

Integrative Optimization of Functional Testing Machines

1 Introduction

Welcome to the 2026 Industry Sprint Workshop (ISW) at the International DSM Conference. ISW have a year-long tradition at DSM conferences, and we are happy to continue this format.

We are delighted to present **ABB** as our industry partner for this year's challenge. We will work on an exciting task to analyze and derive recommended improvements for ABB's **Functional Testing Machines (FTM)**, where current adaptations to new microcontrollers as tested objects are taking too much time. We will investigate the three domains of product, process, and organization, to be able to derive insights on the **integration** of those three domains.

You will have ~ **2,5 h time** to **solve the task** and **prepare** a small **presentation** of **max. 5 min**. A jury will evaluate your presentations and define a winning team, awarded with a small prize. Additionally, each group will get a 30 min guided lab tour visiting the FTMs.

Below, Figure 1 gives you an overview of today's ISW schedule:

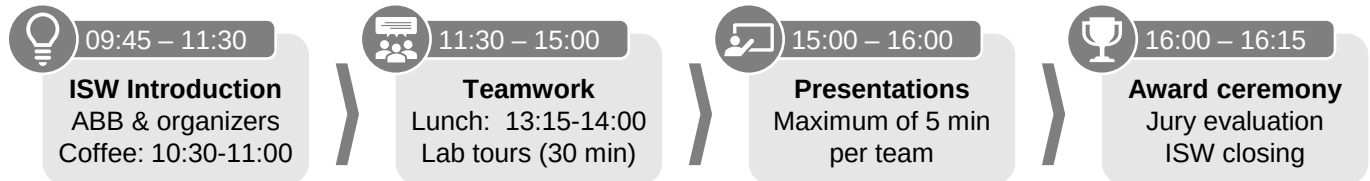


Figure 1: Industry Sprint Workshop (ISW) schedule

2 Background

An end-of-line testing machine (FTM) verifies the quality of the production process, ensuring that each **electronic board** has been correctly manufactured and meets the required functional and accuracy requirements.

The change concerns the replacement of the **main microcontroller with a new MCU-X part in the electronic boards to be tested**. It is reported by **Supply Chain Management (SCM) & Product Engineering**, triggering the **Product Owner** to issue an **Engineering Change Notice (ECN)**. Although the new MCU is considered “functionally compatible” (minimal impact on the FTM design) **the actual impact found by Test Engineering can be much larger** than expected due to three types of dependencies:

- **FTM dependencies (Product DSM):** the new MCU may affect other FTM elements; e.g., the test bench fixture (nest + pogo pins).
- **Process dependencies (Process DSM):** issues may propagate across activities; e.g., electrical design problems discovered only during validation can trigger late redesign.
- **Organizational dependencies (Organization DSM):** the change requires coordination between Test Engineering and the external FTM supplier's Firmware, HW, and Fixture teams.

Identifying these dependencies is key to understanding the real impact of the change and reducing the FTM update lead time, currently estimated at almost 25 weeks.

3 What we ask of you

- Review and discuss the available data/models. Understand all three domains and discuss if anything is missing that you might consider important.
- Review the pre-analyzed change impact reports of the microcontroller. Understand what impact a change in this part causes in the whole multi-domain system and identify which elements are impacted the most. Briefly discuss possible reasons (but focus on next steps)
- Review each domain and suggest possible improvements in each domain separately. Include the pre-analyzed DSM views into your considerations
- Discuss the integration of the three domains: consider dependencies between domains and suggest changes for the overall system
- Prepare a presentation of max. 5 min. At least discuss each domain and the integration view. Also include a traceability from your decisions back to the given models as far as possible
- A more detailed description of the tasks is provided in **Section 7, Guideline**.

Our partners from Lattix are here to support you. All the models shown in the following are available as models in Lattix on the machines of the Lattix representatives. If you want to investigate a certain change you consider, you can consult them to directly view the models.

4 Detailed description of the Functional Testing Machines (FTM)

The following figures describe the product domain separately with its three dependency kinds, and then the mutli-domain view with all three domains.

Product-DSM (Figures 2, 3, 4, 5)

#	PRODUCT
E1	Microcontroller (MCU-X)
E2	Programming connector
E3	Existing & new test points
E4	DUT firmware
E5	FTM Measurement & Signal Conditioning Instrumentation
E6	FTM-to-DUT Programming Interface
E7	FTM Fixture / Mechanical Interface
E8	FTM Electrical Test Interface
E9	FTM Fw & Test sequence
E10	FTM Test Configuration
E11	FTM Technical documentation

* note: the elements from E1 to E4 are part of the Device Under Testing (DUT, the electronic board) and therefore are the initiators of the changes **but are out of scope for the redesign of the FTM** (which instead should include the elements from E5 to E11).

Part of the FTM architecture, focus for the redesign in the workshop

DSM convention: Cell (i, j) shows how strongly the row element i **depends on** the column element j – if j changes, i must be reviewed or modified (1 = weak/indirect, 2 = moderate, 3 = strong/direct).

Color legend: Green: mechanical interface, Pink: electrical interface, Blue: information interface. When a cell has multiple colors it means the interfaces are multiple (e.g. a green and pink cell = both mechanical and electrical interface)

Process-DSM (MDM in Figure 6)

Code	Process activity	Duration (weeks)
P1	Requirements / change analysis	1
P2	FTM Impact assessment	1
P3	Test strategy definition/review	1
P4	FTM Hw design	3
P5	FTM FW/ test sequence development	3
P6	Mechanical fixture design	3
P7	Component procurement*	
P8	Test machine / fixture manufacturing	4
P9	FTM Hw/Mechanical Assembly	2
P10	FTM Hw-Sw Implementation	2
P11	Internal validation	3
P12	Factory Acceptance Test (FAT) & Release	2
	Total nominal process duration	25

*Note: Component procurement is carried out **concurrently** with electrical and mechanical fixture design

DSM convention: Cell (i, j) represents how strongly the process on the row **depends on** the output of process in the column: 1 = weak (informational, low risk), 2 = moderate (functional, requires coordination), 3 = strong (structural/physical, constraining). Cells over the diagonal indicate **feedback loops**.

Organization-DSM (MDM in Figure 6)

Code	Organizational actor / role
B1	SCM & Product Engineering
B2	Product Owner
B3	R&D – HW Designer
B4	R&D – Electronic Layout
B5	R&D – FW Designer
B6	Test Engineering
B7	FTM Supplier – Firmware & Test Sequence
B8	FTM Supplier – Test Machine Hardware
B9	FTM Supplier – Mechanical Fixture

DSM convention: Cell (i, j) represents how strongly actor on the row **depends on** the output of the actor in the column (i → j): 0 = none, 1 = weak/informal, 2 = moderate/formal, 3 = strong/critical (blocking).

Product domain - All dependencies														Organization	13												
			Process	12	E11: FTM Technical documentation	11	E10: FTM Test Configuration	10	E9: FTM Fw & Test sequence	9	E8: FTM Electrical Test Interface	8	E7: FTM Fixture / Mechanical Interface	7	E6: FTM-to-DUT Programming Interface	6	E5: FTM Measurement & Si...umentation	5	E4: DUT firmware	4	E3: Existing & new test points	3	E2: Programming connector	2	E1: Microcontroller (MCU-X)	1	
Product	DUT	E1: Microcontroller (MCU-X)	1	.																						7	6
		E2: Programming connector	2	2	.																					10	6
		E3: Existing & new test points	3	6		.																				11	4
		E4: DUT firmware	4	3			.																			12	6
			E5: FTM Measurement & Signal Conditioning Instrumentation	5				2		.			1	2	1	2										7	5
			E6: FTM-to-DUT Programming Interface	6	3	9	3	1			.			1	2											10	6
			E7: FTM Fixture / Mechanical Interface	7			6	9			3		.	6												9	3
			E8: FTM Electrical Test Interface	8	2	3	9			2	3	1		.	2	2	1									9	3
			E9: FTM Fw & Test sequence	9	2	1	2	3	3	3			2		.	3	1									6	3
			E10: FTM Test Configuration	10				2	1			2	3			.	1									5	2
			E11: FTM Technical documentation	11						3	3	3	3	2	2		.									12	8
			Process	12																						.	50
			Organization	13																							.

Figure 2: FTMs product domain with all dependencies – initial structure

Mechanical - Mechanical														
		E1: Microcontroller (MCU-X)	E2: Programming connector	E3: Existing & new test points	E4: DUT firmware	E5: FTM Measurement & Signal Conditioning Instrumentation	E6: FTM-to-DUT Programming Interface	E7: FTM Fixture / Mechanical Interface	E8: FTM Electrical Test Interface	E9: FTM Fw & Test sequence	E10: FTM Test Configuration	E11: FTM Technical documentation	Process	
Product	DUT	1	.											
		2		.										
		3			.									
		4				.								
		5				.		1						
		6		3	1		.		1					
		7		2	3		1		2					
		8		1	3		1	1	.					
		9								.				
		10									.			
		11										.		
	Process	12											.	
	Organization	13												.

Figure 3: FTMs product domain with mechanical dependencies only – initial structure

Energy - Energy														Organization	13
														Process	12
														E11: FTM Technical documentation	11
														E10: FTM Test Configuration	10
														E9: FTM Fw & Test sequence	9
														E8: FTM Electrical Test Interface	8
														E7: FTM Fixture / Mechanical Interface	7
														E6: FTM-to-DUT Programming Interface	6
														E5: FTM Measurement & Si...umentation	5
														E4: DUT firmware	4
														E3: Existing & new test points	3
														E2: Programming connector	2
														E1: Microcontroller (MCU-X)	1
Product	DUT	E1: Microcontroller (MCU-X)	1	.											
		E2: Programming connector	2	1	.										
		E3: Existing & new test points	3	3		.									
		E4: DUT firmware	4				.								
		E5: FTM Measurement & Signal Conditioning Instrumentation	5			2		.		2					
		E6: FTM-to-DUT Programming Interface	6		3	1			.						
		E7: FTM Fixture / Mechanical Interface	7		2	3		1		.	2				
		E8: FTM Electrical Test Interface	8		1	3		2	1		.				
		E9: FTM Fw & Test sequence	9									.			
		E10: FTM Test Configuration	10										.		
		E11: FTM Technical documentation	11											.	
	Process		12												.
	Organization		13												.

Figure 4: FTMs product domain with energy dependencies only – initial structure

Information - Information														12	13
														12	13
														12	13
														12	13
														12	13
														12	13
														12	13
														12	13
														12	13
														12	13
Product	DUT	E1: Microcontroller (MCU-X)	1	.											
		E2: Programming connector	2	1	.										
		E3: Existing & new test points	3	3		.									
		E4: DUT firmware	4	3			.								
		E5: FTM Measurement & Signal Conditioning Instrumentation	5					.			1	2			
		E6: FTM-to-DUT Programming Interface	6	3	3	1	1		.		2				
		E7: FTM Fixture / Mechanical Interface	7		2	3		1		.	2				
		E8: FTM Electrical Test Interface	8	2	1	3			1		.	2	2	1	
		E9: FTM Fw & Test sequence	9	2	1	2	3	3	3		2	.	3	1	
		E10: FTM Test Configuration	10				2	1		2	3		.	1	
		E11: FTM Technical documentation	11					3	3	3	3	2	2	.	
	Process		12											.	
	Organization		13												.

Figure 5: FTMs product domain with information dependencies only – initial structure

Start MDW - All dependencies

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6 Change impact analysis for the microcontroller

To further support your analysis, we have used the change impact report function of Lattix. It presents you lists of direct dependencies (level 1) and indirect dependencies (level 2) affected by the microcontroller. It is split into “impacts”, i.e., which dependencies from the microcontroller exist to another element (Tables 1 and 2), and “uses”, i.e., which elements the microcontroller depends on (Tables 3 and 4).

For the important dependencies identified and discussed by you, **you should also use your intuition to identify the reason behind the relationship and its strength (weight)**. For example, following **one possible propagation path**:

Microcontroller → FTM-to-DUT Programming Interface → FTM Technical Documentation

At Level 1, the microcontroller directly impacts the FTM-to-DUT Programming Interface (weight = 3) **because** the programming interface must support the MCU’s specific programming protocol, pin assignment, voltage levels, and communication settings.

At Level 2, this change indirectly impacts the FTM Technical Documentation (weight = 3) **because** the documentation must be updated with the revised programming procedure, connector pinout, interface settings, and related test instructions. A change initially affecting the microcontroller can therefore propagate to documentation that supports operation and maintenance of the end-of-line

Use the same reasoning to interpret the other Level 1 and Level 2 dependencies reported by Lattix and reconstruct the possible causal chains through which the change propagates for those dependencies that you identified as the ones you include in your domain-specific and integration-related recommendations for ABB. Of course, if you have time, you can do this for all dependencies, but we encourage to first ensure you derive insights for each domain and the integration view as described in Section 3 (leave enough time for the main priority tasks.).

Subsystem	Dependency	Used By	Strength
E1: Microcontroller (MCU-X)	Energy-Strong	E3: Existing & new test points	3
E1: Microcontroller (MCU-X)	Energy-Weak	E2: Programming connector	1
E1: Microcontroller (MCU-X)	Info-Medium	E8: FTM Electrical Test Interface	2
E1: Microcontroller (MCU-X)	Info-Medium	E9: FTM Fw & Test sequence	2
E1: Microcontroller (MCU-X)	Info-Strong	E3: Existing & new test points	3
E1: Microcontroller (MCU-X)	Info-Strong	E4: DUT firmware	3
E1: Microcontroller (MCU-X)	Info-Strong	E6: FTM-to-DUT Programming Interface	3
E1: Microcontroller (MCU-X)	Info-Weak	E2: Programming connector	1

Table 1: Microcontroller level 1 impact report

Subsystem	Dependency	Used By	Strength
E2: Programming connector	Energy-Medium	E7: FTM Fixture / Mechanical Interface	2
E2: Programming connector	Info-Medium	E7: FTM Fixture / Mechanical Interface	2
E2: Programming connector	Mechanical-Medium	E7: FTM Fixture / Mechanical Interface	2
E3: Existing & new test points	Energy-Medium	E5: FTM Measurement & Signal Conditioning Instrumentation	2
E3: Existing & new test points	Energy-Strong	E7: FTM Fixture / Mechanical Interface	3
E3: Existing & new test points	Info-Strong	E7: FTM Fixture / Mechanical Interface	3
E3: Existing & new test points	Mechanical-Strong	E7: FTM Fixture / Mechanical Interface	3
E4: DUT firmware	Info-Medium	E10: FTM Test Configuration	2
E6: FTM-to-DUT Programming Interface	Info-Strong	E11: FTM Technical documentation	3
E8: FTM Electrical Test Interface	Energy-Medium	E5: FTM Measurement & Signal Conditioning Instrumentation	2
E8: FTM Electrical Test Interface	Energy-Medium	E7: FTM Fixture / Mechanical Interface	2
E8: FTM Electrical Test Interface	Info-Medium	E7: FTM Fixture / Mechanical Interface	2
E8: FTM Electrical Test Interface	Info-Strong	E10: FTM Test Configuration	3
E8: FTM Electrical Test Interface	Info-Strong	E11: FTM Technical documentation	3
E8: FTM Electrical Test Interface	Mechanical-Medium	E7: FTM Fixture / Mechanical Interface	2
E9: FTM Fw & Test sequence	Info-Medium	E11: FTM Technical documentation	2
E9: FTM Fw & Test sequence	Info-Weak	E5: FTM Measurement & Signal Conditioning Instrumentation	1

Table 2: Microcontroller level 2 impact report

Subsystem	Dependency	Uses	Strength
E1: Microcontroller (MCU-X)	Manual	B1: SCM & Product Engineering	1
E1: Microcontroller (MCU-X)	Manual	B2: Product Owner	1
E1: Microcontroller (MCU-X)	Manual	B3: R&D – HW Designer	1
E1: Microcontroller (MCU-X)	Manual	B4: R&D – Electronic Layout	1
E1: Microcontroller (MCU-X)	Manual	B5: R&D – FW Designer	1
E1: Microcontroller (MCU-X)	Manual	B6: Test Engineering	1
E1: Microcontroller (MCU-X)	Manual	P10: FTM Hw-Sw Implementation	1
E1: Microcontroller (MCU-X)	Manual	P11: Internal validation	1
E1: Microcontroller (MCU-X)	Manual	P12: Factory Acceptance Test (FAT) & Release	1
E1: Microcontroller (MCU-X)	Manual	P1: Requirements / change analysis	1
E1: Microcontroller (MCU-X)	Manual	P2: FTM Impact assessment	1
E1: Microcontroller (MCU-X)	Manual	P3: Test strategy definition/review	1
E1: Microcontroller (MCU-X)	Manual	P7: Component procurement*	1

Table 3: Microcontroller level 1 uses report

Subsystem	Dependency	Uses	Strength
B6: Test Engineering	ORG-Moderate/formal	B7: FTM Supplier – Firmware & Test Sequence	2
B6: Test Engineering	ORG-Moderate/formal	B8: FTM Supplier – Test Machine Hardware	2
B6: Test Engineering	ORG-Moderate/formal	B9: FTM Supplier – Mechanical Fixture	2
P10: FTM Hw-Sw Implementation	Manual	B7: FTM Supplier – Firmware & Test Sequence	1
P10: FTM Hw-Sw Implementation	Manual	B8: FTM Supplier – Test Machine Hardware	1
P10: FTM Hw-Sw Implementation	Manual	B9: FTM Supplier – Mechanical Fixture	1
P10: FTM Hw-Sw Implementation	P-Informational	P4: FTM Hw design	1
P10: FTM Hw-Sw Implementation	P-Structural	P5: FTM FW/ test sequence development	3
P11: Internal validation	Manual	B7: FTM Supplier – Firmware & Test Sequence	1
P11: Internal validation	Manual	B8: FTM Supplier – Test Machine Hardware	1
P11: Internal validation	Manual	B9: FTM Supplier – Mechanical Fixture	1
P11: Internal validation	P-Functional	P8: Test machine / fixture manufacturing	2
P11: Internal validation	P-Structural	P9: FTM Hw/Mechanical Assembly	3
P12: Factory Acceptance Test (FAT) & Release	Manual	B7: FTM Supplier – Firmware & Test Sequence	1
P12: Factory Acceptance Test (FAT) & Release	Manual	B8: FTM Supplier – Test Machine Hardware	1
P12: Factory Acceptance Test (FAT) & Release	Manual	B9: FTM Supplier – Mechanical Fixture	1
P3: Test strategy definition/review	Manual	B8: FTM Supplier – Test Machine Hardware	1
P7: Component procurement*	Manual	B7: FTM Supplier – Firmware & Test Sequence	1
P7: Component procurement*	P-Functional	P4: FTM Hw design	2
P7: Component procurement*	P-Functional	P6: Mechanical fixture design	2

Table 4: Microcontroller level 2 uses report

7 Guideline

1. Familiarize yourself with the data provided and try to understand the three domains and the underlying dependencies. Identify potentially missing descriptions.
2. Use the provided pre-analyzed models to derive possible changes in each domain and in the “integration view” of all three domains. You could, for example, consider for your discussions:
 - Identifying strong dependencies: could they be eliminated?
 - Identifying feedback loops: could the process be re-arranged to prevent/reduce them?
 - Identifying activities that can run in parallel
 - Identifying unnecessary handovers
 - Identifying opportunities to standardize or modularize the FTM (product domain)
 - Redefining responsibilities and interfaces
 - Proposing a new Product–Process–Organization architecture
3. We suggest to approximately distribute your time as follows:
 - 15 min reading & understanding
 - 20 min on each domain (60 min total)
 - 45 min lunch break
 - 30 min lab tour (your group will be called separately)
 - 30 min integration view
 - 30 min presentation preparation
4. In addition to the already presented models, we will provide you with the original dataset that ABB has provided us with. While our target was to condense and pre-structure the data for you with this task document, we understand that some of you might want to also view the original dataset. However, we want to emphasize that the task is designed so you do not necessarily have to do this. We therefore recommend to only review this dataset by the time you have developed a clear understanding of the systems and your suggested changes for additional insights.
5. Remember to use the option of consulting one of our Lattix experts where needed.
6. Answer all “what we ask of you” aspects from Section 3 (page 2).

8 Required tools

This year's ISW challenge is designed to not require any specific software. You will just need a **pdf reader** for this document and **Excel** (only if you want to look into the additional dataset).

9 Provided data

On the ISW website, you will find the following provided data:

- Digital file of this challenge narrative
- Additional background excel file (not required to solve the task)

All data is password-secured. The password is given in an email sent to every participant. Further, you have access to the “live” Lattix models at the ISW through our Lattix experts.