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 5.2 – Portugal
# Instituto Superior Técnico Kindergarden

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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"**

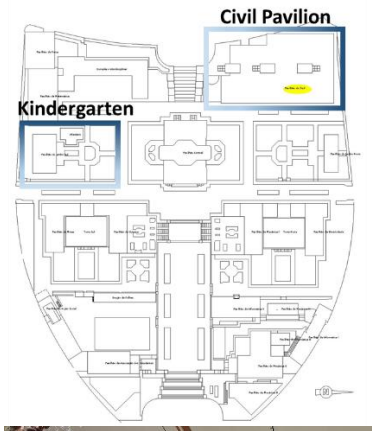
F) COST
G) OCCUPANTS' COMFORT AND BEHAVIOR
H) COMMUNICATION AND QUALITY MANAGEMENT SYSTEMS
I) MAINTENANCE
J) SUSTAINABILITY (ENVIRONMENTAL IMPACT & ENERGY EFFICIENT STRATEGIES)

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-CASE STUDIES: [1]

## 2.1 – General Description

| **Demo-site / Name** | **IST – CAMPUS ALAMEDA – KINDERGARDEN** |
|---|---|
| Location | Av. Rovisco Pais, 1049-001 Lisboa – Kindergarden |
| Year building / Renovation | 1980 |
| Number of building | 1 |
| Total occupancy | 124 |
| Surface | 251 $m^2$ |
| Educational stage | Kindergarden |





## 2.1.1 – BUILDING FACILITIES: TECHNICAL SOLUTIONS ON IAQ AND VENTILATION

### A) POLLUTANT SOURCES:

- Occupancy
- Art classes
- Clean products
- Note: children change the shoes before entering in the classroom

| **The Outdoor Environmental Zone** | | | **The Indoor Environmental Zone** | | |
|---|---|---|---|---|---|
| | Yes | No | | Yes | No |
| Urban area<br>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: split | | |
| Parking lot | x | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Presence of electromagnetic waves | | x | | | |
| Other(s) – to be specified | | | Other(s) – to be specified | | |
| None | | | None | | |

## 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:<br>3m$^2$ |
| Other(s) – to be specified | |
| None | |
| | |

## C) FILTRATION:

| **Filtration Information's** | |
|---|---|
| **AIR CONDITING** | |
| Type of maintenance | Periodic maintenance performed by an External cleaning company (ARAMUS) |
| Upkeep | Splits cleaning and change/cleaning of filters |
| Frequency | Every 6 months |
| **VENTILATION** | |
| Type of maintenance | |
| Upkeep | |
| Frequency | |
| **HEATING** | |
| Type of maintenance | |
| Upkeep | |
| Frequency | |
| **OTHER** | |
| Type of maintenance | |
| Upkeep | |
| Frequency | |

## D) AIR RENEWAL SYSTEMS:

{Describe the equipment provided for air renewal}

Natural Ventilation

| **Air Renewal System Information's** | |
|---|---|
| Planned air change rates | |
| Possibility opening windows | [ x ] yes [ ] no |
| Windows operability | [ ] single-hung [ ] French window (casement)<br>[ ] slinding [ ] tilt and turn<br>[ ] pivot [ ] |
| Air renewal system | [x] natural ventilation [ ] single-flow<br>[ ] double-flow [ ] over-ventilation at night |
| Air System | [ ] mechanical [ ] programmed<br>[ ] automated [ ] |

Flowrate

| | | | | | Q ($m^3$/h) | | | Q (m3/h) |
|---|---|---|---|---|---|---|---|---|
| | Area ($m^2$) | occupants | Q ($m^3$/h.$m^2$) | Q ($m^3$/h.occupant) | area | occupants | maximum | regulated |
| Classroom kindergarden | 50 | 24 | 3 | 28 | 150 | 672 | 672 | 672 |

| | |
|---|---|
| Ventilation protocol | • The windows are almost always opened |
| **HEATING MODE** | |
| Summer | |
| Winter | |
| Air conditioning | Yes |
| **OTHER** | |
| | |
| | |
| | |

## E) AIR PUTIFICATION:

| **Air Cleaning Information's** | |
|---|---|
| Use and type of purifier | None |
| Mode of operation | None |
| **OTHER** | |
| | |

| | |
|---|---|
| | |

## 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 | |
| Cool system | |

### F) COST

| **Cost Information's** |
|---|

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** |
|---|

### G) OCCUPANTS' COMFORT AND BEHAVIOR

| **Occupants' Comfort Information's** | |
|---|---|
| Description of activities | Teaching activities |
| Frequency of site occupancy | ≈ 8AM – 6PM (when the weather is good children spend more time outdoors) |
| Accommodation capacity | 24 occupants in the pilot classroom |
| 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 –** | |
| Date of last acquisition | |
| Support procedures have been put in place | |
| **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** | |
|---|---|
| A/C | Twice a year |
| Room cleaning | Daily |
| Vegetation | Daily |
| Other | |

## 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 | |
| Material and equipment life cycle analysis | |
| Means implemented to ensure the sustainability of the facilities | |
| **IDENTITY CARD** | |
| Actions | |
| Resources | |
| Objectives | |

# 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.

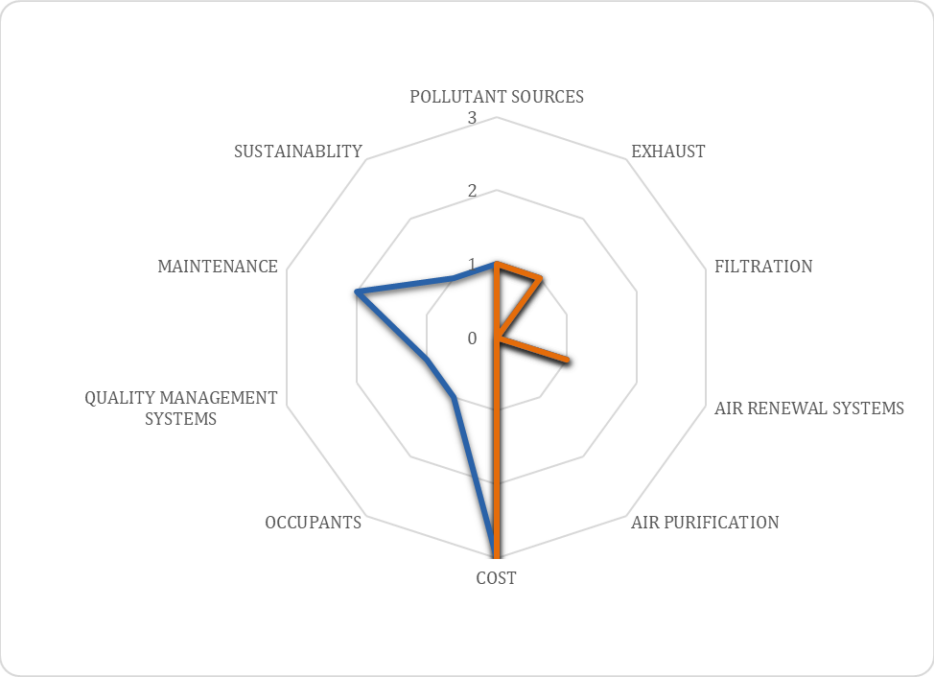
A summary of the multi-criteria analysis for this operation is presented in the form of a radar made up of the 10 benchmark indicators, established in task 3.1.2 of the 3SqAir project.

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 IST –ALAMEDA – KINDERGARDEN 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.