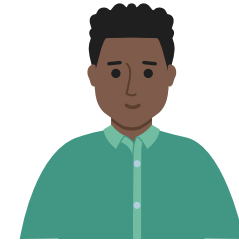


Release V1.0
delivered to
customer

New Customer Request



Customer



Project
Manager

To Jack

Cc Bcc

Issues with attitude controller in V1.0

Hi Jack,

I hope you're well. We're experiencing issues with the attitude controller software, which currently allows a max error of 0.3 radians on our testing scenario—exceeding the 0.2 radians required by our new camera supplier. This is critical for maintaining product quality. Could we discuss solutions and a timeline for improvements at your earliest convenience? Your prompt attention to this is appreciated.

Best regards,

Tim

Project Content

Project specific features

Dashboards, Dependency Analysis



Path and init/shutdown



Source Control Management



Project Design

Requirements

myReq.slreqx



Model Source

myModel.slx
myData.slidd



Test

myTestFile.mldatx
myHarness.slx



Documentation

mydoc.mlx



Data

myComputationData.mlx



Library source

myLibrary.slx



Tools source

myTools.slx



Other Source

myModel.slx
myData.slidd



☐ Local

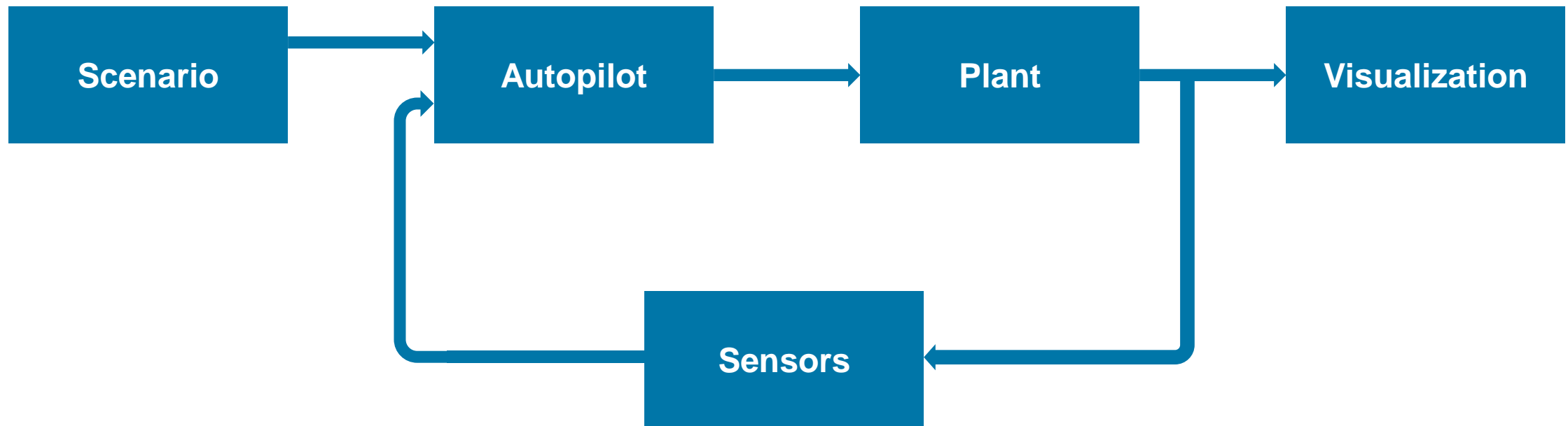
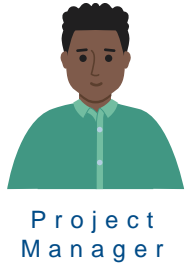
☐ Reference

☐ Reference from another project

Project - TRX3

Name	Status	Git
+ci	✓	.
data	✓	.
model	✓	.
script	✓	.
test	✓	.
.gitattributes	✓	●
.gitignore	✓	●
.gitlab-ci.yml	✓	●
.gitmodules	✓	●

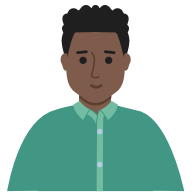
Project architecture



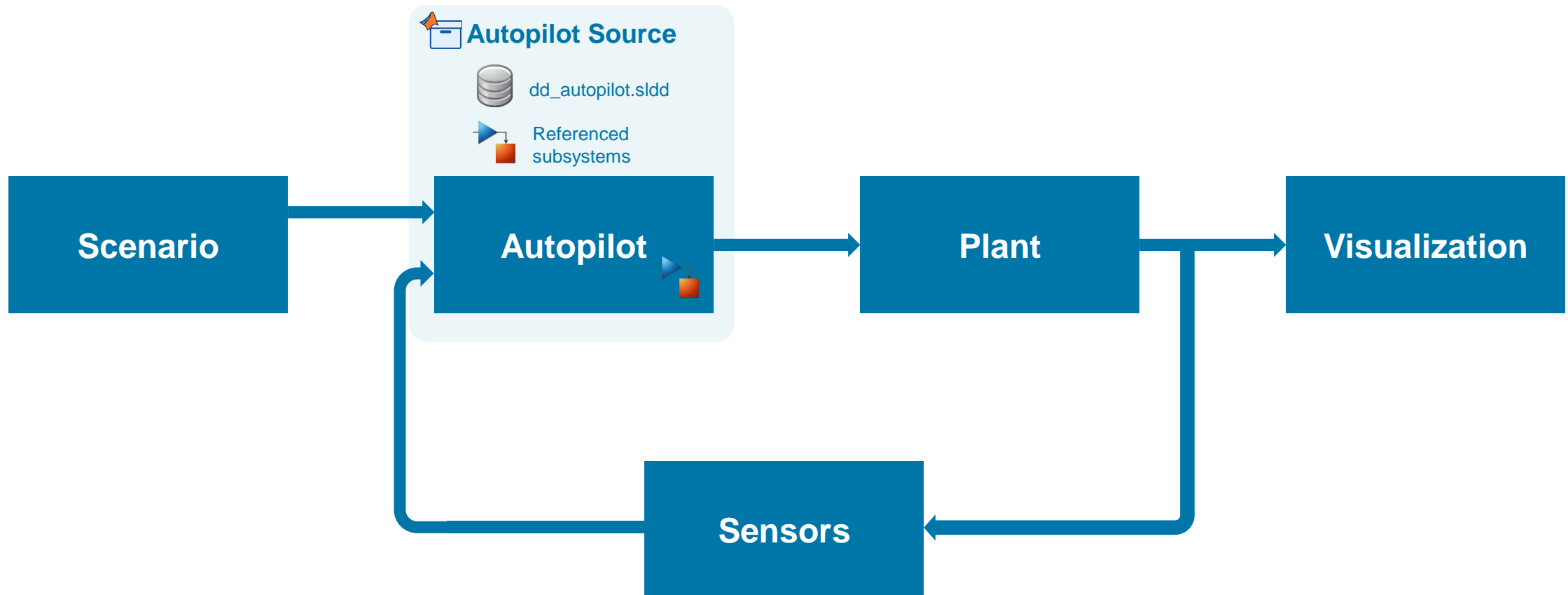
Project architecture



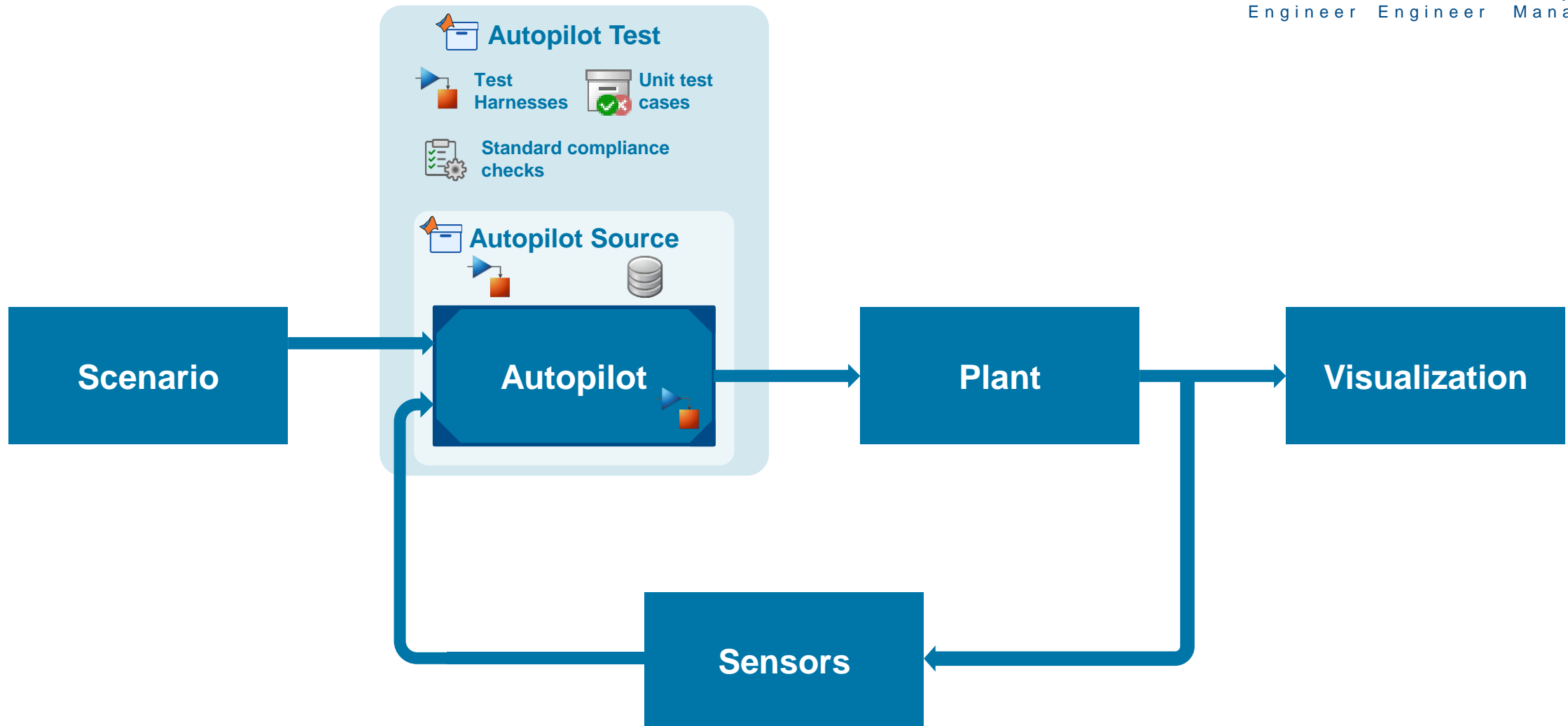
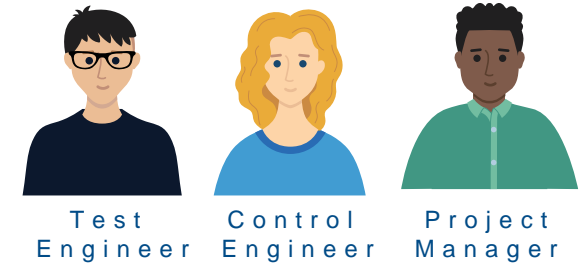
Control
Engineer



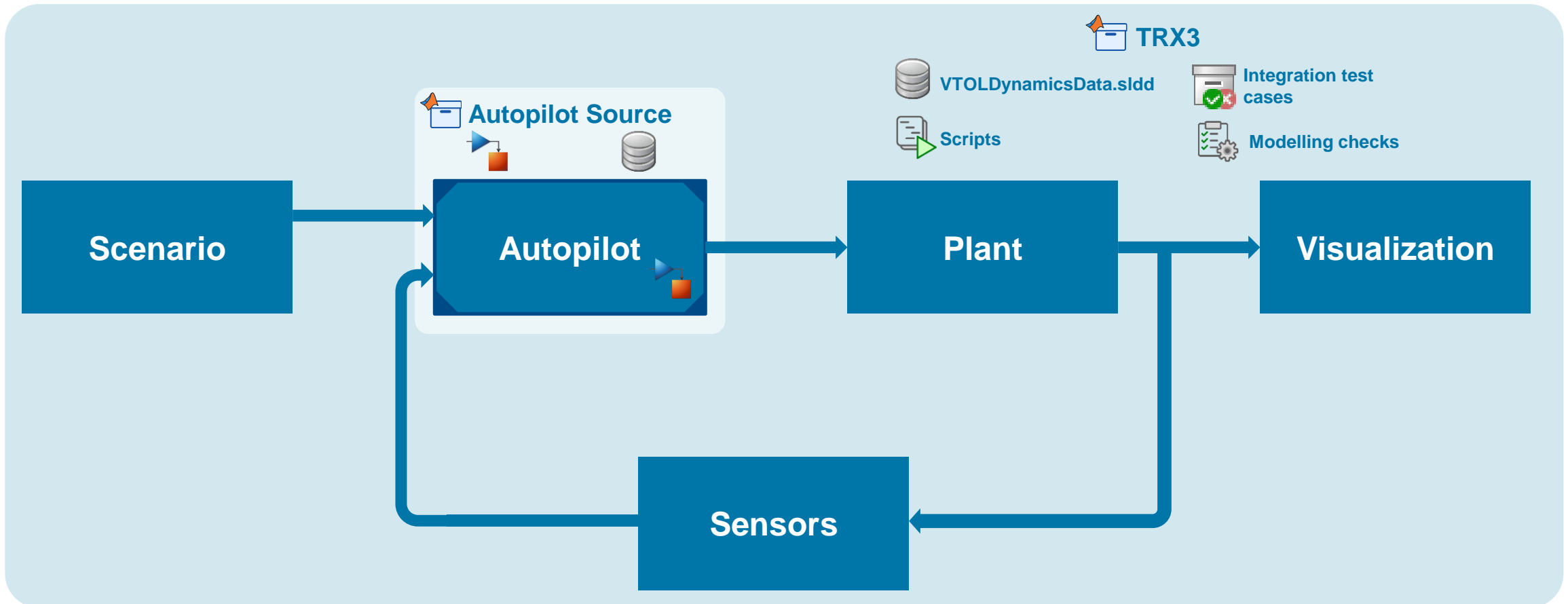
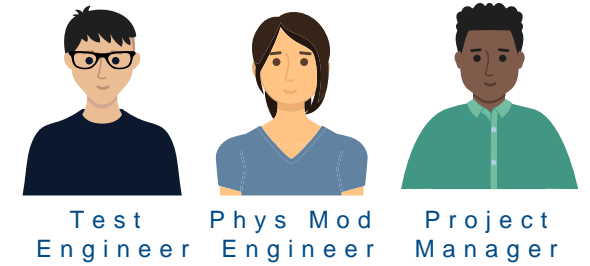
Project
Manager



Project architecture



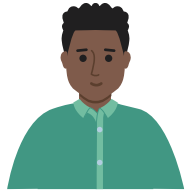
Project architecture



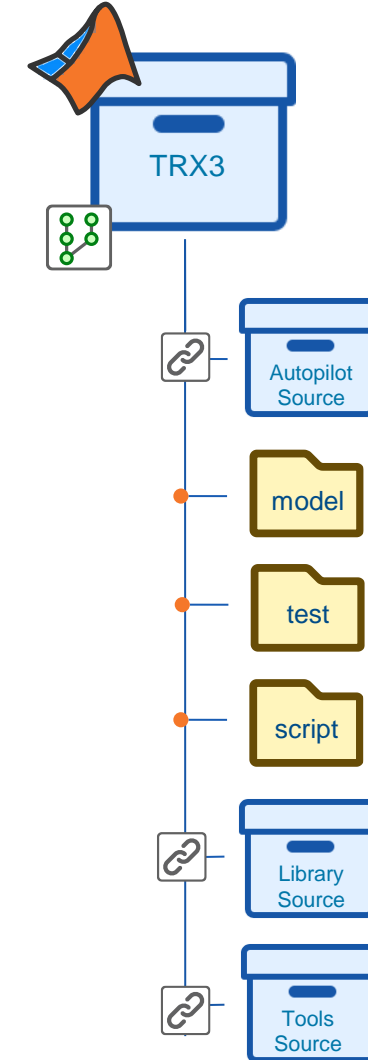
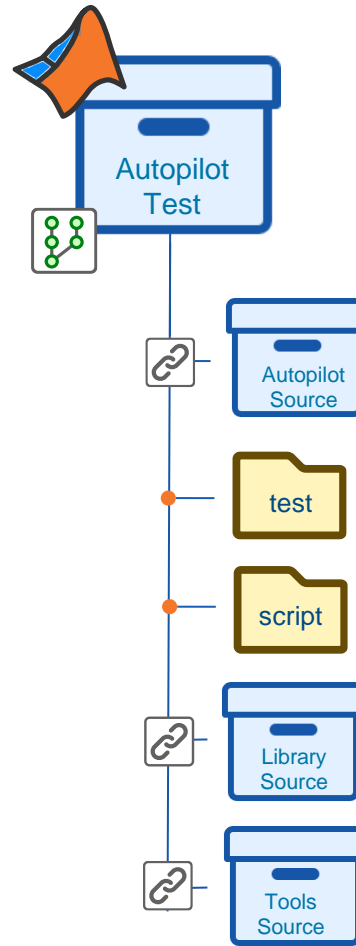
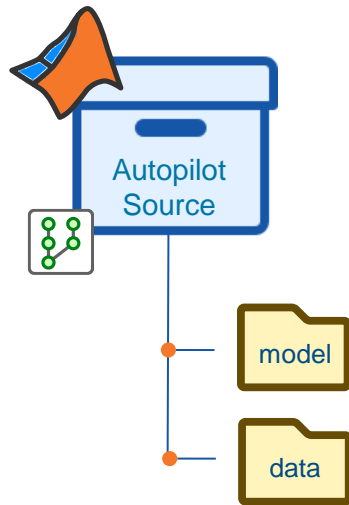
Repository Architecture



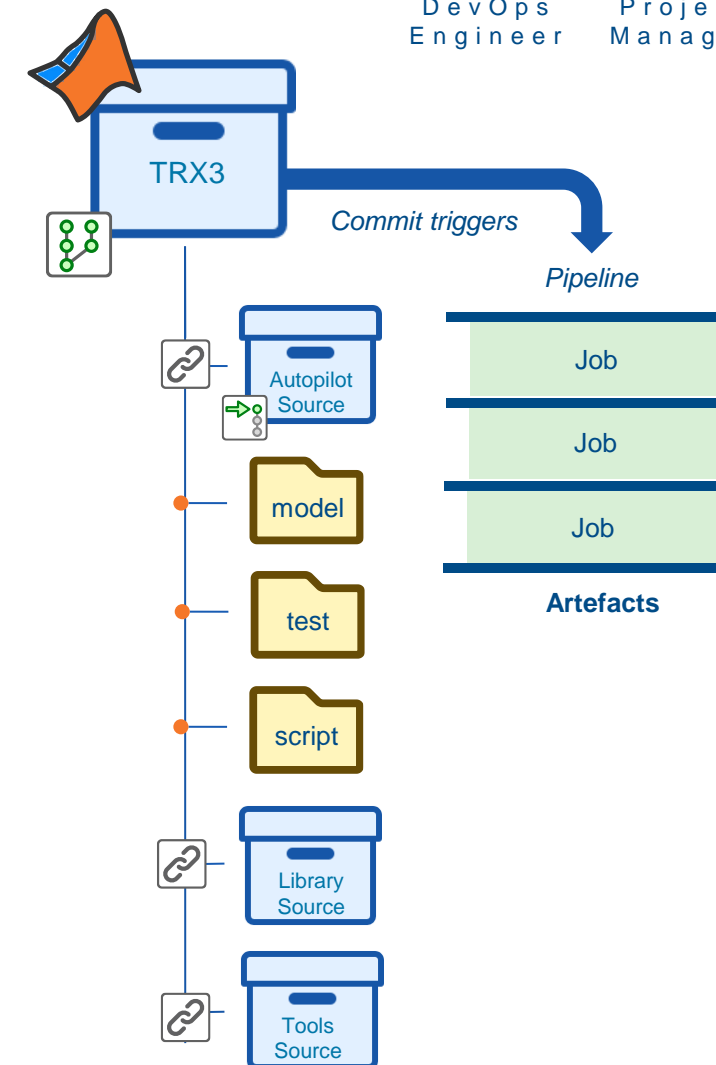
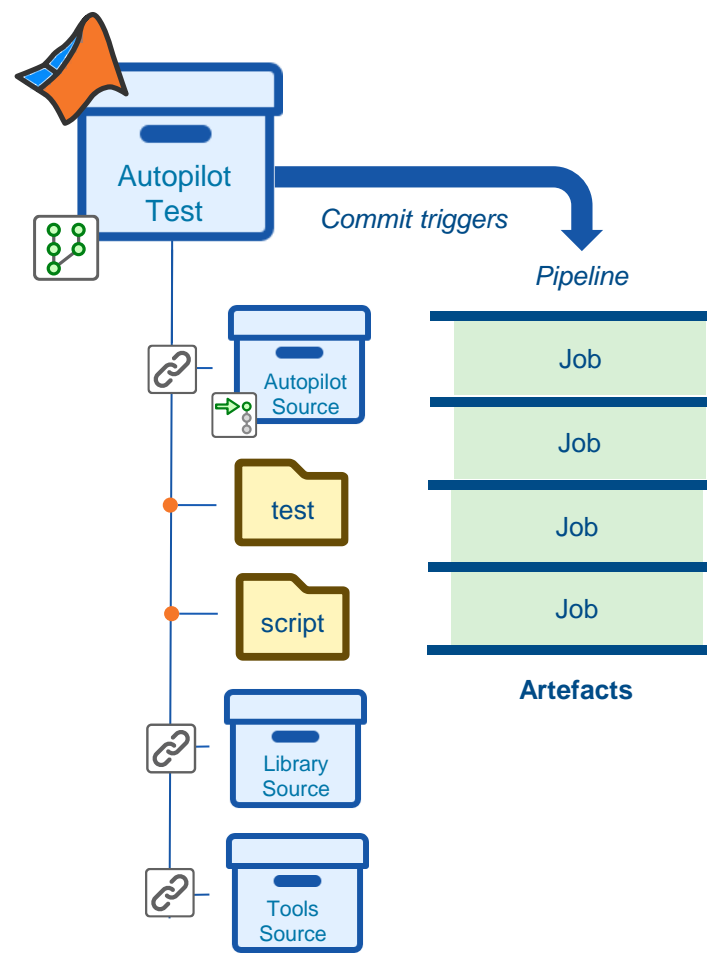
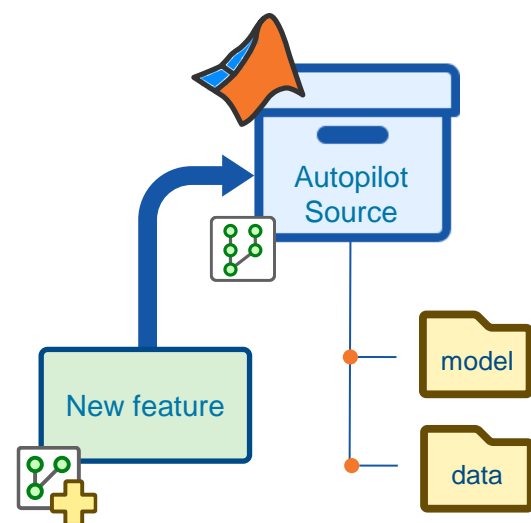
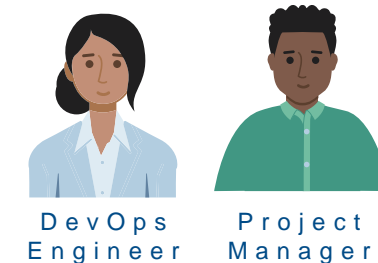
DevOps
Engineer



Project
Manager



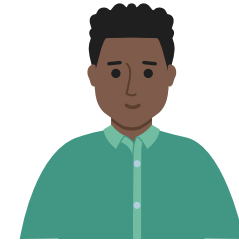
Repository Architecture



New Customer Request



Customer



Project
Manager

To Jack

Cc Bcc

Issues with attitude controller in V1.0

Hi Jack,

I hope you're well. We're experiencing issues with the attitude controller software, which currently allows a max error of 0.3 radians on our testing scenario—exceeding the 0.2 radians required by our new camera supplier. This is critical for maintaining product quality. Could we discuss solutions and a timeline for improvements at your earliest convenience? Your prompt attention to this is appreciated.

Best regards,

Tim

Team Meeting

[discussion] Meeting notes 11/09/2024

Edit



Open

Participants

- Project Manager
- DevOps Engineer
- Control Engineer
- Phys Mod Engineer
- Tests Engineer

Notes

- New request from customer:

Hi Jack,

I hope you're well. We're experiencing issues with the attitude controller software, which currently allows a max error of 0.3 radians on our testing scenario—exceeding the 0.2 radians required by our new camera supplier. This is critical for maintaining product quality. Could we discuss solutions and a timeline for improvements at your earliest convenience? Your prompt attention to this is appreciated.

Best regards,

Tim

- Conclusion controller needs to be more precise on following the trajectory to achieve the prevision imposed by the camera supplier.
- We decided that we should create a variant model of the controller to address this new requirement.

Actions

- ☐ [documentation] Modify autopilot requirements with precision imposed by camera supplier #21 (closed)
- ☐ [feature] Modify fail condition in controller tests #22
- ☐ [feature] Add customer test scenario to our automated tests #23
- ☐ [feature] Modify and tune controller to meet requirements
- ☐ [feature] Integrate new controller to TRX3 #24

0 of 5 checklist items completed



Create merge request



Issue Assignment

▼ Open

4 +

[documentation] Modify autopilot requirements with precision imposed by camera supplier

documentation

#21

[feature] Modify fail condition in controller tests

test

#22

[feature] Add customer test scenario to our automated tests

test

#23

[feature] Integrate new controller to TRX3

feature

#24

[feature] Modify and tune controller to meet requirements

feature

#10

[feature] Modify fail condition in controller tests

Edit



Open

Issue created 2 weeks ago by Michelle Valente

☐ Change fail condition to 0.2 radians

0 of 1 checklist item completed · Edited 2 weeks ago by Michelle Valente



0



0



Create merge request

 Drag your designs here or [click to upload](#).

Child items ✓ 0

Show labels



Add

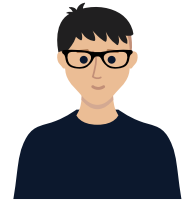


No child items are currently assigned. Use child items to break down this issue into smaller parts.

Linked items 0

Add

Link issues together to show that they're related. [Learn more](#).



Test
Engineer

Tests Modification

Open 4 +

[documentation] Modify autopilot requirements with precision imposed by camera supplier
documentation #21

[feature] Modify fail condition in controller tests
test #22

[feature] Add customer test scenario to our automated tests
test #23

[feature] Integrate new controller to TRX3
feature #24

[feature] Modify and tune controller to meet requirements
feature #10

Trajectory Accuracy Test

trx3_test » Functional Test Suite » Trajectory Accuracy Test

Simulation Test

☐ Create Test Case from External File

► TAGS

► DESCRIPTION

► REQUIREMENTS

► SYSTEM UNDER TEST*

▼ PARAMETER OVERRIDES*

PARAMETER SET / WORKSPACE VARIABLE	OVERRIDE VALUE	SOURCE	MODEL ELEMENT
▼ Customer Mission			
<input checked="" type="checkbox"/> guidanceType	4	base workspace	VTOLTiltrotor/Ground Control St...
▼ Fixed Wind Mission			
<input checked="" type="checkbox"/> guidanceType	1	base workspace	VTOLTiltrotor/Ground Control St...
▼ Hover Mission			
<input checked="" type="checkbox"/> guidanceType	2	base workspace	VTOLTiltrotor/Ground Control St...
▼ Transition Mission			
<input checked="" type="checkbox"/> guidanceType	3	base workspace	VTOLTiltrotor/Ground Control St...

Variant Configuration: [None]

► CALLBACKS

► INPUTS

► SIMULATION OUTPUTS

► CONFIGURATION SETTINGS OVERRIDES

► FAULT SETTINGS

► ITERATIONS*

▼ LOGICAL AND TEMPORAL ASSESSMENTS*

► ASSESSMENT CALLBACK

☒ Extend Result

EN...	NAME	ASSESSMENT	REQUIREMENTS
<input checked="" type="checkbox"/>	Assessment1	At any point of time, x_diff must be greater than -8 and less than 8	None
<input checked="" type="checkbox"/>	Assessment2	At any point of time, y_diff must be greater than -8 and less than 8	None
<input checked="" type="checkbox"/>	Assessment3	At any point of time, z_diff must be greater than -5 and less than 5	None
<input checked="" type="checkbox"/>	Assessment4	At any point of time, roll_diff must be greater than -0.2 and less than 0.2	None
<input checked="" type="checkbox"/>	Assessment5	At any point of time, pitch_diff must be greater than -0.2 and less than 0.2	None
<input checked="" type="checkbox"/>	Assessment6	At any point of time, yaw_diff must be greater than -0.2 and less than 0.2	None

Visual Representation

Issue Assignment

▼ Open

4 +

[documentation] Modify autopilot requirements with precision imposed by camera supplier

documentation

#21

[feature] Modify fail condition in controller tests

test

#22

[feature] Add customer test scenario to our automated tests

test

#23

[feature] Integrate new controller to TRX3

feature

#24

[feature] Modify and tune controller to meet requirements

feature

#10

[feature] Modify and tune controller to meet requirements

Edit

Open

- ☐ Create variant subsystem for attitude controller
- ☐ Tune the controller to achieve requirements
- ☐ Create activation variable for variant

0 of 3 checklist items completed

0

0

Create merge request

Drag your designs here or [click to upload](#).

Child items 0

Show labels

Add

No child items are currently assigned. Use child items to break down this issue into smaller parts.

Linked items 0

Add

Link issues together to show that they're related. [Learn more](#).

Draft: Resolve "[feature] Modify and tune controller to meet requirements"

Overview 0 Commits - Pipelines 0 Changes 0

 0
 0

Use merge requests to propose changes to your project and discuss them with your team. To make changes, use the **Code** dropdown list above, then test them with **CI/CD** before merging.

All activity

- A screenshot of the GitHub repository interface. At the top, there's a navigation bar with a 'Preview' tab selected. To its right are icons for bold (B), italic (I), strikethrough (ABC), list (≡), code (</>), link (🔗), table (≡), edit (📝), insert (📎), and comment (💬). Below this bar, the main content area shows the text 'Write a comment or drag your files here...' in a monospaced font. At the bottom of the interface, there's a footer with the text 'Switch to rich text editing' and a small icon.

Comment Close merge request

Mark as done



None - assign yourself

doing × feature ×

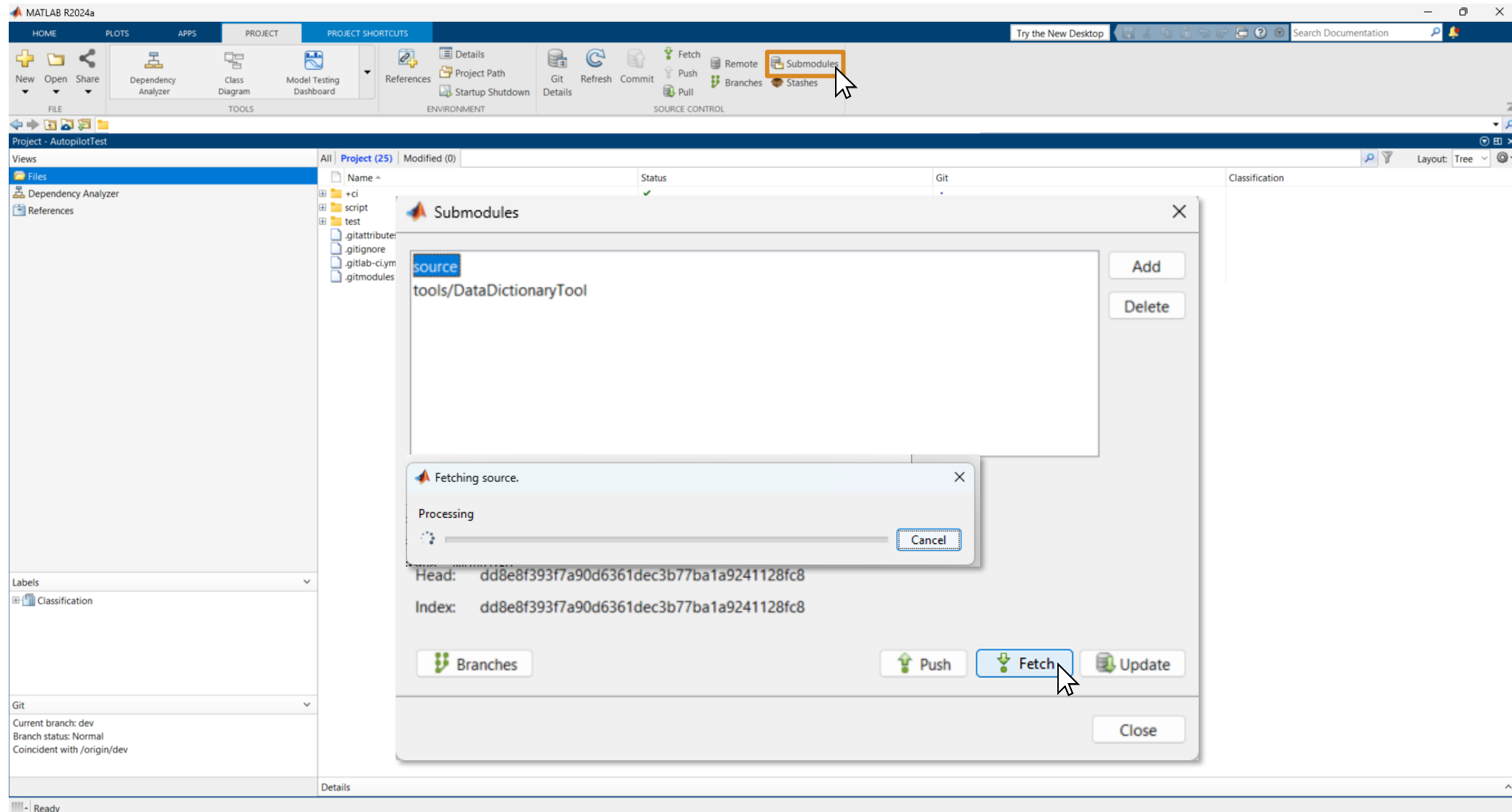
None

No estimate or time spent





New Controller Development



New Controller Development



Branches

Current Branch

Name: dev
HEAD: dd8e8f393f7a90d6361dec3b77ba1a9241128fc8
[Revert to HEAD](#)

Branch Browser

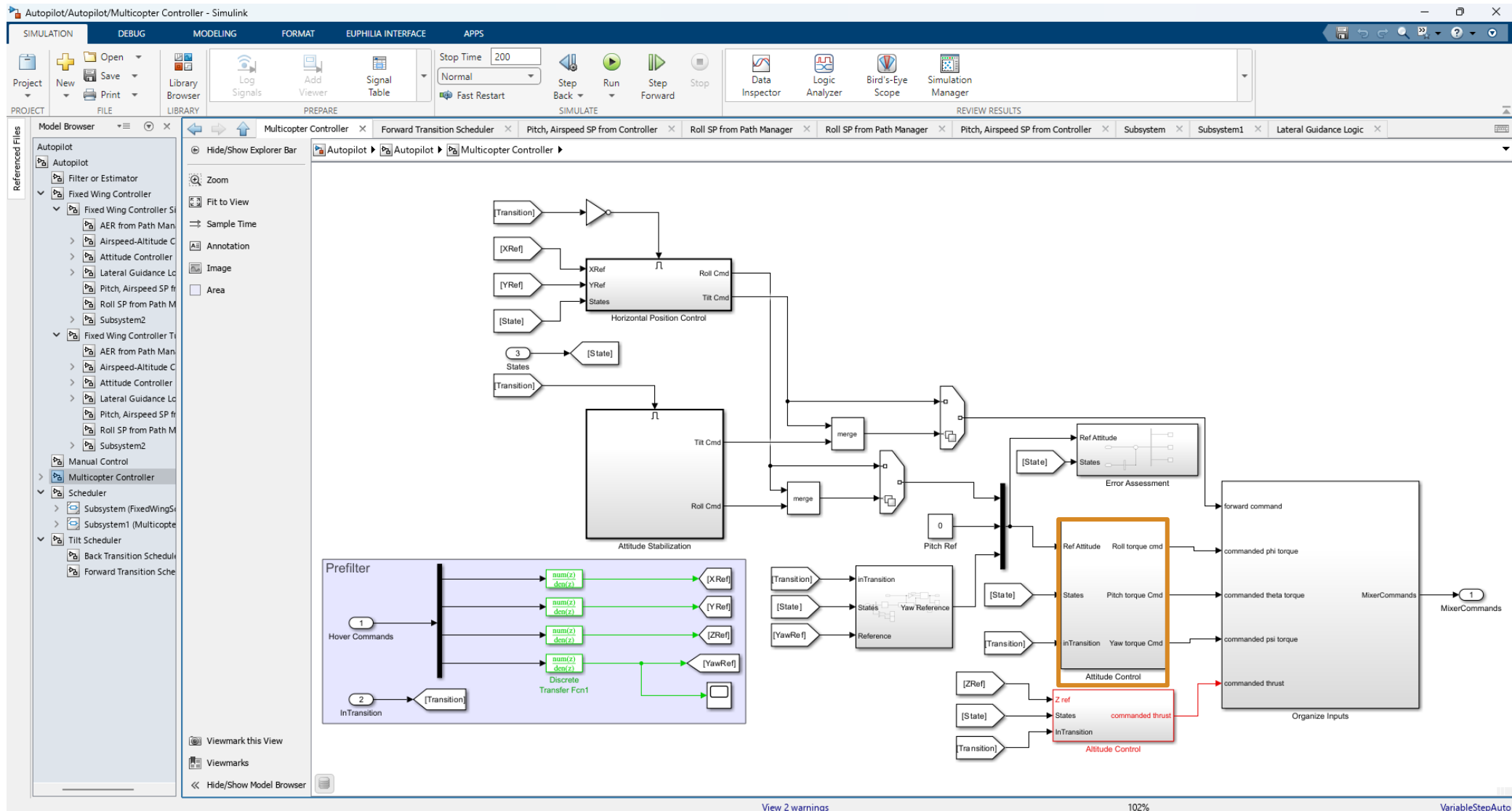
Branches: 10-feature-modify-and-tune-controller-to-meet-requirements

Branch	Author
10-feature-modify-and-tune-controller-to-meet-requirements	Maxime Francois
11-feature-prepare-controller-for-demo	Maxime Francois
12-fix-remove-internal-harnesses	Maxime Francois
9-feature-modify-autopilot-test	Maxime Francois
8-feature-initiate-working-harness	Zakaria ...
7-feature-define-autopilot-data-dictionary	Zakaria ...
5-feature-add-autopilot-and-dependencies	Zakaria ...
2-feature-configure-matlab-project	Zakaria ...
origin/main	Initial commit

Branch and Tag Creation

Current branch: dev
Branch status: Normal
Coincident with /origin/dev

New Controller Development

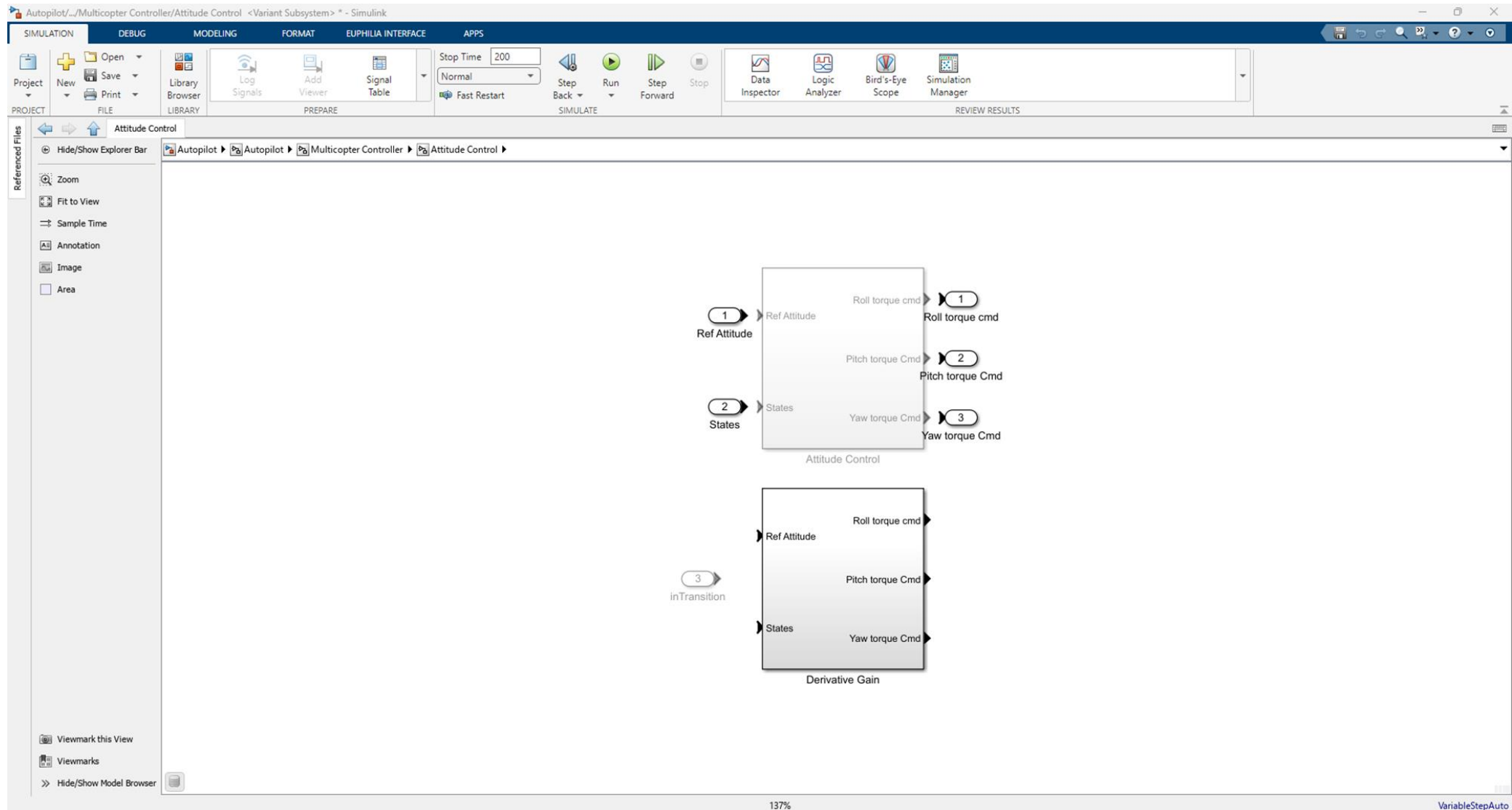


New Controller Development



*After countless cups of coffee, a few minor crises,
and just a little procrastination...*

New Controller Development



New Controller Development

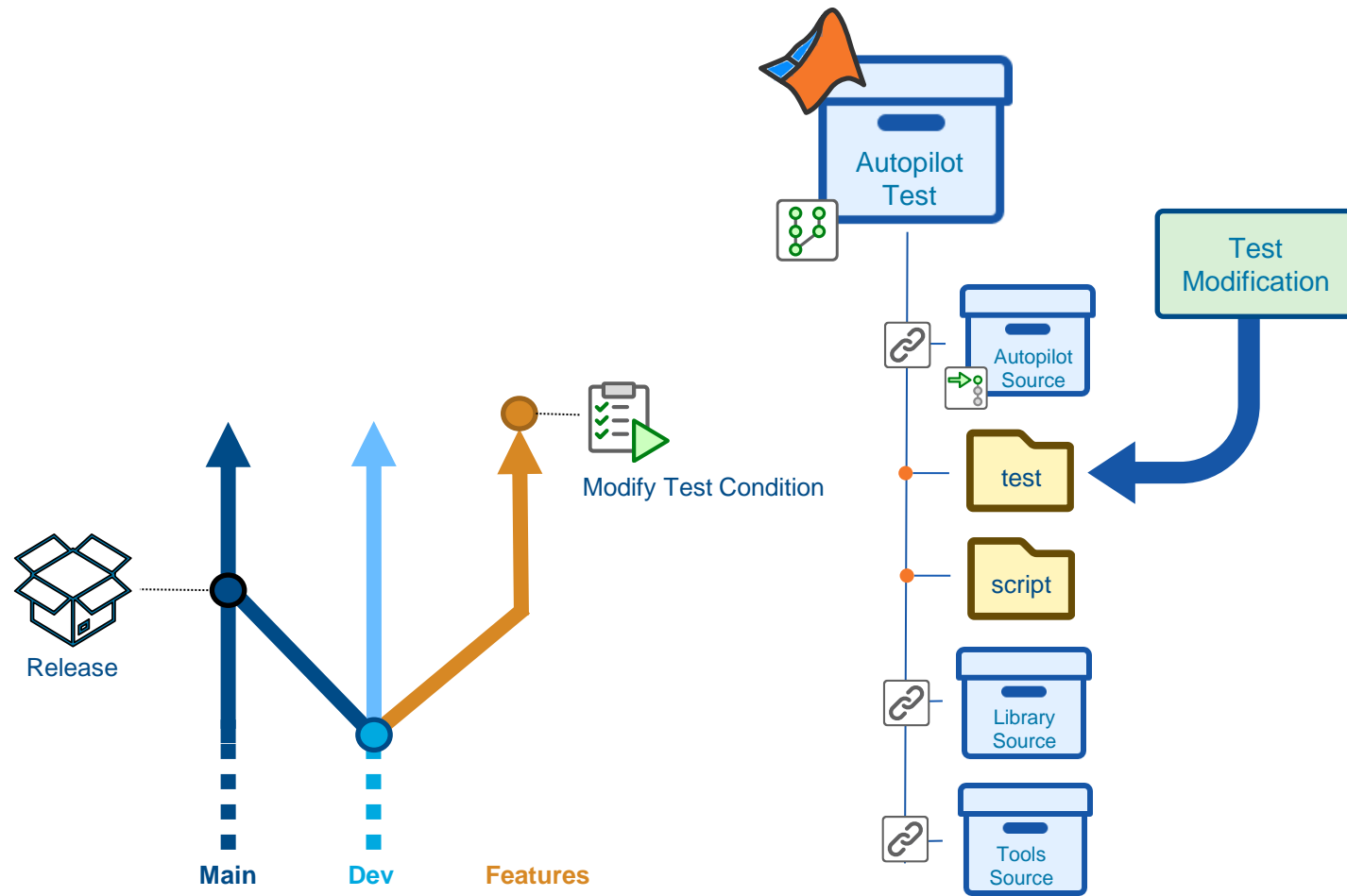


The screenshot displays the MATLAB R2024a interface with the 'Submodules' dialog box open. The dialog shows the following details for the 'source' submodule:

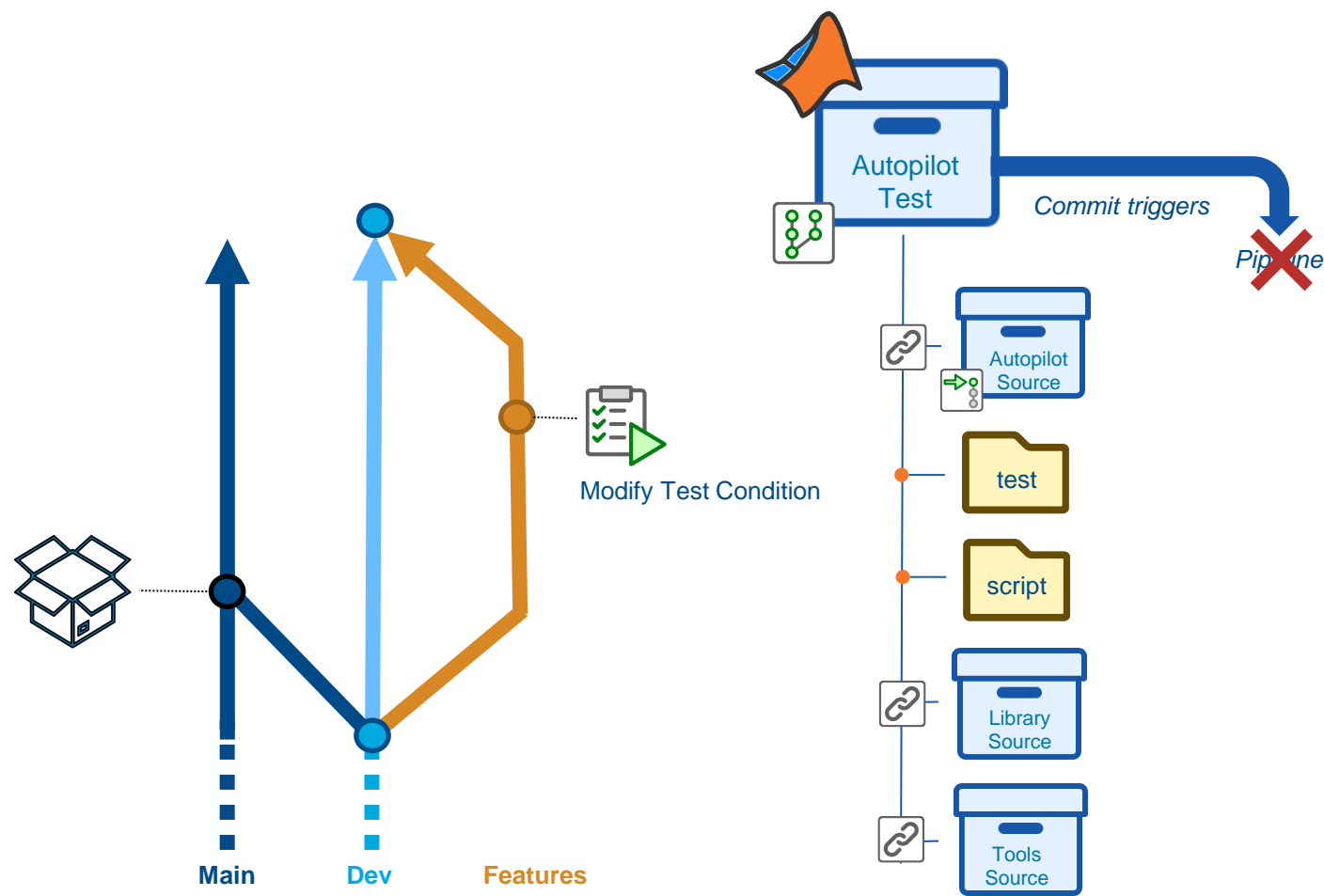
- Path: source
- Remote: ../source.git
- Status: REV_CHECKED_OUT
- Head: a08802cc64c1e3c75a1cf6d432e48eb37447a018
- Index: dd8e8f393f7a90d6361dec3b77ba1a9241128fc8

The background shows the MATLAB Project tool with the 'Project - AutopilotTest' window open. The 'source' folder is selected, and its contents are visible in the 'References' pane. The 'Git' pane shows the current branch as 'dev' and its status as 'Normal'.

New test in Autopilot Test



New test in Autopilot Test



✖ Pipeline #200616 has failed!

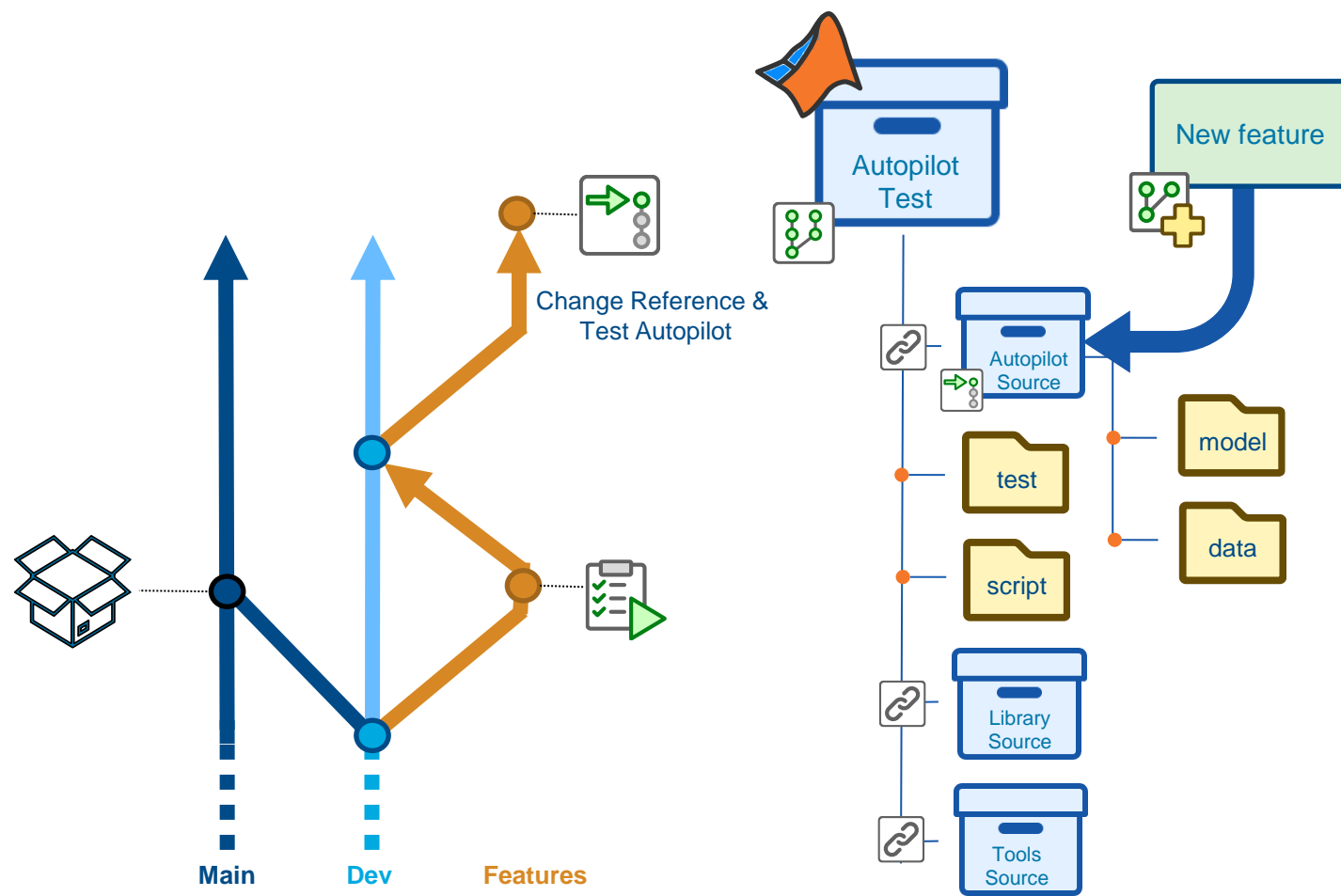
Project	VTOL / Autopilot / Test
Branch	22-feature-modify-fail-condition-in-controller-tests
Commit	64ef1cd7 in !17 feat: Modify fail condition in controller tests
Commit Author	mfrancoi

Pipeline #200616 triggered by had 1 failed job

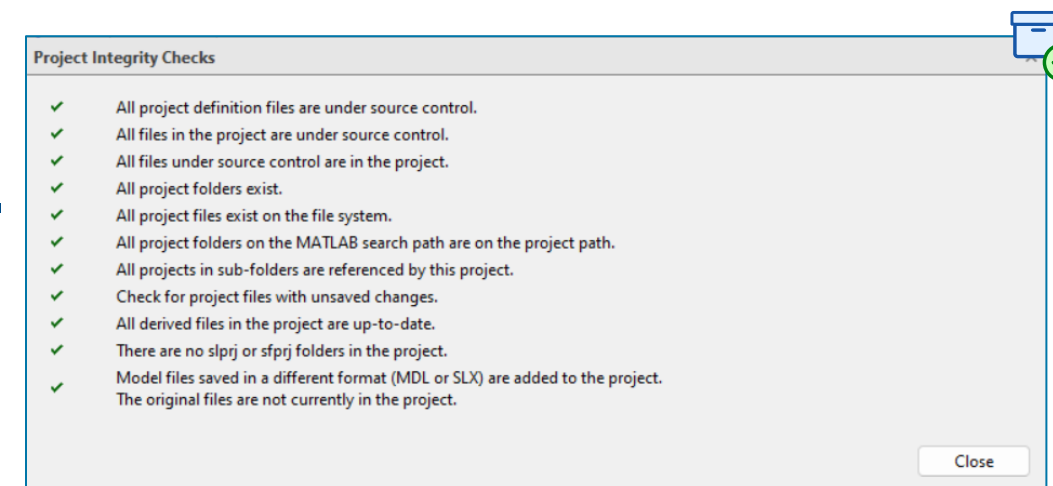
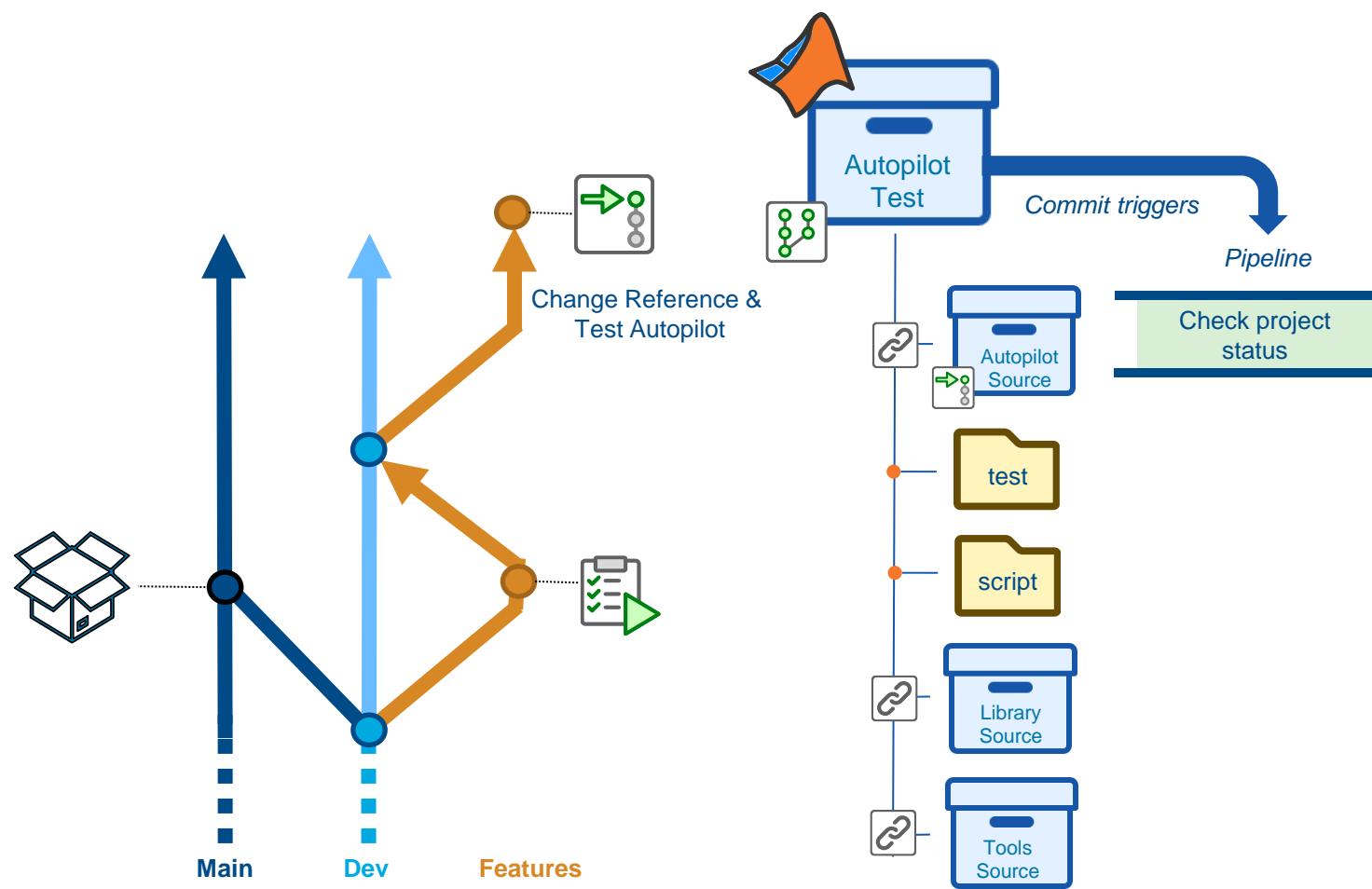
Failed job

✖ test	test-simulation
--------	-----------------

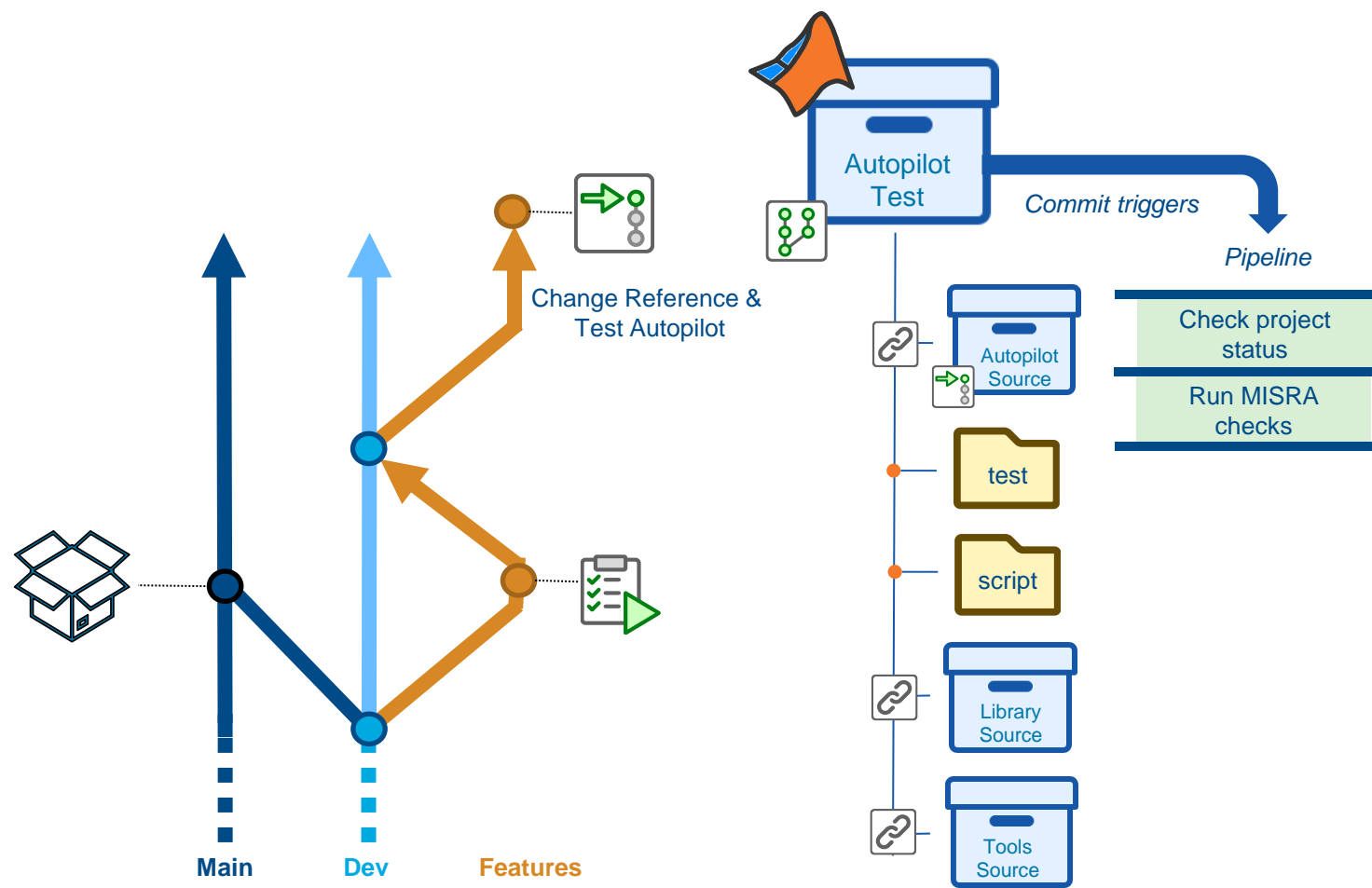
New feature is now on branch Feature



New feature is now on branch Feature



New feature is now on branch Feature



Check Selector

Search

- ☒ Modeling Standards for MISRA C:2012
 - ☒ Check configuration parameters for MISRA C:2012
 - ☒ Check for blocks not recommended for C/C++ production code deployment
 - ☒ Check for blocks not recommended for MISRA C:2012
 - ☒ Check for unsupported block names
 - ☒ Check usage of Assignment blocks
 - ☒ Check for switch case expressions without a default case
 - ☒ Check for missing error ports in AUTOSAR receiver interfaces
 - ☒ Check for bitwise operations on signed integers
 - ☒ Check for recursive function calls
 - ☒ Check for equality and inequality operations on floating-point values
 - ☒ Check for missing const qualifiers in model functions
 - ☒ Check integer word lengths
 - ☒ Check bus object names that are used as bus element names
 - ☒ Check for variant blocks that do not have a default choice

Verify compliance with modeling guidelines

Tips

- To enable or disable a check, select or clear the check box next to the check name.
- To enable or disable all checks within a folder, right-click the folder and then click "Select All" or "Deselect All".
- To run checks, select a folder or check in the left pane.
- For a list of all possible actions, right-click an object in the left pane.

Check Types

- Edit-time check support
- Check triggers update diagram on model
- Check triggers an extensive analysis of model

Result Status

- Not Run
- Information
- Passed
- Justified
- Warning
- Failed
- Incomplete

Configurations

Check Configuration: Default

Justifications File: -

Model Advisor Report for 'Autopilot'

Location: file:///C:/Tests/Autopilot_test/work/Report_2024_09_17_16_15.html

Model Advisor Report - Autopilot.slx

Simulink version: 24.1
System: Autopilot
Treat as Referenced Model: off

Model version: 4.4
Current run: 13-Aug-2024 14:46:00

Run Summary

Incomplete	Failed	Warning	Justified	Passed	Information	Not Run	Total
0	0	0	1	13	0	0	14

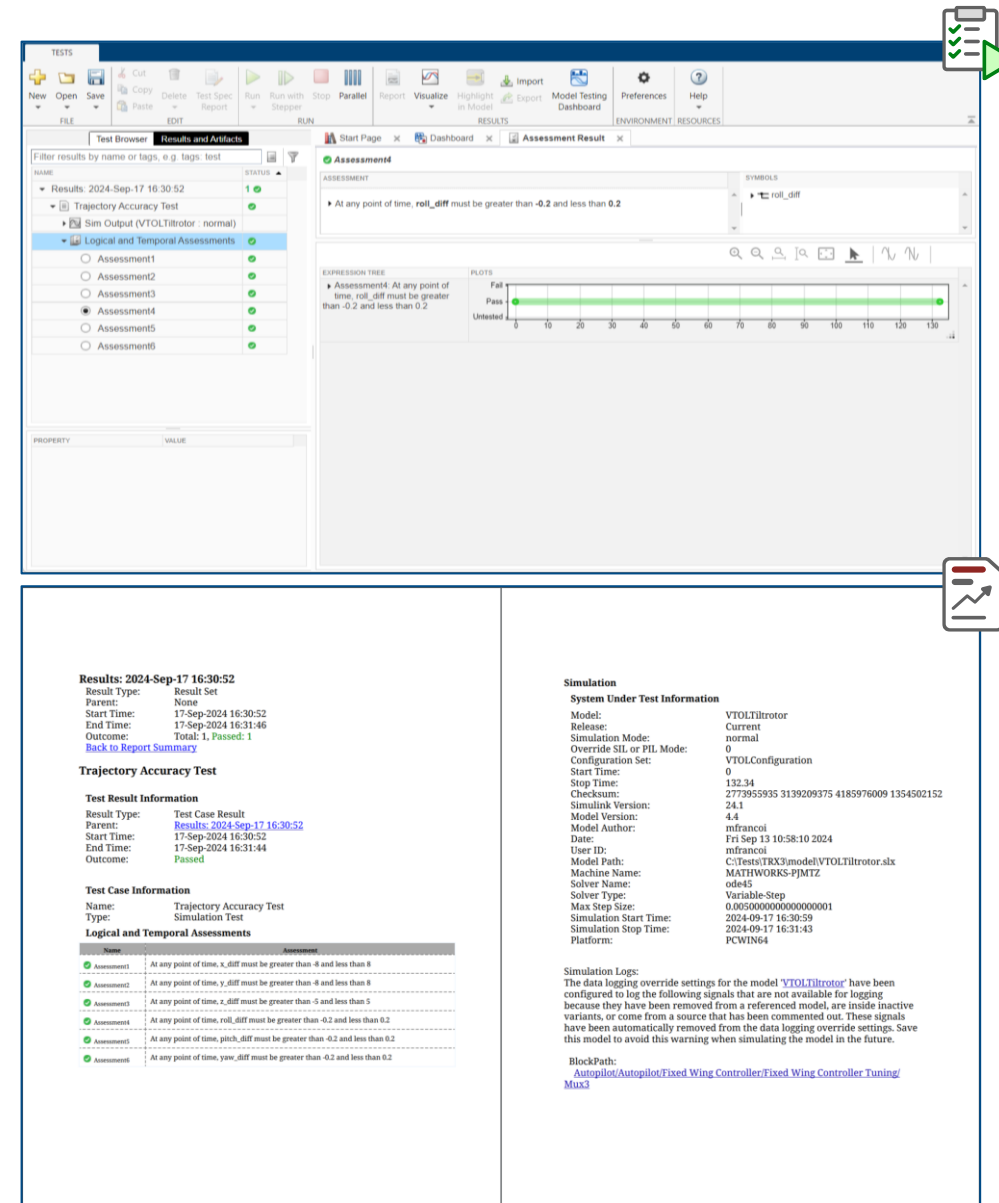
Modeling Standards for MISRA C:2012

- ☒ Check configuration parameters for MISRA C:2012

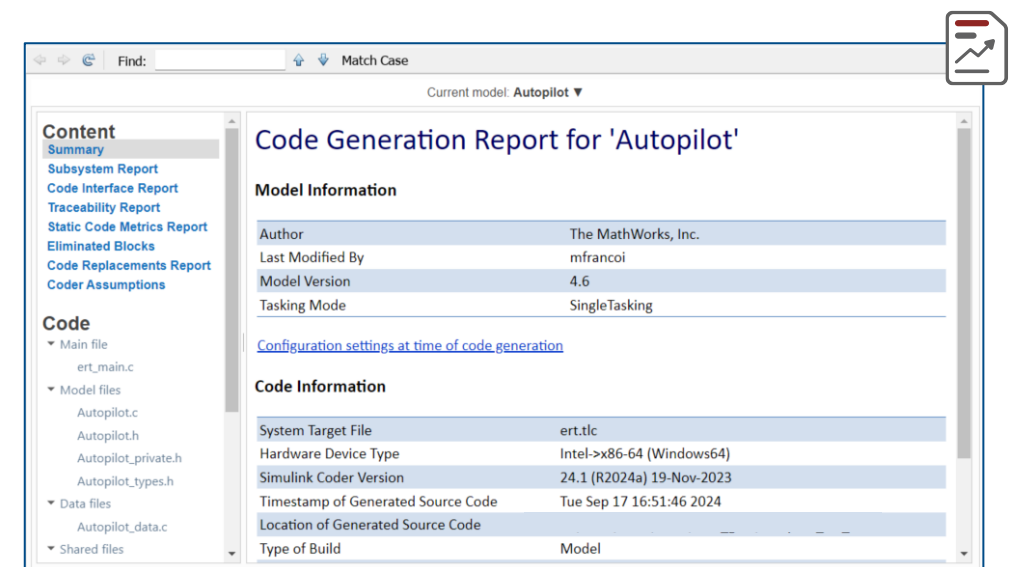
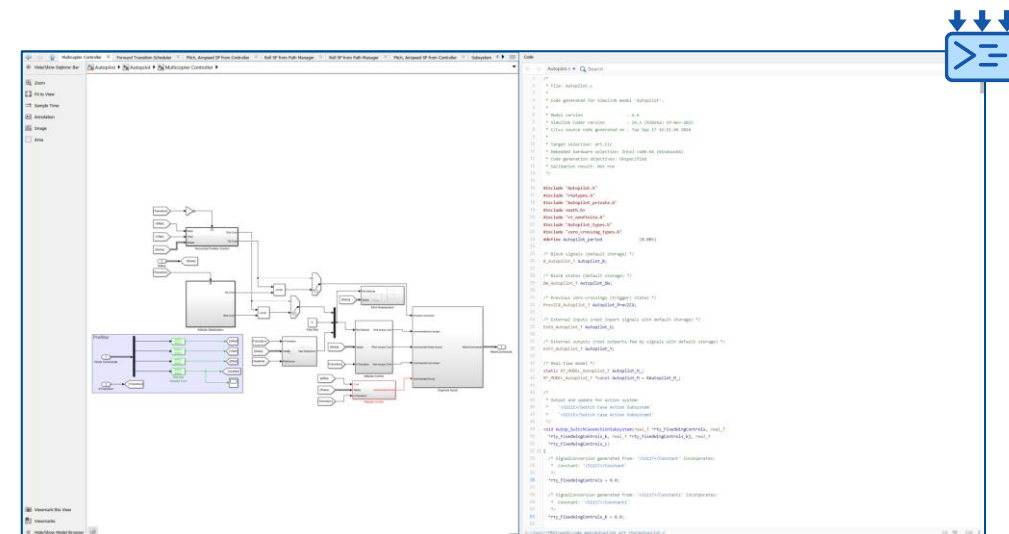
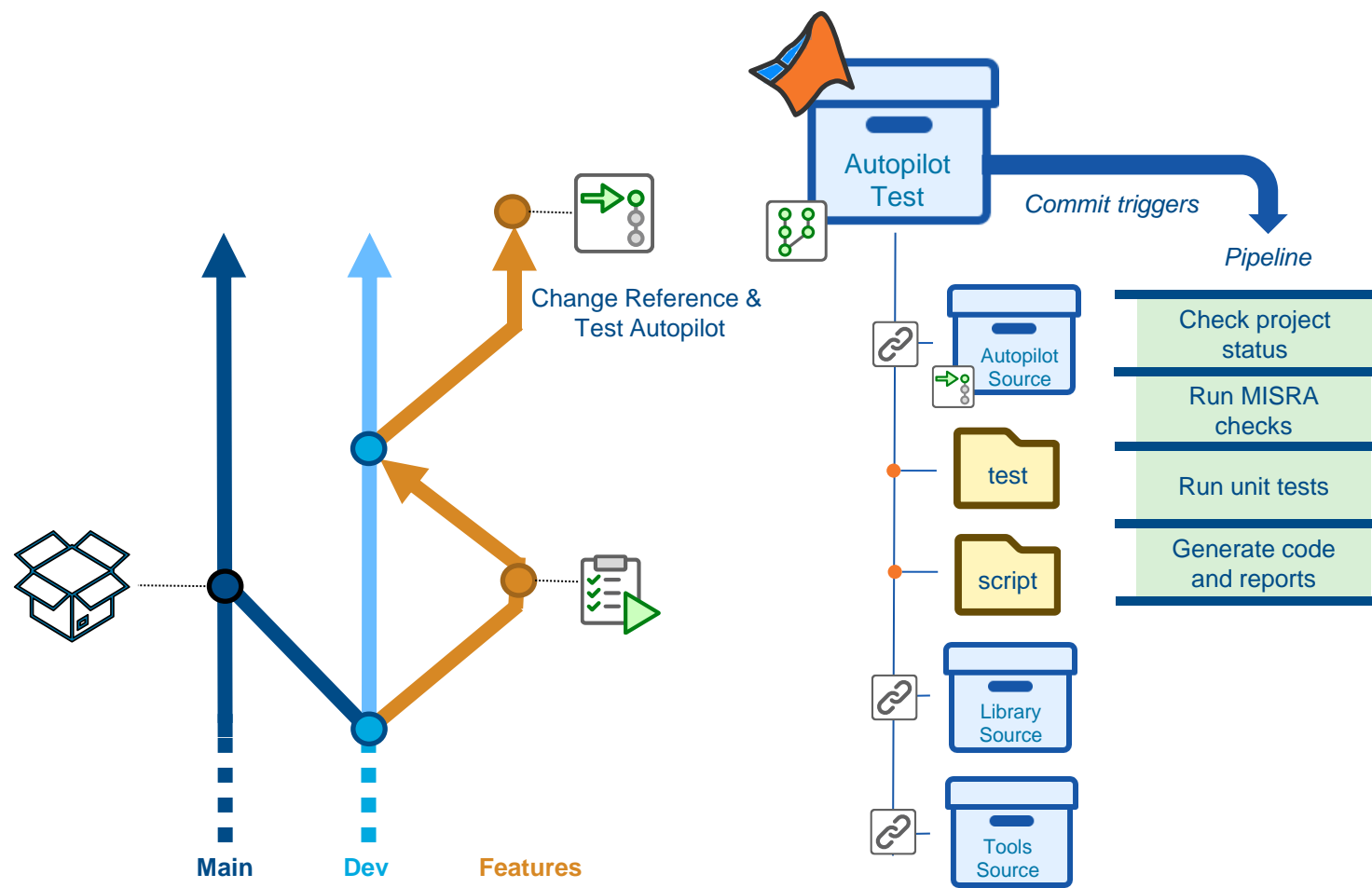
Identify configuration parameters that might impact MISRA C:2012 compliant code generation.

Passed
All constraints on model configuration parameters have been met.

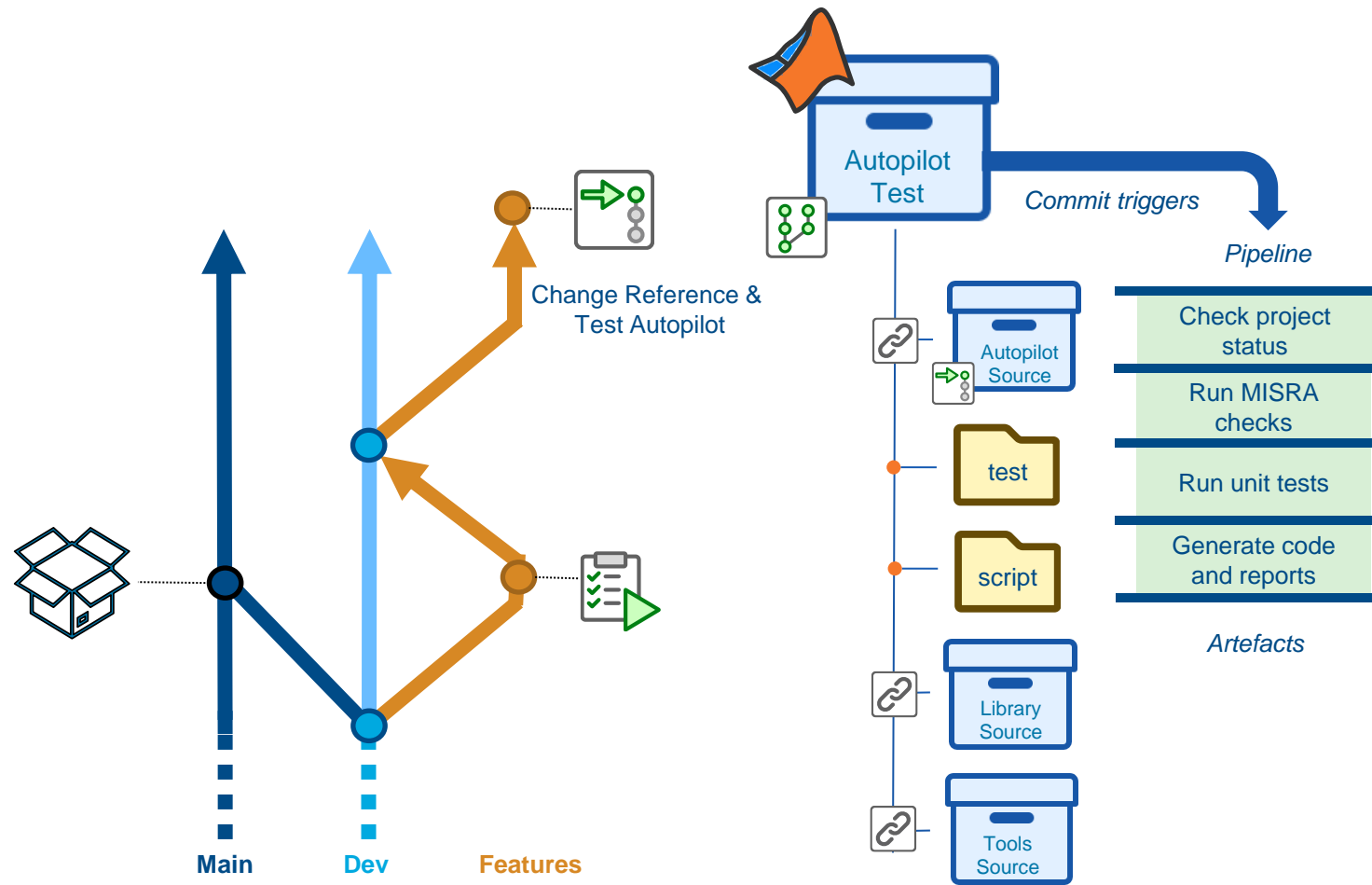
Status	Parameter	Current Value	Recommended Values	Prerequisites
Pass	Model Verification block enabling (AssertControl)	DisableAll	DisableAll	
D -	Shared code placement (UtilityFuncGeneration)	Shared location	Shared location	
Pass	Generate shared constants (GenerateSharedConstants)	off	off	UtilityFuncGener
D -	System target file (SystemTargetFile)	ERT based target	ERT based target	



New feature is now on branch Feature



New feature is now on branch Feature



Resolve "[test] Integrate new derivative gain controller"

Open Maxime Francois requested to merge 8-test-integrate-new-deriv... into dev 4 days ago

Overview 0 Commits 1 Pipelines 2 Changes 1

Closes #8

0 0 0

✓ Pipeline #200736 passed

Pipeline passed for cb2ac29c on 8-test-integrate-ne... 3 days ago

8v Approve Approval is optional ?

✓ Ready to merge!

☒ Delete source branch ☐ Squash commits ? ☐ Edit commit message

1 commit and 1 merge commit will be added to dev. · Closes issue #8

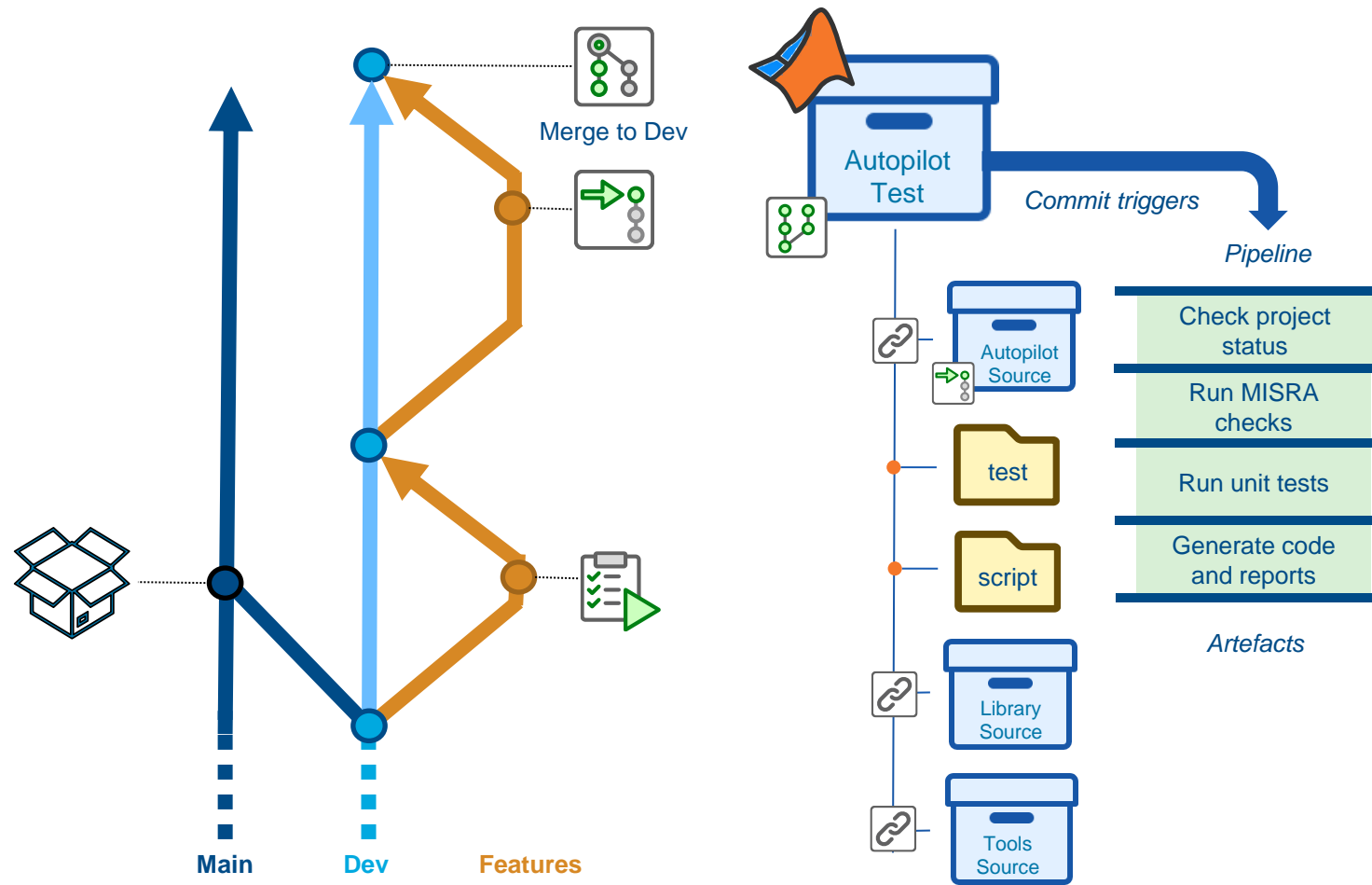
Merge

Artifacts

Total artifacts size 8.80 MiB

Artifacts	Job	Size	Created
3 files	test-model-advisor CO #200736 cb2ac29c 8-test-integrate-new-derivative-gain-controller	1.85 MiB	5 minutes ago
artifacts.zip	archive	1.84 MiB	
metadata.gz	metadata	1.55 KiB	
job.log	trace	14.64 KiB	

Feature branch is ready to merge in Dev



Resolve "[test] Integrate new derivative gain controller"

Open Maxime Francois requested to merge 8-test-integrate-new-deriv... into dev 4 days ago

Overview 0 Commits 1 Pipelines 2 Changes 1

Closes #8

0 0 0

✓ Pipeline #200736 passed

Pipeline passed for cb2ac29c on 8-test-integrate-ne... 3 days ago

8✓ Approve Approval is optional ?

✓ Ready to merge!

☒ Delete source branch ☐ Squash commits ? ☐ Edit commit message

1 commit and 1 merge commit will be added to dev. · Closes issue #8

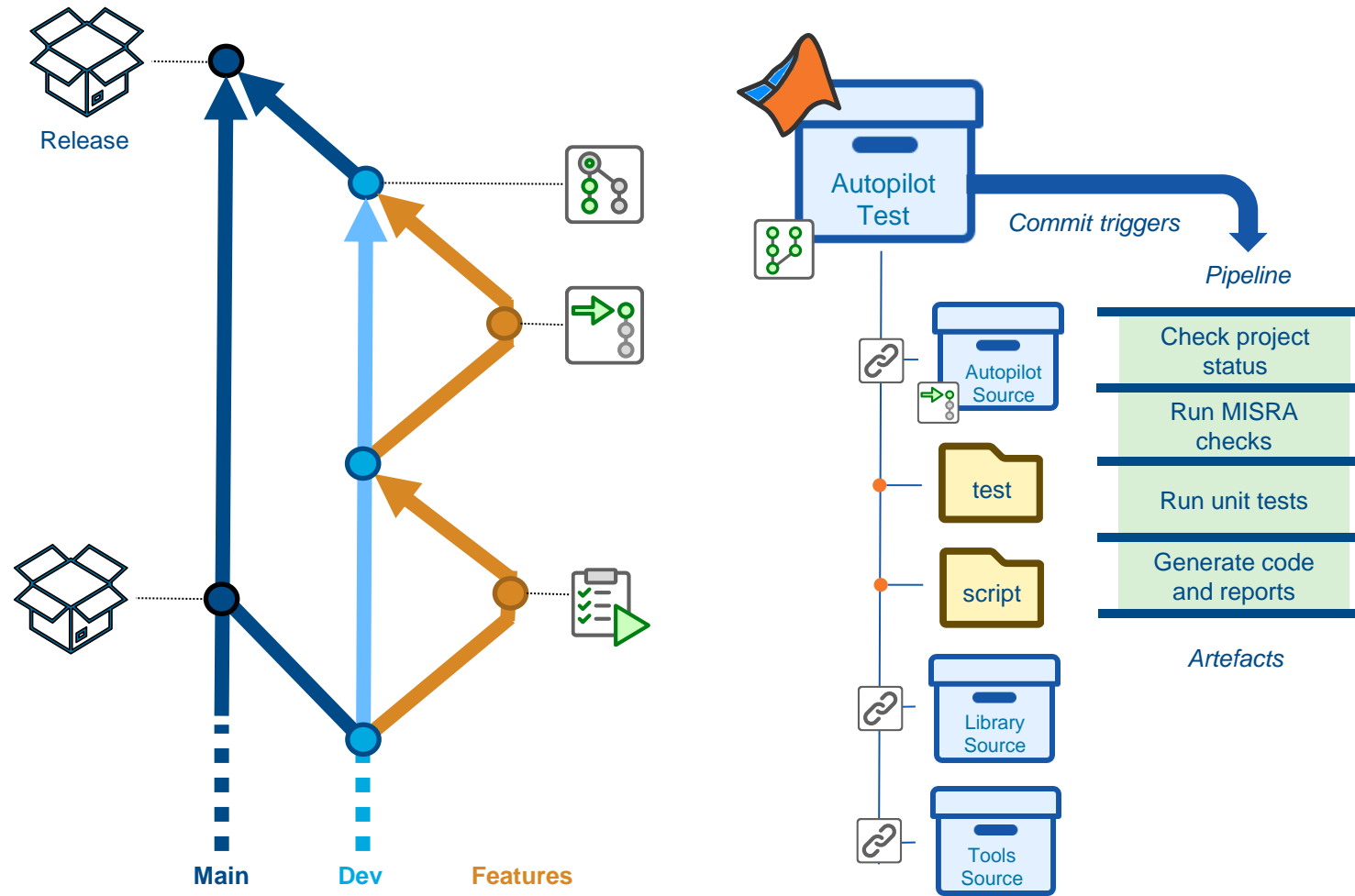
Merge

Artifacts

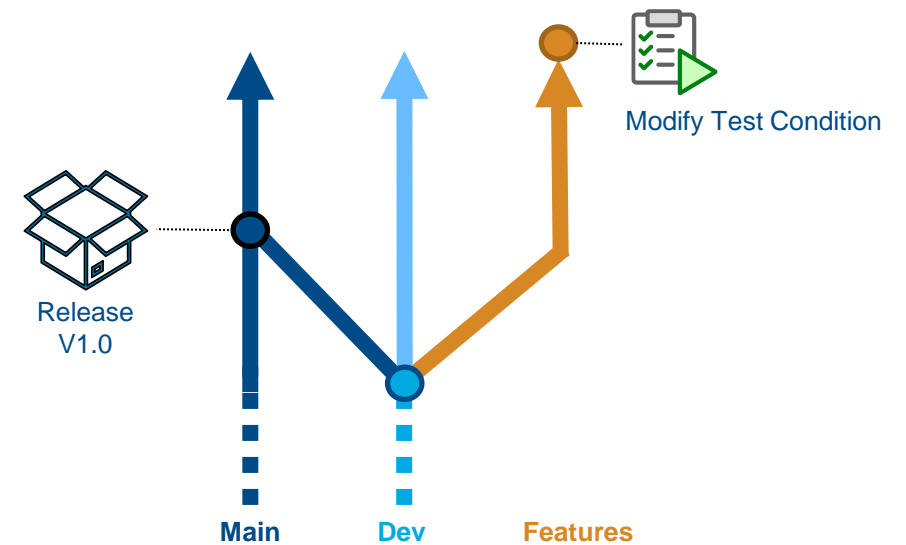
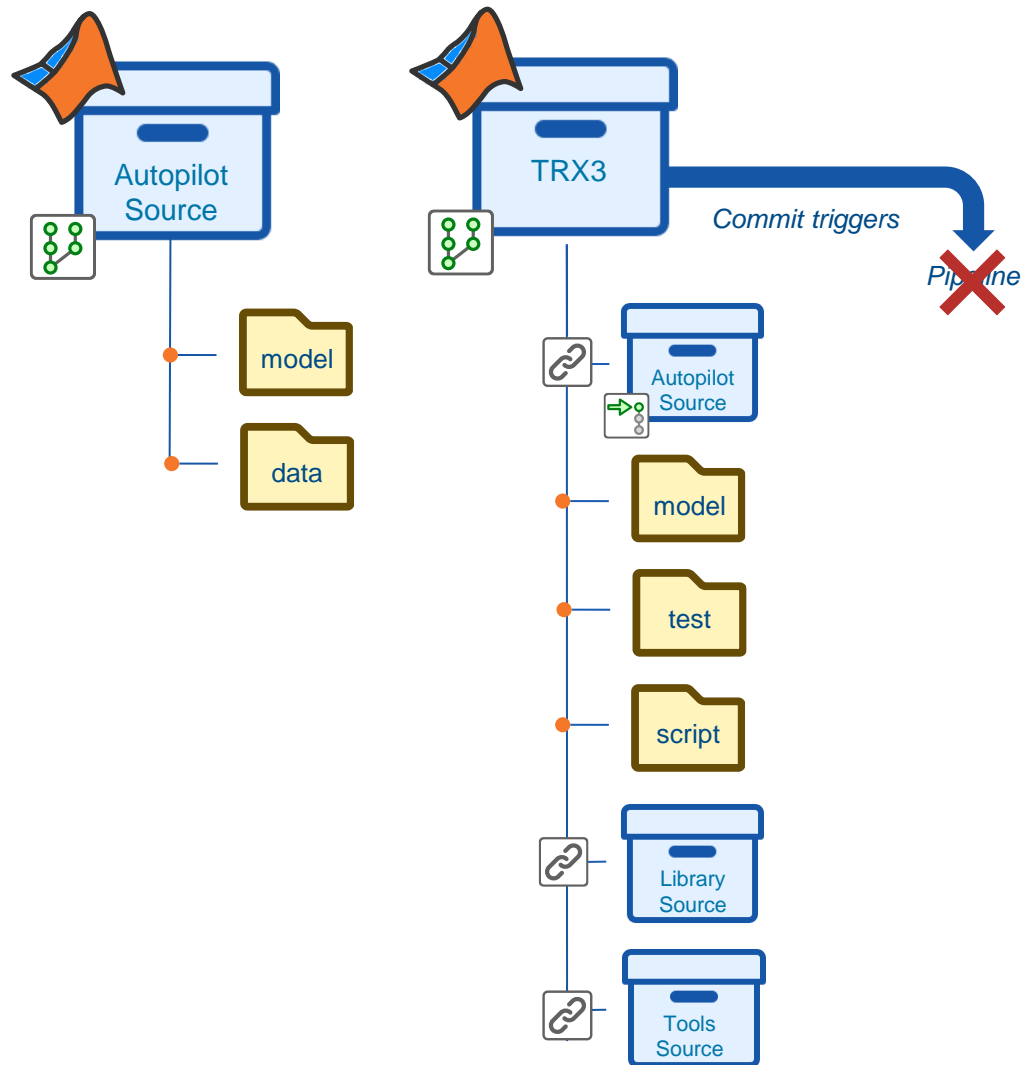
Total artifacts size 8.80 MiB

Artifacts	Job	Size	Created
3 files	test-model-advisor #200736 cb2ac29c 8-test-integrate-new-derivative-gain-controller	1.85 MiB	5 minutes ago
artifacts.zip	archive	1.84 MiB	
metadata.gz	metadata	1.55 KiB	
job.log	trace	14.64 KiB	

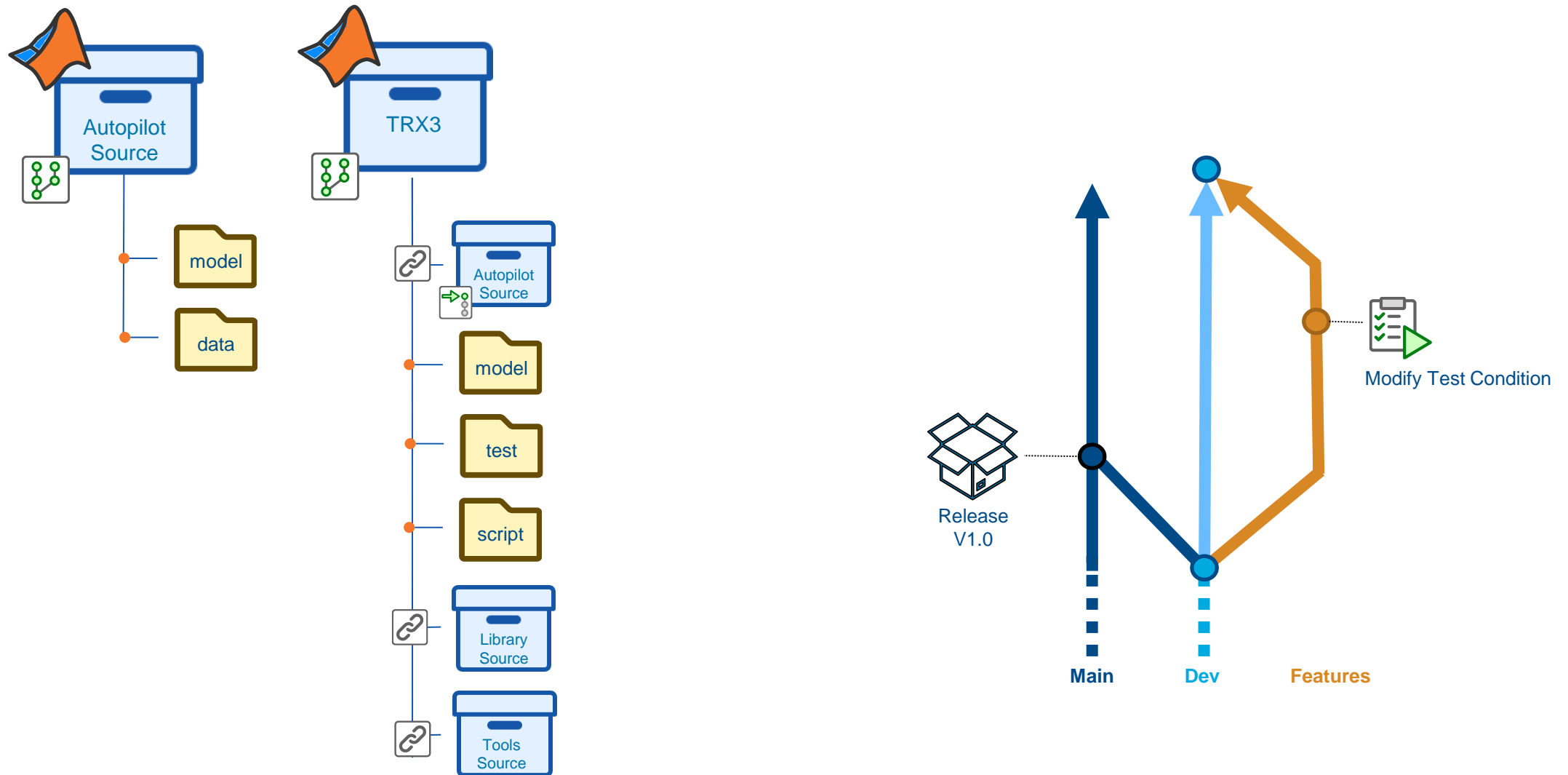
Dev branch is ready to merge in Main



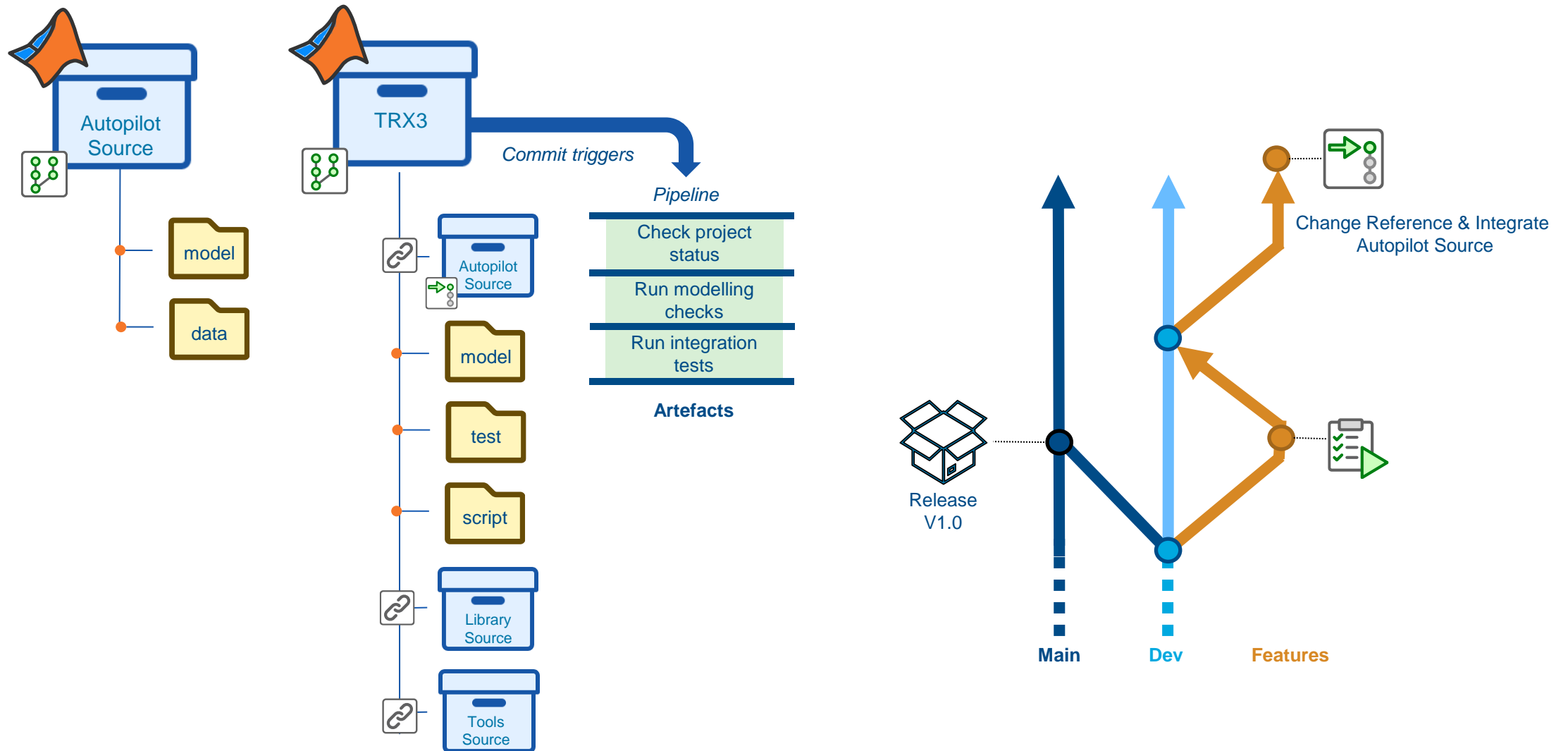
Integrate new controller to TRX3



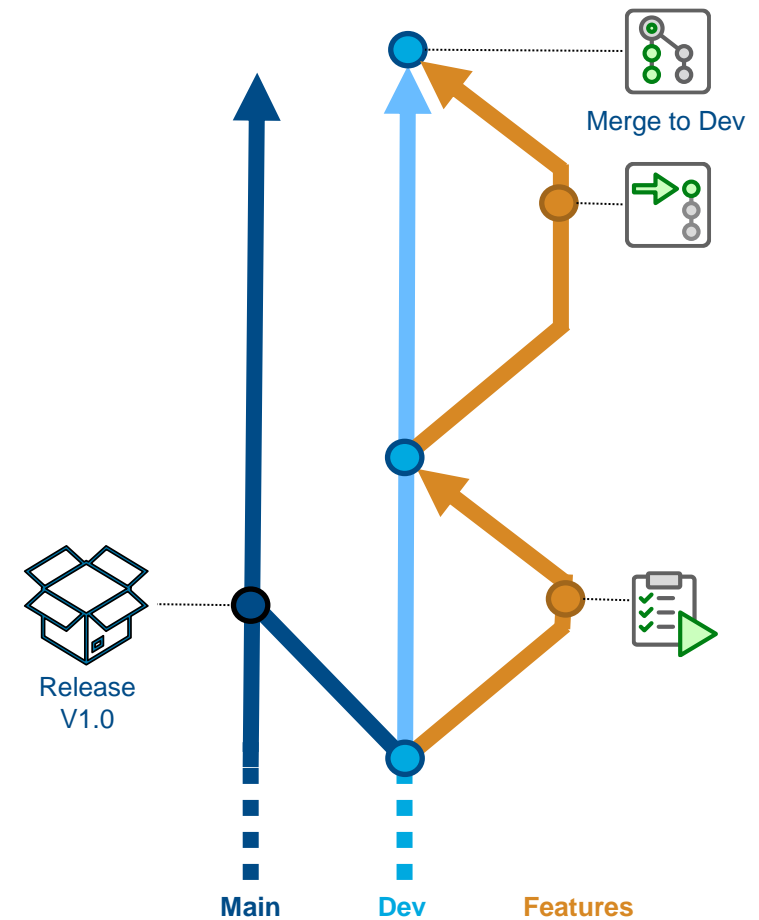
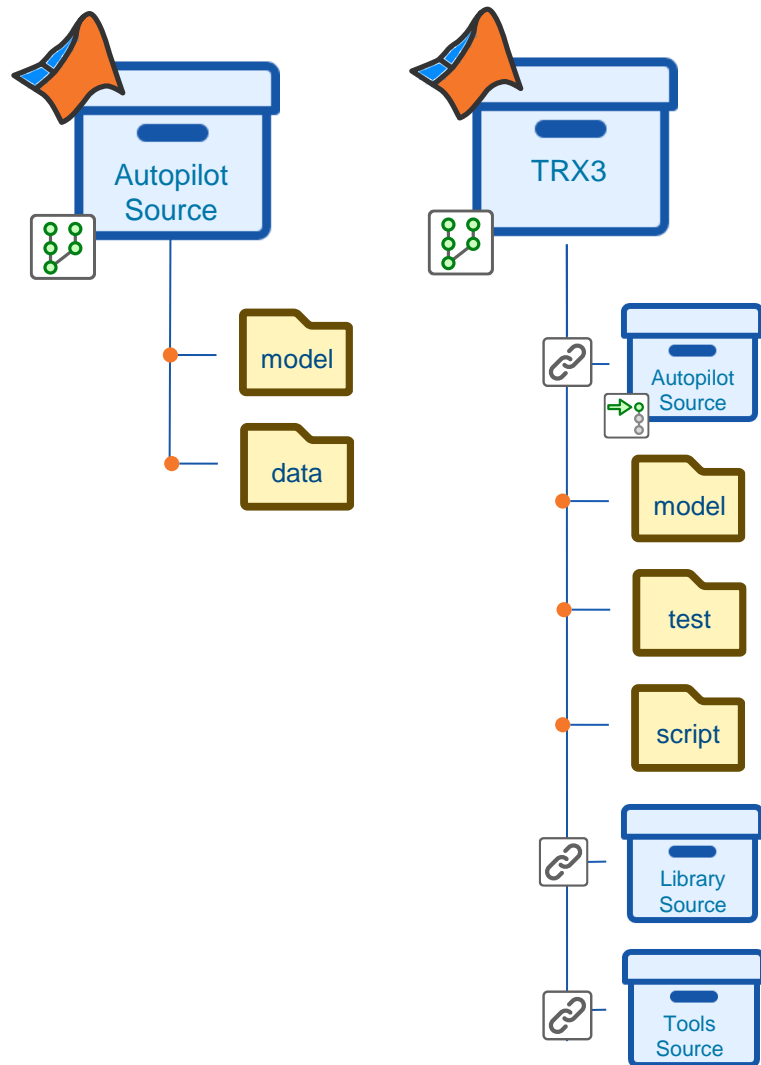
Integrate new controller to TRX3



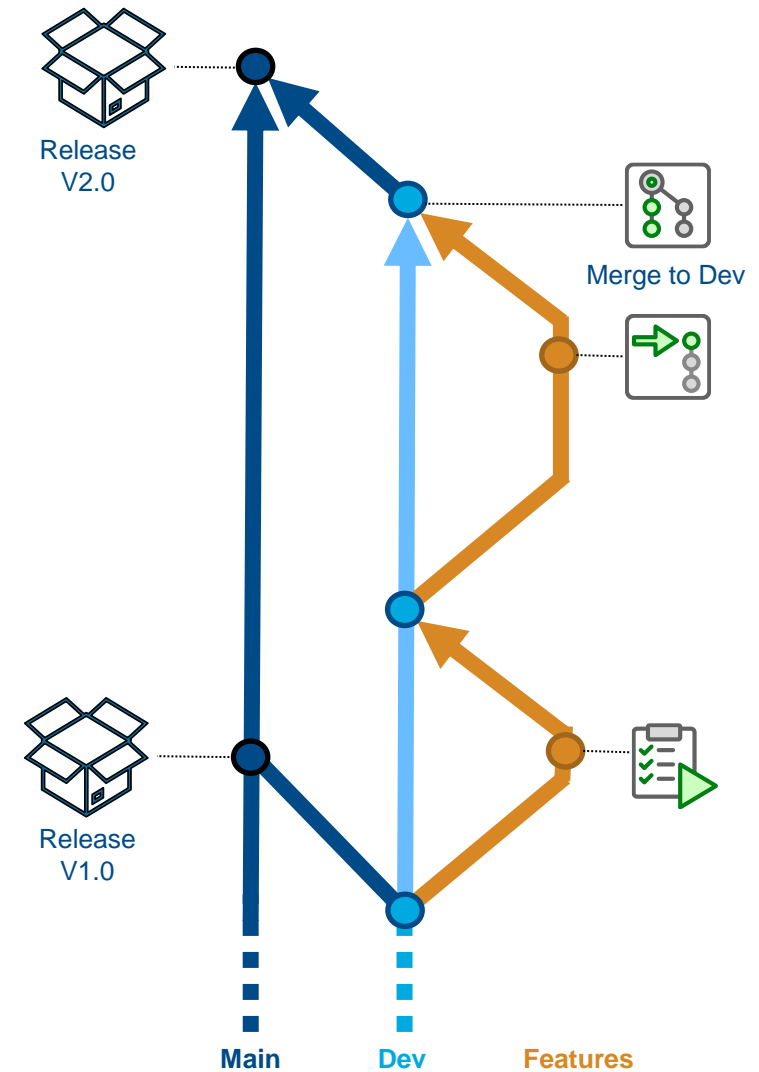
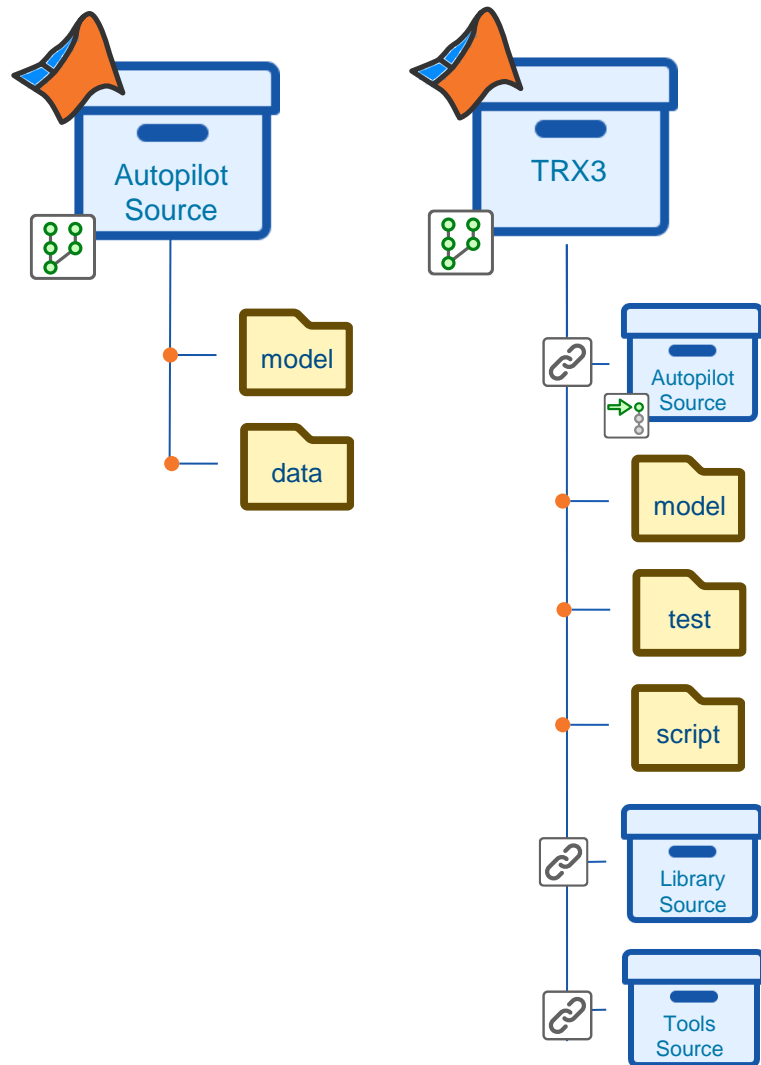
Integrate new controller to TRX3



Integrate new controller to TRX3

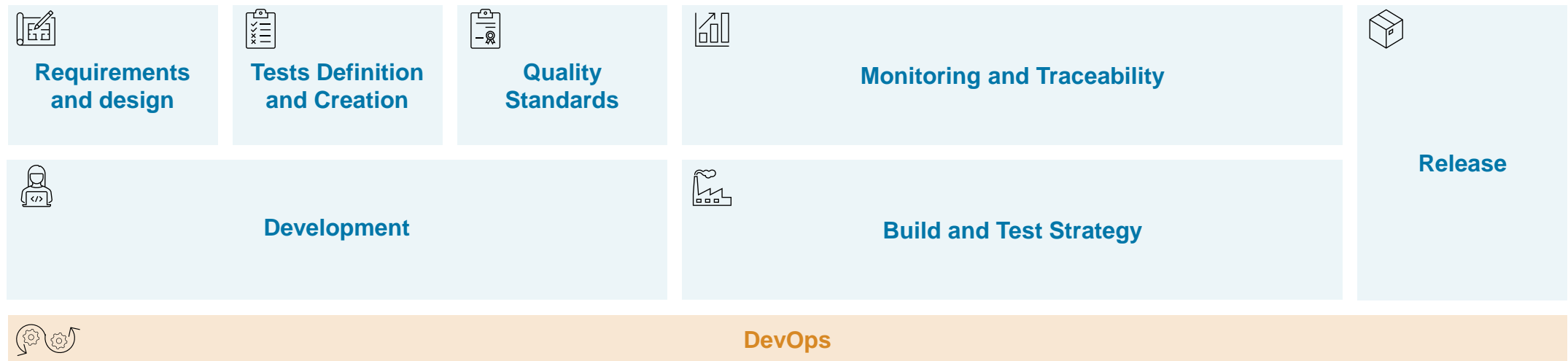


Integrate new controller to TRX3



Conclusion

Industrializing Development with MATLAB & Simulink



Next Steps



**Improve your software
development**



Enhance Automation

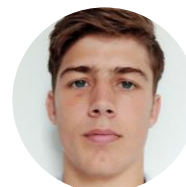


Scale Up

Reach out for support to implement these practices in your projects



Michelle Valente
mandrade@mathworks.com



Maxime François
mfrancoi@mathworks.com

MATLAB EXPO

Merci



© 2024 The MathWorks, Inc. MATLAB and Simulink are registered trademarks of The MathWorks, Inc. See [mathworks.com/trademarks](https://www.mathworks.com/trademarks) for a list of additional trademarks. Other product or brand names may be trademarks or registered trademarks of their respective holders.

