Calibration of AQSens/SensEURCity project – Standardisation for sensor evaluation at CENT TC 264 WG 42

Joint Research Centre
The European Commission's science and knowledge service

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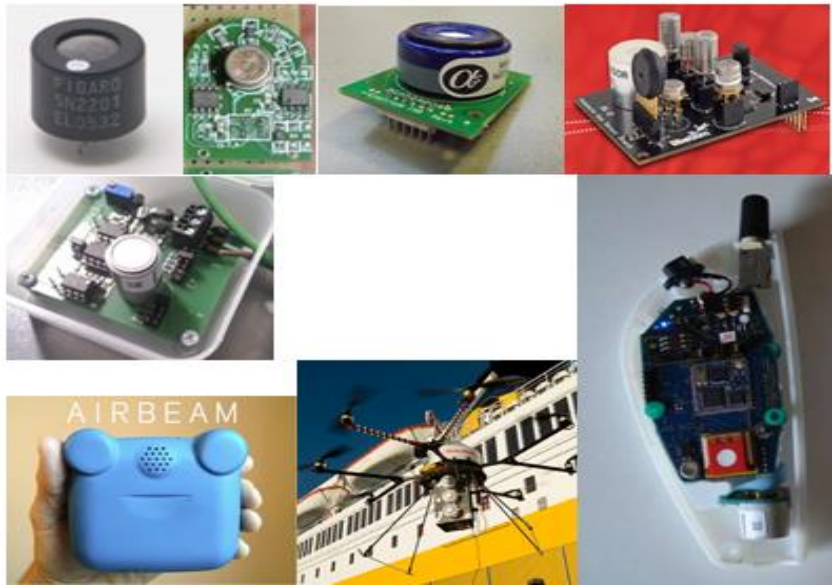
AQSens/SensEURCity project

Partners: DG ENV, JRC

Deployment: VITO, NILU, IMI

Web platform: 52 North

Sensor manufacturing: LiberaIntentio s.r.l.



High level objectives:

- Supporting the development of Sensor Networks in Europe
- Integrating smart sensors and modelling for air quality monitoring in cities

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General AQSens Tasks

1. **Compare the capability and performance** of lower-cost sensor systems to measure air pollution with conventional monitoring and modelling;
2. **Develop a traceable calibration technique** for lower-cost sensor systems;
3. Elaborate on a potential **way to integrate** lower-cost sensor systems in existing **monitoring** networks and **modelling** systems;
4. Develop a **platform for integration and visualization** of data from sensors;
5. Establish **guidance** on the use of lower-cost sensor systems and their interrelationship with already existing conventional monitoring and modelling systems.

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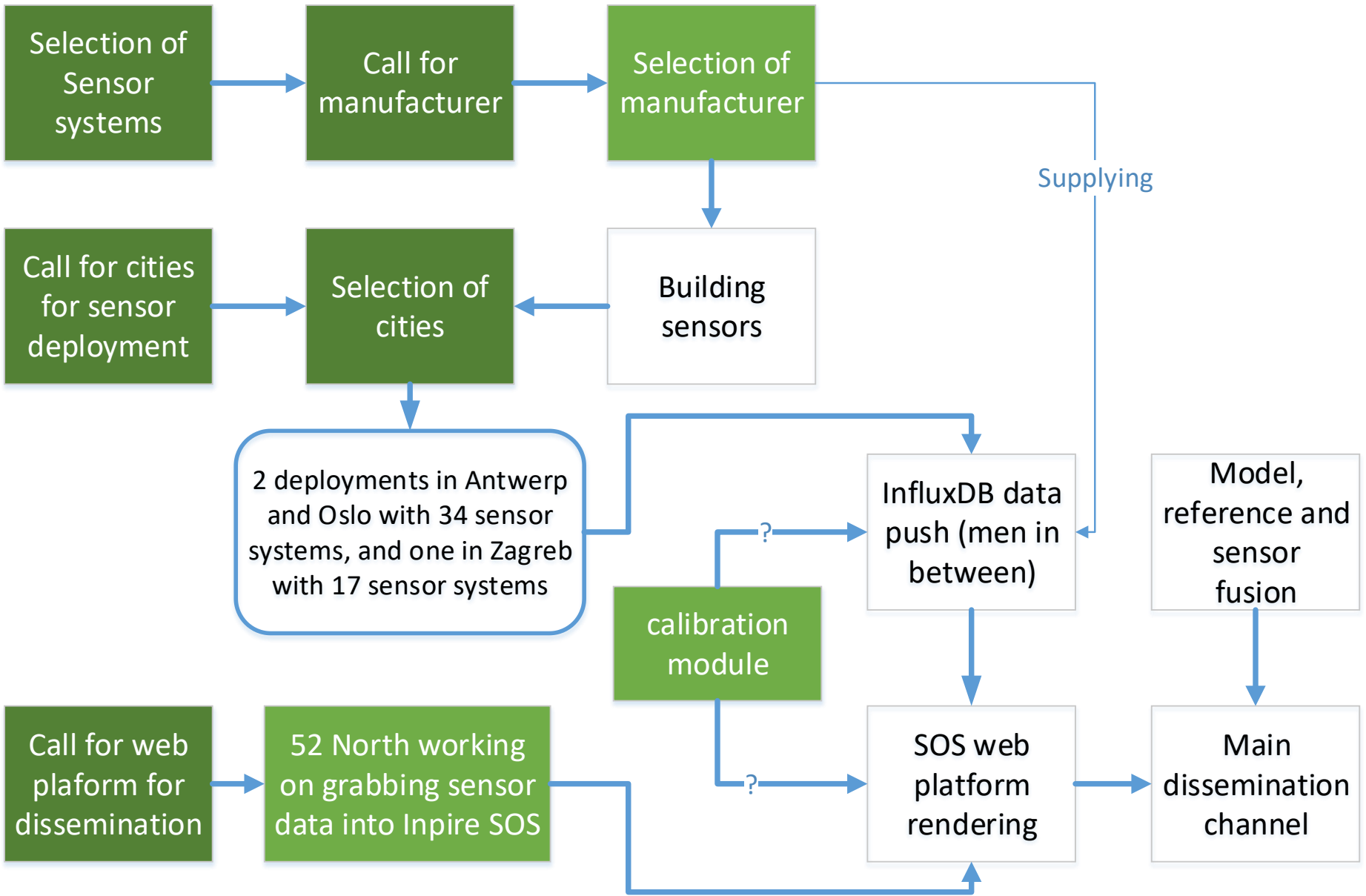
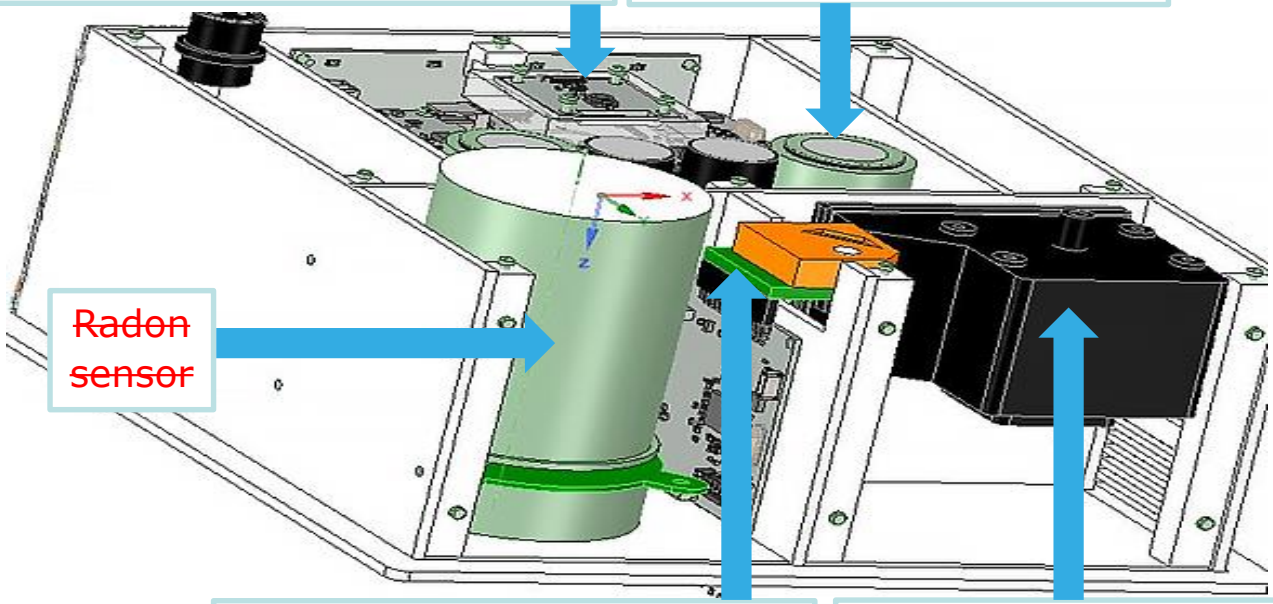

Selection of Sensor systems
Call for manufacturer
Selection of manufacturer
Supplying
Call for cities for sensor deployment
Selection of cities
Building sensors
2 deployments in Antwerp and Oslo with 34 sensor systems, and one in Zagreb with 17 sensor systems
?
InfluxDB data push (men in between)
Model, reference and sensor fusion
calibration module
Call for web plaform for dissemination
52 North working on grabbing sensor data into Inpire SOS
?
SOS web platform rendering
Main dissemination channel

Selected sensor system AirSensEUR

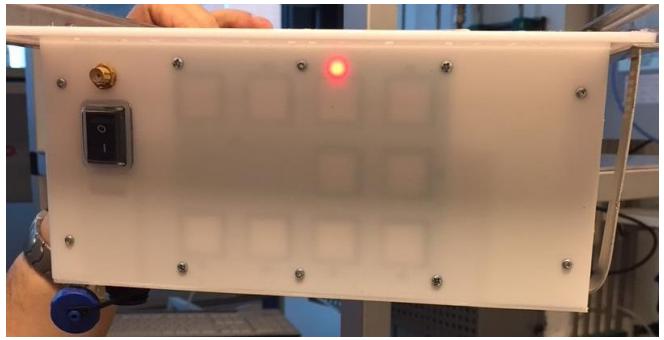
Temperature - Humidity,
Sensirion SHT31,
Pressure Bosh BMP280

CO, NO, NO2, O3
AlphaSense
CO-A4, NO2-B43F,
OX-A431 and NO-B4

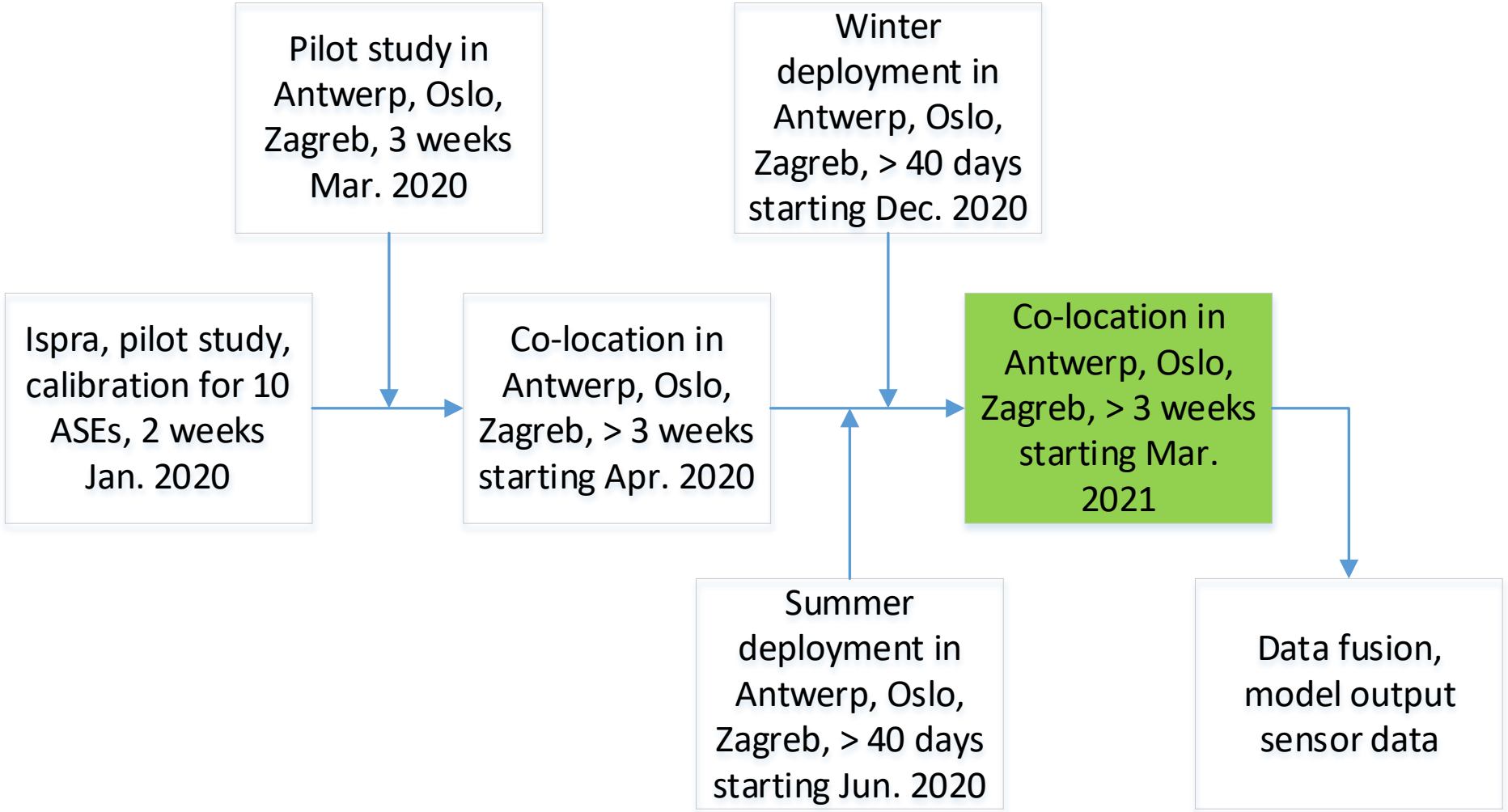


CO2
ELT D-300G

PM
PMS5003, OPC-N3



Strategy for calibraton and validation



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Calibration statistics for all AirSensEURs

	Calibration model	Calibration (2 weeks) R^2 - slope, minute data in Ispra, Antwerp, Oslo, ~~Zagreb~~	Prediction (2 to 4 weeks) R^2 - slope, hourly data in Ispra*, Antwerp, Oslo, ~~Zagreb~~
CO (CO-A4)	Quantile regression (median)	0.97–0.99;0.70–0.94;0.41-0.99	0.98–0.99;0.63–1.05;0.46-1.01
NO (NO-B4)	Exponential growth of temperature	0.88–0.95;0.15–0.88;0.59-0.90	0.92–0.96;0.04–0.54;0.22-0.99
NO_2 (NO2-B43F)	MultiLinear (T/*Tdeficit*, Absolute humidity, *OX-A431*)	0.76–0.97;0.77–1.02;0.62-1.03	0.85–1.03;0.67–0.99;0.80-1.14
O_3 (OX-A431)	MultiLinear (NO2-B43F, *Absolute humidity*)	0.91–1.00;0.90–0.98;0.86-1.03	0.93–1.00;0.90–0.99;0.77-0.95
PM_1 – PMS5003	Kohler model** (RH)	0.89–1.04;0.86-1.14	0.91–1.24;0.90-0.94
$PM_{2.5}$ – PMS5003	Kohler model** (RH)	0.94–1.00;0.83-1.23	0.92–1.03;0.80-1.13
PM_{10} – PMS5003	Kohler model** (RH)	0.91–1.01***;0.88–1.05;0.46-0.93	0.93–1.01***;0.68–0.86;0.49-0.94
PM_1 – OPC-N3	Kohler model** (RH)	0.73–1.21;0.72-1.09	0.80–0.85;0.68-0.51
$PM_{2.5}$ – OPC-N3	Kohler model** (RH)	0.61–0.91;0.57-1.06	0.41-0.86;0.42-0.66
PM_{10} – OPC-N3	Kohler model** (RH)	0.42–1.07***;0.47–1.04;0.39-0.84	0.47–1.16***;0.29–0.88;0.42-0.65

*The prediction of data in Ispra uses hourly data of the same time interval as for calibration
**Crilley et al., https://doi.org/10.5194/amt-11-709-2018
*** Reference PM mass concentrations are from a TEOM FDMS, while the rest of reference data is given by a FIDAS
In italic, parameters of model that are occasionally significant

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Current thoughts on calibration of sensors

- CO-A4: higher levels in Ispra than Antwerp and Oslo (2 ppm vs 400 ppb) -> R^2 goes from 0.9 to 0.4-0.5
- NO-B4 as for CO levels 250 vs 50 ppb. Better baseline correction models are needed
- OX-A431 with NO2-B43F correction, good agreement
- NO2-B43F: R^2 0.70 to 0.85, variations of covariates
- PMS5003: R^2 0.8 to 0.95 for $PM_{2.5}$ - PM_1, 0.5 to 0.7 for PM_{10}
- OPC-N3: always lower agreement than for PMS5003. AlphaSense is proposing to apply a new correction method.

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Status at CEN TC 264 WG 42, Techical Specifications for sensors

- For voting: December 2020 TC 264 WI 00264179 Air quality — Performance evaluation of air quality sensors — Part 1: Gaseous pollutants in ambient air
- In preparation: TC 264 WI 00264208 Air quality — Performance evaluation of air quality sensors — Particulate matter in ambient air
- New convenor: Martine Van Poppel, VITO
- On going: preparation of a pre-normative research to test the robustness of the TS method with laboratory and field tests + evaluation. This is necessary in order to transform TSs in ENs.

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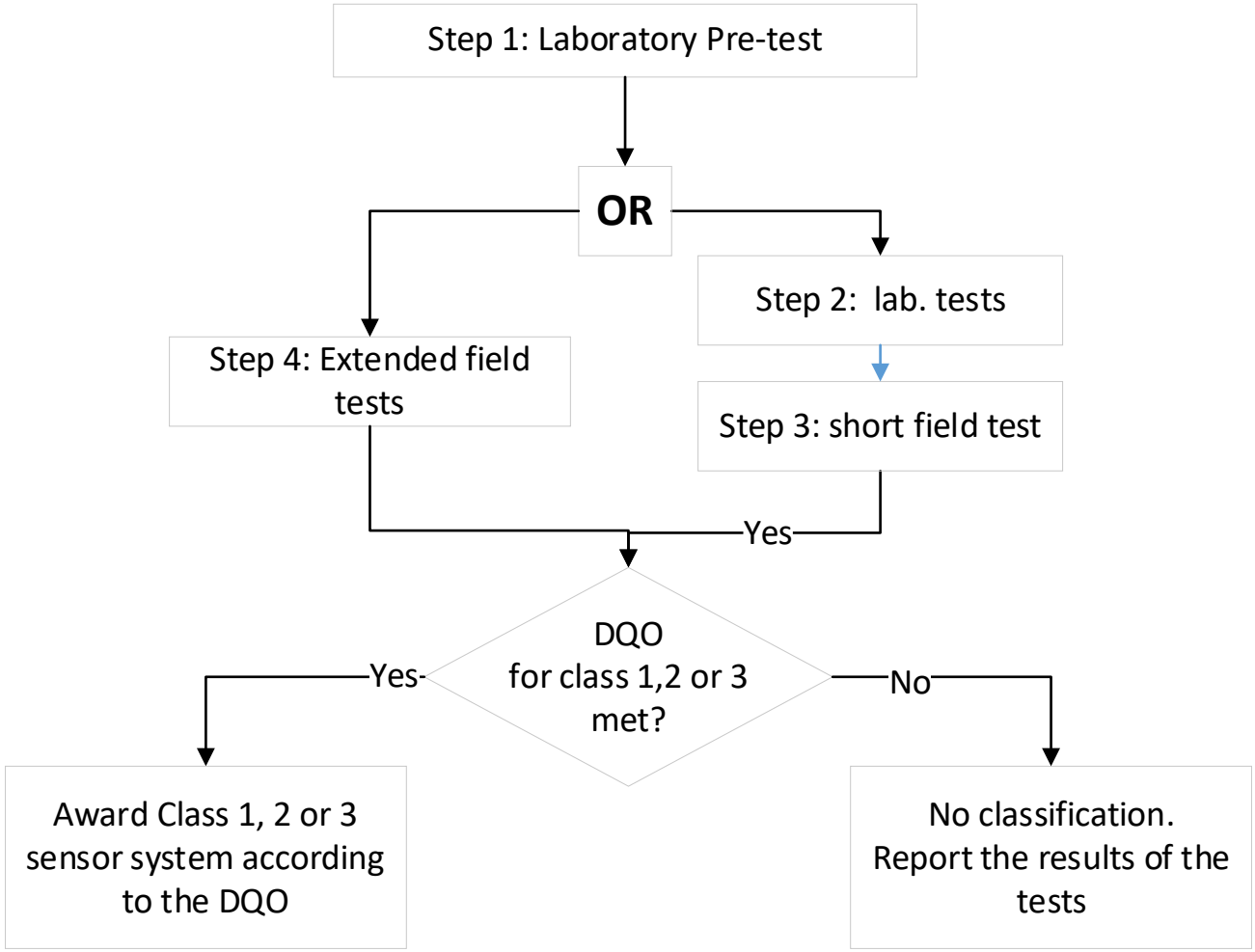

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Possible input of AQUILA to revision of Air Quality Directives (under discussion)

- Network design & measurement strategy (siting/sampling criteria),
- Data quality objectives,
- Indicative measurements/objective estimation,
- Update of reference methods and review other references,
- Quality Assurance/Quality Control,
- Additional pollutants.

In collaboration with FAIRMODE

Sensors!

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Suggestions on options for collaboration between CT6 and WG42?

To WG42 side: join the WG or attend as Observer …
Input from CT6 to WG42 for future TS on network of sensors?

To CT6?

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