FINE2

Furthering Improvements in Integrated Mobility Management (I2M),
*Noise and Vibration (N&V), and Energy in Shift2Rail*

UIC meeting Noise – 02-11-2021

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Validation of railway exterior noise simulation

- The aim of the project is to validate and improve the exterior noise simulations

- The physical phenomena to take into account are the noise diffraction, the ground absorption, the train equipment directivity and propagation
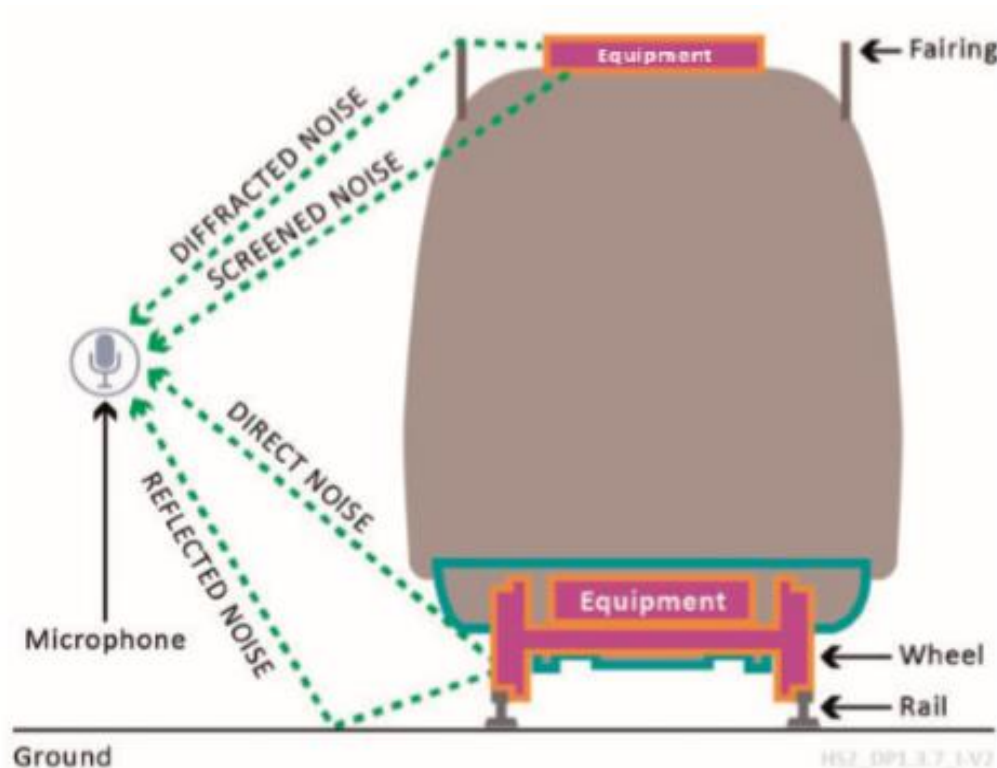
Validation of railway exterior noise simulation

The work is focused in the following questions:

- Are the current exterior noise simulations tools from the train manufacturers/operators good enough to allow the virtual certification?

- Which is the uncertainty linked to the exterior noise simulations?

- Can this uncertainty be reduced with new methodologies of train equipment characterization?

Validation of railway exterior noise simulation

The work uses what was already learn from previous projects

ACOUTRAIN
(specially WP3, WP4 and WP5)

S2R FINE-1

SILENCE

FINE-2 WP6

The added value with respect the previous work done on ACOUTRAIN is to focus the effort on the train integration.

It will be done by means of measuring the same sources stand alone and installed on the train.

Validation of railway exterior noise simulation

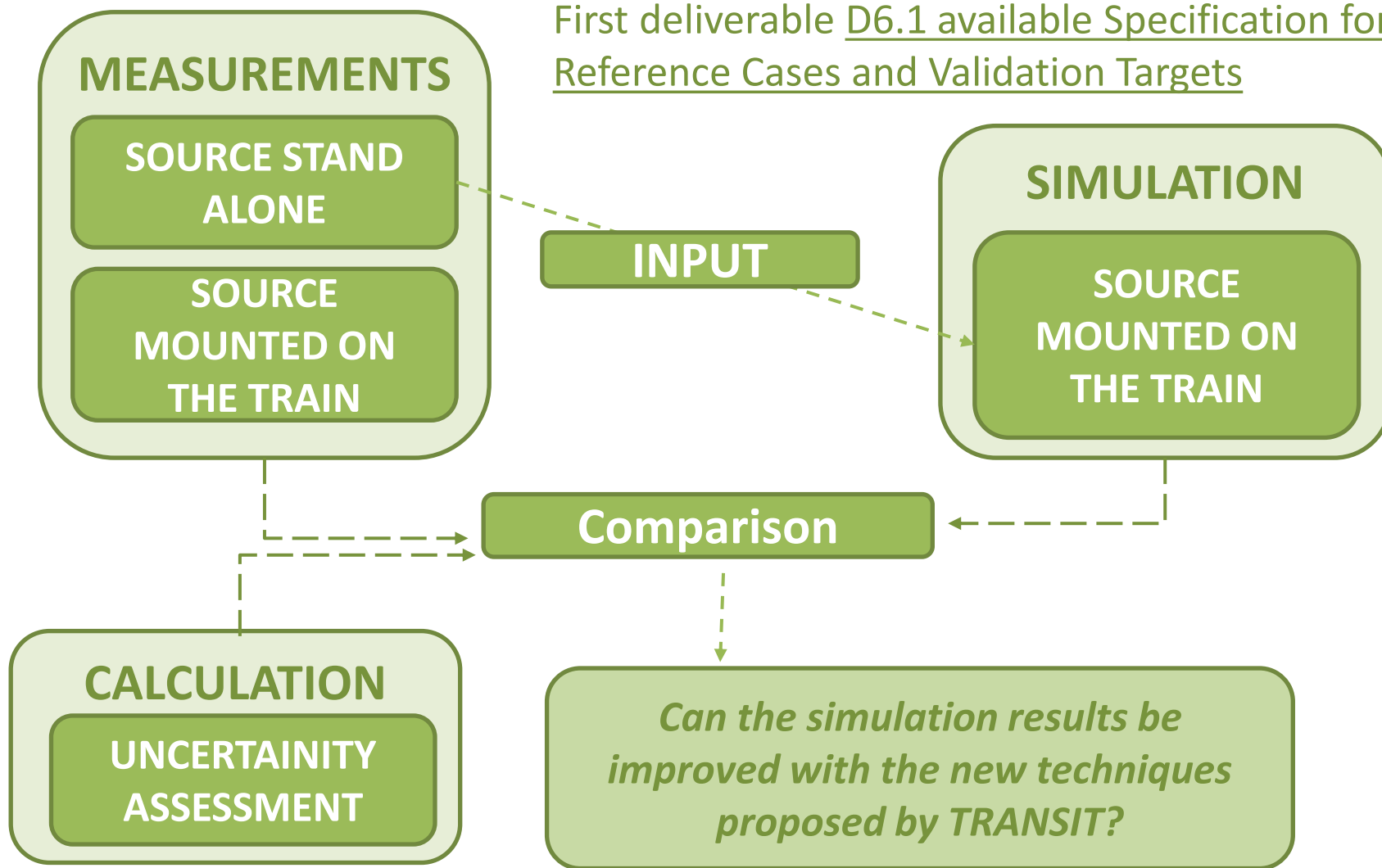- The validation is done in a close collaboration with S2R Open Call TRANSIT.

FINE-2 partners, composed of rolling stock manufacturers and operators, bring the vision and the needs of the industry

TRANSIT partners, composed of research centres, universities and consultancies, will enhance existing methods and propose new techniques based on their knowledge and experience.

FINE-2 WP6 activities

First deliverable D6.1 available Specification for Reference Cases and Validation Targets

MEASUREMENTS

SOURCE STAND ALONE

SOURCE MOUNTED ON THE TRAIN

INPUT

SIMULATION

SOURCE MOUNTED ON THE TRAIN

Comparison

CALCULATION

UNCERTAINITY ASSESSMENT

Can the simulation results be improved with the new techniques proposed by TRANSIT?

FINE-2 WP6 activities

Matrix of reference cases depending on type of noise and train integration. All tests to be done in static to avoid rolling noise (covered by FINE-2 WP7).

Type of noise

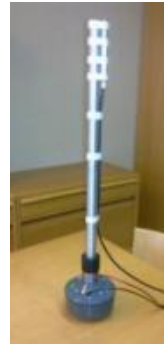|	Cooling noise	Electro magnetic noise	Mechanical noise	Other
Bogie area				Loudspeaker test
On the roof with/without roof fairings	HVAC, cooling unit, etc.	Auxiliary converter, main transformer, traction inverter, etc.	Main air compressor, Diesel powerpack	
Underframe with/without skirts				

Train integration

Reference cases

✓ Already measured

HVAC saloon installed on the underframe	**Speaker in the bogie area**	**HVAC Cabin on the roof** ✓
Without skirts	**Without skirts**	**Without roof cover**
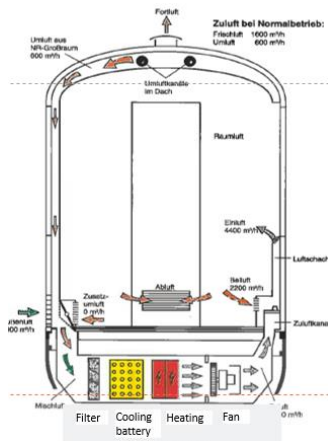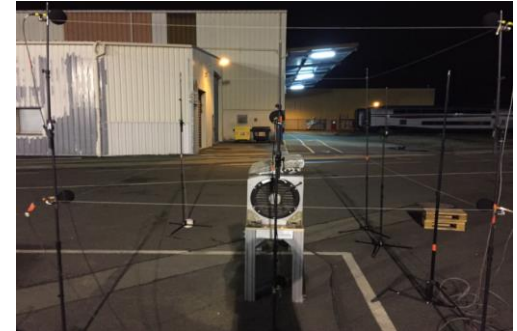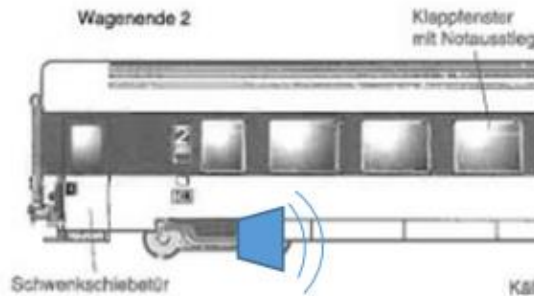
Reference cases

Auxiliary converter on the underframe ✓

Main transformer on the roof ✓
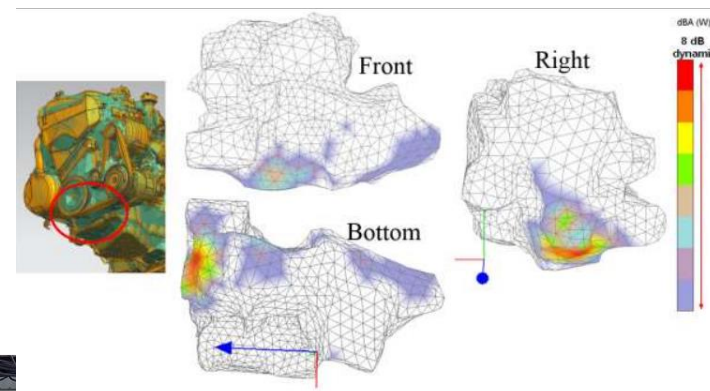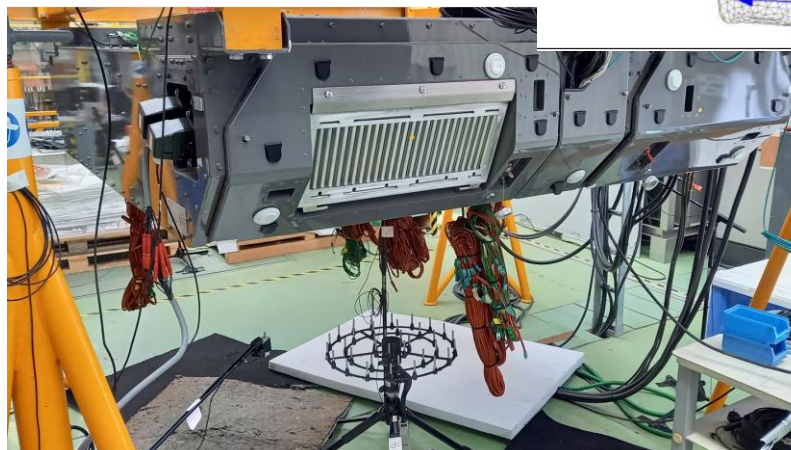
HVAC or motor cooling on the roof ✓

Without skirts

Without roof fairings

With roof fairings

FINE-2 WP6 activities

MEASUREMENTS

SOURCE STAND ALONE

- Measurements performed by TRANSIT are with microphone array and ISO 9614-2, including source directivity information

- Measurements performed by FINE-2 participants are in terms of SWL according to ISO 9614-2 when possible, otherwise ISO 3744
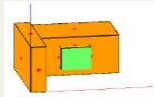
FINE-2 WP6 activities

MEASUREMENTS

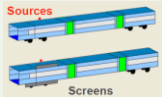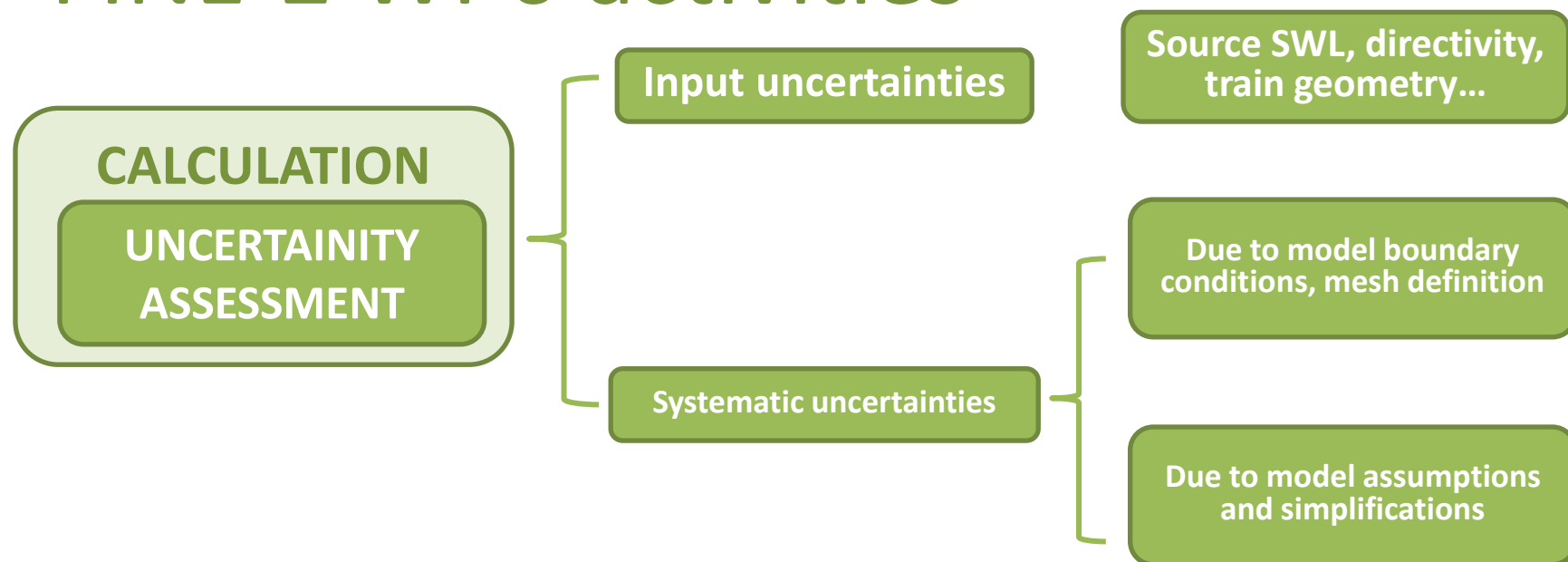**SOURCE MOUNTED ON THE TRAIN**

- Measurements of sound pressure level around the train. The source under test is isolated from the rest by switching off the other equipment

- Transfer function from the equipment surfaces and the microphones with KTH methodology. See TRANSIT deliverable D1.1 Validated procedure for source characterization based on equivalent monopoles and tests involving generic sources

FINE-2 WP6 activities

> **SIMULATION**
>
> **SOURCE MOUNTED ON THE TRAIN**

	FINE-2 participants					TRANSIT
	Alstom/ Bombardier		CAF	SNCF	TRV (KTH)	Vibratec
Used tool for simulation	SITARE	BRAINS	TrainNoiS	Train noise expert Acoutrain tool	Finite element (Comsol Multiphysics)	SONOR
Small description	Analytical tool in third octave bands. Box source, monopole, dipole, fan, air inlet/outlet, etc.	Analytical tool in third octave bands. Point sources as monopole or dipole.	Analytical tool in third octave bands.	Analytical tool in third octave bands. Diffraction is not taken into account, reflexion on the ground is considered.	Narrow band	Boundary Energy Element Method (BEEM) for medium to high frequencies ([500-5000] Hz)

FINE-2 WP6 activities

CALCULATION

UNCERTAINITY ASSESSMENT

- **Input uncertainties**
  - **Source SWL, directivity, train geometry…**

- **Systematic uncertainties**
  - **Due to model boundary conditions, mesh definition**
  - **Due to model assumptions and simplifications**

The assessed cases will be done for a specific train:

- Averaged positions at 7.5 m from the track centre when the train is at standstill according to ISO 3095

- Starting noise during acceleration according to ISO 3095

- Pass-by at 80 kph, 200 kph and 320 kph according to ISO 3095

Conclusions

Comparison

Simulation

FINE-2 participants

TRANSIT (advanced techniques)

Measurements

SOURCE MOUNTED ON THE TRAIN

- The simulation results will be compared with the validation requirements and the uncertainty

- Depending the results, two possible options:
  - Simulations or source characterization from FINE-2 participants need to be improved with more advanced techniques
  - Simulations results are already acceptable and could be used in the future for Virtual Certification

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Thank You for Your Attention