Interreg Sudoe

3SqAir

European Regional Development Fund

SUSTAINABLE SMART STRATEGY FOR AIR QUALITY ASSURANCE IN CLASSROOMS

Deliverable E.3.2.1
Case Studies
Demo-site 5.1 – Portugal
Instituto Superior Técnico
University

Authors: Marta Almeida, Nuno Canha (IST)

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SUMMARY

The 3SqAir project is a multi-partner and cross-border project. Its main goal is to design a "Smart" and "Sustainable" action plan, to ensure, through a common quality approach, the indoor air quality of French, Spanish and Portuguese educational buildings.

1-OBJECTIVES:

The Deliverable 3.1.2-Best Practices guidelines and criteria indicators for better Indoor Air Quality in classrooms - was developed within the scope of the Activity 3.1 of the project 3SqAir. The objective of this technical report is to define and present feedback on a remarkable indoor air quality (IAQ) management operation, through a reference framework of IAQ criteria in order to assess the inclusion of IAQ in school buildings.

This reference framework was established as part of the task 3.1.2 of the 3SQAIR project, the deliverable of which can be downloaded from the project website www.3SqAir.com

The approach has a dual objective:

- improve stakeholder knowledge on how to manage IAQ in their own buildings;
- propose a common methodology for comparative studies on "best practice" case studies.

1.1 – Methodology:

The objective of the 3SQAIR project is to define **RIS3**[1] strategies to improve indoor air quality IAQ in classrooms. One of the levers to achieve this objective is to share best practices (BP) with all stakeholders in order to enhance their knowledge, and consequently, their practices. To this end, we propose to identify the major action criteria to help stakeholders to improve IAQ in educational buildings.

Our work consisted in drawing up a first state of the art of methodologies for assessing the IAQ in educational buildings. This first analysis made it possible to identify a list of IAQ improvement levers considering technical and organizational. And, we propose a simplified methodology assessing a synthesis profile of the IAQ for feedback from operations.

In fact, the characterization of IAQ has many components, themselves linked to the complexity of the life cycle of a building. Such an analysis must be holistic because the IAQ of a classroom also depends on organizational aspects (maintenance and management of real estate), sociological (behavior and comfort of the occupants), economic (available resources) and even political considerations (exemplary public policies for contractors).

We propose a baseline to define common criteria for promoting best practices in IAQ in classrooms, which also lays down common guideline settings for smart, sustainable and energy efficient IAQ solutions.

[1] RIS3 = Research and Innovation Strategies for Smart Specialisation

Through a selective bibliographic study and an in-depth presentation of the modelling of IAQ pollutants, we have identified 10 major indicators for the inclusion of IAQ, classified into two areas:

1) BUILDING FACILITIES: "TECHNICAL SOLUTIONS ON IAQ AND VENTILATION"

A) POLLUTANT SOURCES
B) INTAKE AND EXHAUSTS
C) FILTRATION
D) AIR RENEWAL SYSTEMS
E) AIR PURIFICATION

2) STAKEHOLDERS ORGANIZATION: "MANAGEMENT"

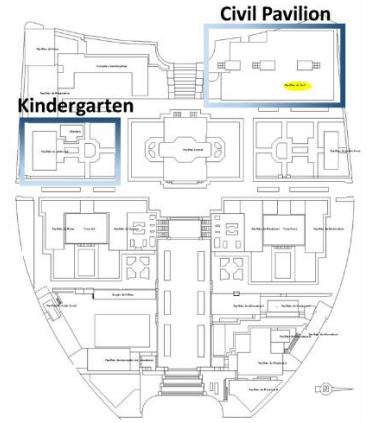
F) COST
G) OCCUPANTS' COMFORT AND BEHAVIOR
H) COMMUNICATION AND QUALITY MANAGEMENT SYSTEMS
I) MAINTENANCE
J) SUSTAINABILITY (ENVIRONMENTAL IMPACT & ENERGY EFFICIENT STRATEGIES)

This report offers a common reference simplified methodology to establish comparative studies on IAQ in educational buildings. This methodology constitutes a basis for the practical resource (best practices experience feedback case studies) for stakeholders that have to be produced within the 3SqAir project, through the eponymous online platform website. It will be used to build an analysis framework for the 12 operations that are the subject of experience feedback as part of task 3.2.1 of the 3SqAIR project.

2- STUDIES: [1]

2.1 – General Description

Demo-site / Name	CIFP Usurbil LHII – Usurbilgo Lanbide Eskola
Location	Av. Rovisco Pais, 1049-001 Lisboa – Civil Pavilion
Year building / Renovation	1990 and 2019 for VA1
Number of building	1
Total occupancy	3744
Surface	waiting
Educational stage	University



2.1.1 – BUILDING FACILITIES: TECHNICAL SOLUTIONS ON IAQ AND VENTILATION

A) POLLUTANT SOURCES:

- Occupancy
- Chalk board
- Clean products

The Outdoor Environmental Zone			**The Indoor Environmental Zone**		
	Yes	No		Yes	No
Urban area Main sources of pollutants: vehicles (exhaust and non-exhaust sources)	x		Maintenance products used for interior cleaning	X	
Rural area		x	Room's Activity	X	
Industrial area nearby		x	Wall and floor coverings		X
Nearest gas station (less than 1km)		x	Luminaire type: Led		
Commercial zone		x	Heating method: central HVAC		
Parking lot	x				
Presence of electromagnetic waves		x			

B) INTAKE AND EXHAUSTS:

Intake and Exhausts Information's	
Self-adjusting	
MECHANICAL VENTILATION	
humidity-controlled air inlets	No
humidity-controlled air outlets	No
NATURAL VENTILATION	
Air entry/evaluation through openings	Windows surface: Study room 0.22 – 71 m² Classroom VA1 – without windows Classroom 1.04 – 10 m² Classroom 1.06 – without windows to the outdoor; 10 m² to the corridor Classroom 1.23 - 10 m²
Other(s) – to be specified	
None	
	Rooms VA1 and 1.06 – do not have windows to the outdoor; Room 1.04 – has windows to the campus (limited number of cars and trees); Room 1.23 and 0.22 – have windows to roads with intense traffic.

C) FILTRATION:

Filtration Information's	
AIR CONDITING	
Type of maintenance	waiting
Upkeep	waiting
Frequency	waiting
VENTILATION	
Type of maintenance	waiting
Upkeep	waiting
Frequency	waiting
HEATING	
Type of maintenance	waiting
Upkeep	waiting
Frequency	waiting

D) AIR RENEWAL SYSTEMS:

Room VA1

- Served by a new HVAC system
- Air supplied to the classroom: 2600 m^3/h
- Fresh air supplied to the classroom: 1375 m^3/h
- The HVAC system is equipped with a main AHU, which is equipped with filters M5 + F7 and serves several classrooms. Then the air pass in several AHUs dedicated to specific classrooms that promote the recirculation of the air and are equipped with filters G4 + F7.

Room V1.23

- Served by AHU 5
- Filter G4
- Without recirculation
- Without energy recovery system

Room V1.04 and V1.06

- Served by AHU 2
- Filter G4
- Without recirculation
- Without energy recovery system

Room 0.22

- Without fresh air only through natural ventilation
- Filter G4

Air Renewal System Information's	
Planned air change rates	
Possibility opening windows	[x] yes [x] no (VA1 and 1.06)
Windows operability	[ ] single-hung [ ] French window (casement) [x] slinding [ ] tilt and turn [ ] pivot [ ]
Air renewal system	[0.22] natural ventilation [1.23, 1.04, 1.06] single-flow [VA1] double-flow [ ] over-ventilation at night
Air System	[x] mechanical [ ] programmed [ ] automated [ ]
Flowrate	VA1 – supply - 2600 m^3/h; fresh air - 1375 m^3/h 0.22 waiting 1.04 waiting 1.06 waiting 1.23 waiting
Ventilation protocol	Classroom A2EERR: based on CO2 levels and on the occupancy schedule. This classroom A2EERR is equipped with a dual-flow ventilation system from AIRVEN/Luymar UR55-HE, which includes a Heat Recovery Unit (high-performance backflow exchanger, up to 93%). Classroom A209: natural ventilation, there's no any protocol, windows are open when needed.
HEATING MODE	
Summer	Cooling batteries in the AHUs
Winter	Heating batteries in the AHUs
Air conditioning	None

E) AIR PUTIFICATION:

Air Cleaning Information's	
Use and type of purifier	None
Mode of operation	None

2.1.2 ORGANISATION OF STAKEHOLDERS – BUILDING MANAGEMENT:

Indicate the maintenance manager(s) of the site's various systems and the service providers. Explain their role and importance in the decision chain.

Building Management Information's	
Type of system	HVAC system
Companies	Preventive Maintenance – Company ARAMUS
OTHER	
Photovoltaic system	No
Air renewal system	Yes, only in the new system that serves the room VA1

F) COST

Cost Information's	
Consumption (kWh)	waiting
Surface building (m²)	waiting
Price (€)	waiting
Energy (Type of energy is the site using)	waiting
Energy's comsuption	waiting

This is to quantify the building's energy cost. Any piece of information on the cost of air renewal will be of interest.

Energy source Information's	
Type	waiting
Nominal power	waiting
Annual Electric consumption	waiting
Annual thermal consumption	waiting
Renewable energy power	waiting
Annual electric generation	waiting
Electrochemical energy storage	waiting

G) OCCUPANTS' COMFORT AND BEHAVIOR

Occupants' Comfort Informations	
Description of activities	Room 0.22 –study room Classroom VA1,1.23,1.04,1.06 - Teaching activities
Frequency of site occupancy	Room 0.22 – 24h Classrooms VA1,1.23,1.04,1.06 – 8AM – 7PM
Accommodation capacity	0.22 – 60 VA1 – 63 1.23 – 62 1.04 – 50 1.06 - 60
Presence of vegetation	[x , outside the building] yes [ ] no
Ability for occupants to control:	
Ventilation equipment	[ ] yes [x] no
windows	[x] yes [ ] no

H) COMMUNICATION AND QUALITY MANAGEMENT SYSTEMS

Quality Management Systems Information's	
Certification 1 – Energy Certificate	
Date of last acquisition	2021
Support procedures have been put in place	Energy audit
Certification 2 -	
Date of last acquisition	
Support procedures have been put in place	
Certification 3 -	
Date of last acquisition	
Support procedures have been put in place	

I) MAINTENANCE

Company ARAMUS for the preventive maintenance
Local Maintenance team

Maintenance Frequency Information's	
Ventilation	Twice a year
Filter	When needed (sensors)
Air inlets	waiting
Extractions	waiting
Room cleaning	Daily
Exterior	Daily
Vegetation	Daily

J) SUSTAINABILITY (ENVIRONMENTAL IMPACT AND ENERGY EFFICIENCY STRATEGIES)

Sustainability refers to the ability to maintain or support a process continuously over time. Sustainability seeks to prevent the depletion of natural or physical resources, so that they remain available over time.

Sustainability Information's	
CO2 emissions reduction	waiting
Material and equipment life cycle analysis	waiting
Means implemented to ensure the sustainability of the facilities	waiting
IDENTITY CARD	
Actions	waiting
Resources	waiting
Objectives	waiting

3-CONCLUSION AND PERSPECTIVES

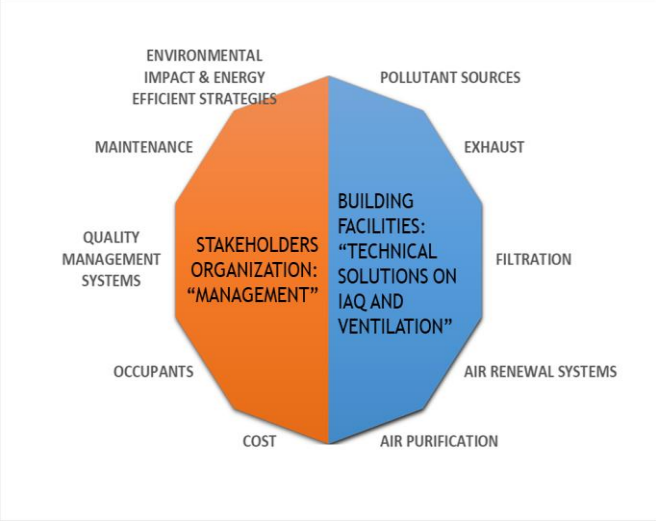
This work proposes a methodology for evaluating the IAQ in educational buildings. Through a deliberately simplified approach, we have defined a baseline based on two domains describing the building's facilities and the organization of the whole stakeholder chain actors.

A summary of the multi-criteria analysis for this operation is presented in the form of a radar made up of the 10 benchmark indicators, established in task 3.1.2 of the 3SqAir project.

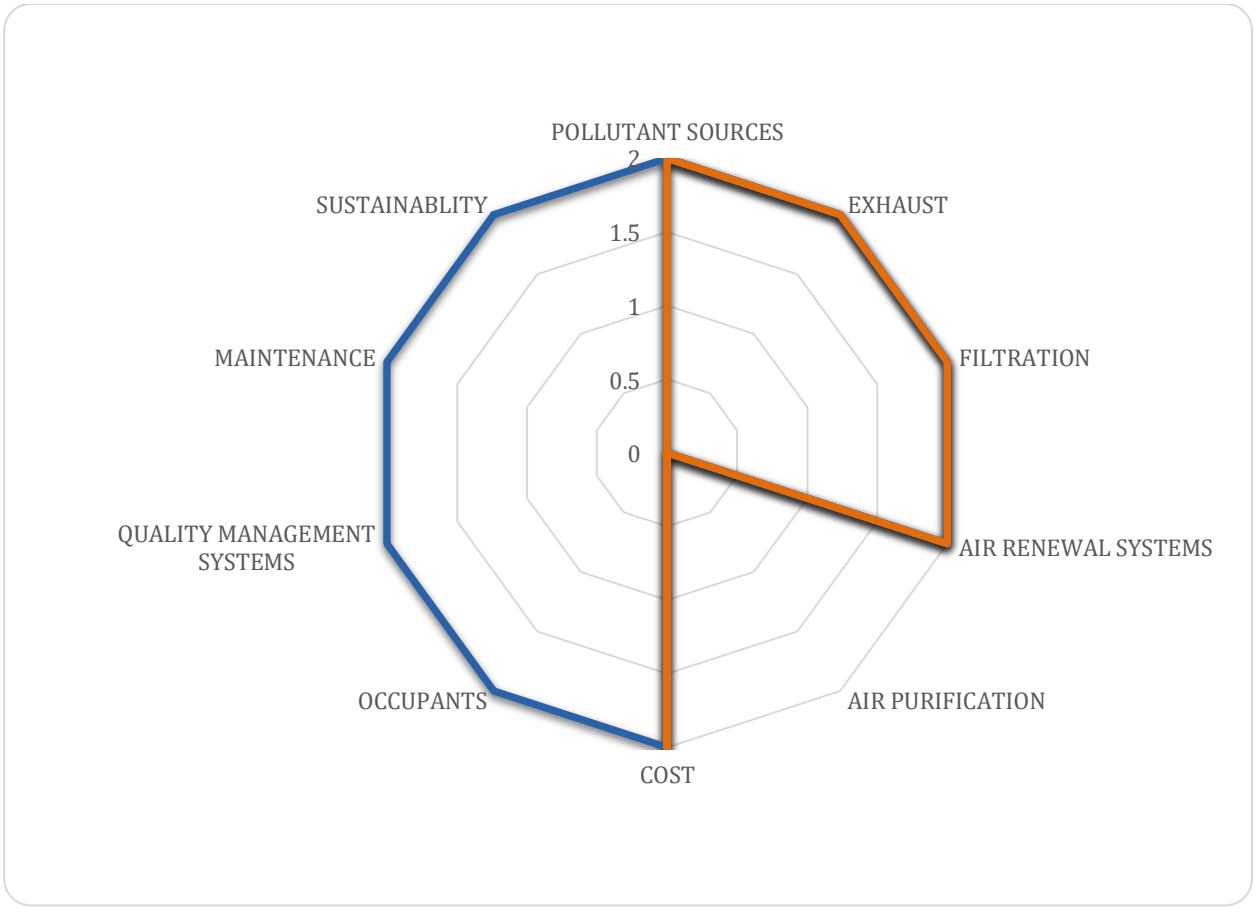
We have previously indicated that this type of analysis requires a transversal (holistic) approach, since all these criteria are interconnected and influence each other. In order to determine the relevance of taking into account the IAQ of a building, we propose to carry out a two-step approach:

1)First, an analytical approach: characterization of each of the 10 criteria separately, through a qualitative or quantitative approach;

2)Secondly, a global synthesis, through a graphic representation in the form of a "3SqAir profile", with a radar representation, according to the a “basic” or “thorough” rating scale (see below, an example of fictive radars on the basis of a 1-5 scale, with a representation mode).



For operation Alameda Campus University-IST, the result is as follows:



This result was established after a collective analysis of all operations, during the workshop held in Coimbra (Portugal) on 08/11/2022. During this workshop, the partners presented the 12 feedbacks and voted collectively to define the level of performance for each criterion and establish the corresponding radar profile.