NATIONAL INDOOR AIR QUALITY ACTION PLAN

CZECH REPUBLIC

Version 1

11.2018

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2 Introduction

The Action Plan is a tool for preventing, identifying and solving indoor air quality (IAQ) problems in school buildings. It helps integrate activities that affect the IAQ into the system's normal use, management and maintenance. The aim is to provide a high quality indoor air by improving or maintaining the situation, by solving problems and by setting rules and preventive measures.

The preparation of the Action Plan is based on the Joint Transnational Strategy for Indoor Air Quality Action Plans developed within the InAirQ project.

The preparation of Indoor Air Quality Action Plans is based on risk assessment. An integral part of the preparatory process is the SWOT analysis, in the framework of evaluating the legal and political possibilities of the regional authorities, developing protocols for the field campaign and the possibilities of involving the parties (education, health, social and environment).

The indoor environment in schools is a complex system containing many interacting parameters that affect the health and well-being of their users. In order to describe the quality of the indoor environment in a particular school, the measured values (mostly in relation to the established limits or recommendations) or their aggregation, for example in the form of an indoor air quality index, are used. Within the school building can be defined several types of spaces that are used for different purposes (eg. the classrooms, canteen, laboratories, teacher's cabinets, gyms, locker rooms) and which are subject to different requirements with respect to their use.

The extent of air pollution in the building of a school depends on the interaction between the building and its external environment, as well as the way the building was built, how it is equipped and how it is used. The procedure for drawing up the action plan takes place in the following steps.

3 Backgrounds

3.1 Vulnerability Assessment

In the Czech Republic is ensuring of adequate indoor air quality and their inspection among the tasks of the public health service as public health authorities. Most of the people spend approximately 90% of their time indoors. And primary schools are among the major type of microenvironment where 827 thousand Childs spend approximately 8 h daily; it represents approximately 6.5 thousand of individual school buildings. Investigation of indoor air quality in primary school buildings and in classrooms is needed to ensure children`s health and well-being.

As in other countries the state of primary school buildings in Czech Republic varies considerably. Several types of renovation works including the replacement of windows and/or the modernization of lighting, insulation and heating have been carried out in the past years. However, there are several factors (e.g., ambient air pollution, consumer/building products, etc.) which might have an effect on indoor air quality. The main problem of indoor air quality in primary schools in the Czech Republic are microclimatic conditions (temperature, humidity) and higher dust levels; in some cases, volatile organic compounds, including the excessive use perfumed cleaning products and exceptionally contamination by various substances as a result of technological indiscipline, even during routine maintenance.

The requirements for indoor air quality are quite well covered by legislation In the Czech Republic. Currently, limits of the indoor quality environment and the relevant legislation in the Czech Republic are updated. The problem is necessary methodical unification, staffing cover and keep a continuous control system and implementation measures, which are also dependent on the financial possibilities. We assume that just designed system, in which the school itself will control indoor air quality, will improve the situation.

Indoor air quality measurements have already been performed under lot of realised national campaigns and in the frame of international projects (f.e. SINPHONIE).

The basic problem can still be considered as a lack of awareness among management and staff of schools and the need to increase their responsibility for the quality of the indoor school environment.

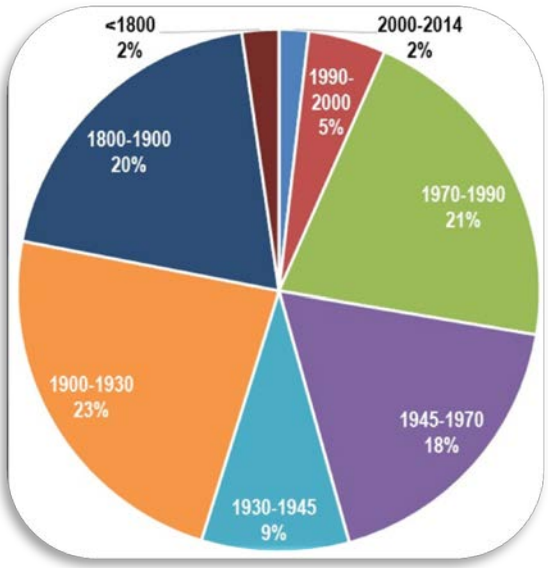
3.2 Primary school education and the state of school buildings in the Czech Republic

According to data for the school year 2016/2017 (later are not available even on the MINISTRY of EDUCATION) are/were in the Czech Republic 4 629 primary schools including 489 special schools and schools of art. And total of about 6.5 thousand school facilities, buildings, which were attended by, in the school year of 2016/2017, more than 906 thousands "children" in 45.1 thousands classrooms.

[Source: http://www.msmt.cz/vzdelavani/skolstvi-v-cr/statistika-skolstvi/statisticka-rocenka-skolstvi-vykonove-ukazatele).].

The state is responsible for providing public education, thus most of the schools (99%) are maintained by the state, private and church schools is less than 1%. Accordingly, the amount of financial support for reconstruction works can differ significantly among the schools.

A comprehensive overview about the types of school buildings is not available in the CR. In general, it is a complex of buildings from more than 100-year age to the newly-designed. And, of course, each period had different requirements and its own building characteristics; they differ in the building materials used, dimensions of the classrooms or energy consumption.



The percentage distribution of schools in the Czech Republic by age - results of the questionnaire survey of the state of school buildings, M. Begeni, V. Zmrhal, Czech Technical University in Prague, Faculty of Mechanical Engineering, Department of Environmental Engineering

[Source: http://vetrani.tzb-info.cz/vnitrni-prostredi/12873-dotaznikovy-pruzkum-stavu-skolskych-

budov]

In the past decade, in relation to the possibility of using the EU operational programs and energy efficiency programs, some renovation works possible including the replacement of windows and/or the modernization of lighting, insulation and heating were made. Natural ventilation is used in the primary schools, installed forced air exchange systems are still few exceptions.

Outside the limited financial resources, the biggest problems during the reconstruction of school buildings, causing frequent occurrence of asbestos materials, and after reconstruction it is sealing new windows and increased demands on saving energy. Asbestos was a frequently used material for the construction of buildings mainly between 1950 and 1990. The risk associated with asbestos in the indoor environment is very widely understood by the public, a survey for the presence of asbestos in schools in the Czech Republic is carried out only in connection with the possible renovation of the building. At least at the present time, requirements for the use of low-emission materials are gradually beginning to be accepted. But - a new problem becomes significant - pressure from commercial entities seeking their own products to ensure air quality requirements and air exchange. These include the promotion of projects of forced ventilation, air cleaners, active coatings using photocatalytic activity of TiO_2 installed fragrant sources of aerosols ...).

Typical school (given the results of the questionnaire of frequency relative to the total number of responses received) restored in the form of insulation and replacement windows because of the energy savings. It is equipped with tight windows and ventilation is designed as a natural opening windows with manual operation at the discretion of the teacher. The windows are closed due to energy savings or safety of pupils during breaks (students are not supervised). For these reasons, there are problems with the quality of indoor air in large parts of the buildings. At some schools (26% of responses), complications arise with respect to its location near a busy road (noise) or pollution sources (local heating, industrial zones, etc.). Most schools have a relatively low number of floors, material used perimeter walls are brick and the roof is mostly sloping.

[Source: http://vetrani.tzb-info.cz/vnitrni-prostredi/12873-dotaznikovy-pruzkum-stavu-skolskych-budov].

3.3 Policies on the indoor environment in school buildings

Current legislation covering elementary schools in the Czech Republic:

- Act no. 258/2000 Coll. The act on protection of the public health, § 13 users buildings equipment for education and instruction, universities, school in nature, buildings for recreational events, buildings of health care facilities preventive care, social care institutions, accommodation facilities, buildings for trade and for gathering more people are required to ensure that the internal environment residential rooms in these buildings corresponded to hygienic limits of chemical, physical and biological indicators, adapted by implementing legislation
- Decree no. 6/2003 Coll., which define hygienic limits of chemical, physical and biological indicators for indoor environment of residential rooms
- Decree no. 20/2012 Coll., which amends Decree no. 268/2009 Coll., On technical requirements for buildings
- Decree no. 343/2009 Coll., which amends Decree no. 410/2005 Coll., On hygienic requirements on the premises and operation of facilities and establishments for the education of children and adolescents.
- Atomic Act no. 13/2002 Coll., as amended, and other regulations
- Decree no. 307/2002 Coll., on radiation protection

Table 2. Indoor air quality standards (hour average in µg/m^3) for some selected air pollutants in Czech (Decree no. 6/2003 Coll.)

Pollutant	limit	Pollutant	limit
$PM_{2.5}$	80	Styrene	40
PM_{10}	150	Ethylbenzene	200
Nitrogen dioxide	100	Formaldehyde	60
Ozone	100	Trichloroethylene	150
Carbon monoxide	5 000	Tetrachloroethylene	150
Asbestos and MMMF	1 000 fibres/m^3	Bacteria (in air)	500 CFU/m^3
Ammonium	200	Mould (in air)	500 CFU/m^3
Benzene	7	Radon (*)	200 Beq/m^3
Toluene	300	Carbon dioxide (**)	1 500 ppm
Σ Xylene	200		

Note:
(*) and 400 Beq/m^3 for reconstructed buildings (Atomic Act no. 13/2002 Coll.)
(**)Decree no. 20/2012 Coll., Value should never be exceeded

MMMF – man made mineral fibers

3.4 Review of indoor air quality data

Realized studies of national importance within the MZSO system - Environmental Monitoring System in the Czech Republic (since 1994):

- 1994 - 1997, 60 flats of families with preschool children
- 1999 - 2001, 20 kindergarten and 120 flats of selected children
- 2003 - 2004, 100 flats in the most frequented area in the Czech Republic in five cities
- 2006, 20 primary schools in five cities
- 2008, 14 schools (10 classrooms in each of them) in 14 regions, total 140 classrooms
- 2015 - 2016, 25 nursery schools in five cities

Others:

- 2010 - 2012, Project SINPHONIE (5 elementary schools, weekly measurements always in three classes)

  Indoor Air quality data are available in variably structured (pollutants, intervals ..) worksheets, for their additional use in the project InAiRQ is necessary to define a uniform template. Realized measurements in schools, in the long term confirms, that the biggest problem of the indoor environment in Czech primary schools are aerosol particles fractions PM_{10} and $PM_{2.5}$ and approximately at 30 % of cases microclimatic parameters - i.e. insufficient air exchange and ensuring optimal range of temperature and relative humidity in the class rooms and gyms.

  Exceptionally contaminations of areas are caused by technology lack of discipline during reconstruction occurs (unsuitable floor coverings and their installation and their emissions, using materials intended primarily for the outdoor environment - VOC, non-compliance with regulations in force in the reconstruction of buildings - asbestos, inadequate classroom equipment …..).
- Independent measurements/dates of different organizations (businesses, universities, etc.), for lack of a national unified data platform are not available and usable ..

Based on the above studies, where 221 classes were measured in 85 schools and kindergartens, it is likely that the most common problems are likely to be identified. These are the parameters of discomfort (which are usually sorted CO_2, temperature and humidity), which in extreme measured values can reach levels negatively affecting vulnerable populations. Furthermore, dustiness - especially

coarse fraction (from 2.5 to 10 μm particles) given primarily by class activities and some organic substances (eg formaldehyde). A separate problem is the non-observance of technological procedures for repairs / modifications or reconstructions or the use of incorrect / inappropriate building materials.

If we try to summarize what most affects indoor air quality, we will end up with a simple enumeration that is without exception appliable to all types of indoor environments, even though they differ in importance or share of internal and external resources:

1. Architectural design / project, construction, used building materials including adherence to technological procedures during construction (and subsequent during construction and reconstruction)
2. Comply with ventilation / air exchange requirements and heat-humidity standard
3. Equipment (including items of normal use)
4. Maintenance - Object operation (cleaning, small repairs …)
5. Activities
6. Outdoor air (ambient sources - transport, industry, energy) ie infiltration
7. Awareness of potential risks to operators and users

3.5 Outdoor air pollution in Czech

For the evaluation of the environmental burden from the ambient air we can use the processing of air pollution data (currently at 2017) in defined types (categories) of urban areas. The assessment criterion included not only the intensity of surrounding traffic, but also the relative proportions of different types of heating systems and possible burden from significant industrial source. Air quality in the different types of locations is evaluated for health most relevant pollutants NO_2, PM_{10}, $PM_{2.5}$, As, Cd, Ni, Pb, benzene and BaP. In addition, the estimate of the burden of the common urban environment (i.e. the urban “background”, without an extremely heavy transport and industry) is included. This estimate is based on average annual concentration data obtained from urban monitoring stations in categories 2–5. The data of similar urban stations in the Moravian-Silesian region

Česká republika 2017

Střední roční hmotnostní koncentrace pro hodnocené kategorie městských stanic

Rok 2017 - MZSO - Monitoring zdravotního stavu obyvatelstva		Městské dopravou a průmyslem nezatížené lokality		Městské středně dopravou zatížené lokality			Dopravní Hot-spoty	Městské oblasti zatížené průmyslem			Pozaďové stanice ČHMÚ	Venkovské, předměstské stanice						Odhad střední hodnoty ve městech ČR	Do hodnocení zahrnuto celkem stanic
látka	kategorie	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	2 - 5	
PM_{10} µg/m³/rok	ČR(bez MSK)	22,1	21,6	18,2	24,3	26,5	25,3	25,2	-	27,9	15,6	21,5	31,6	35,6	23,8	31,6	-	23,2	91
	M-S kraj	28,5	29,4	38,3	30,3	30,4	-	32,8	35,1	-	14,7	29,3	41,0	-	-	-	-	31,3	26
$PM_{2,5}$ (µg/m³/rok)		20,4	18,3	22,2	19,9	18,6	16,6	25,2	27,2	-	13,5	18,3	25,8	-	19,7	-	-	19,8	69
SO_2 (µg/m³/rok)		4,6	5,3	5,5	4,3	7,2	-	5,1	8,3	-	2,9	5,1	8,8	-	2,7	4,7	-	4,6	46
NO (µg/m³/rok)		4,4	4,3	3,9	8,1	20,5	31,8	6,5	6,9	24,8	0,8	2,6	3,0	-	4,7	5,7	-	6,0	67
NO_2 (µg/m³/rok)		15,8	17,0	16,6	20,6	29,5	41,9	22,8	23,4	32,4	5,8	12,4	14,2	-	15,3	15,1	-	17,6	68
NO_x (µg/m³/rok)		21,9	22,7	22,5	33,2	62,5	90,8	29,9	34,1	72,3	6,9	15,7	18,9	-	22,6	24,0	-	26,2	69
CO (µg/m³/rok)		-	328	321	332	415	424	-	269	649	221	-	-	-	-	-	-	324	13
O_3 (µg/m³/rok)		50,0	52,3	53,3	46,9	48,2	36,6	50,6	48,9	-	68,0	54,4	46,6	-	50,8	-	-	48,0	57
Benzen (µg/m³/rok)		1,1	1,2	1,7	1,1	1,3	1,3	1,3	3,8	-	0,7	-	2,1	-	-	-	-	1,3	33
BaP (ng/m³/rok)		1,31	1,29	2,14	1,0	1,08	-	3,39	3,51	-	0,52	1,49	-	-	3,29	3,71	-	1,46	44
As (ng/m³/rok)		0,88	1,33	1,41	1,57	1,15	-	2,49	2,52	-	0,67	0,58	3,18	3,06	-	6,02	-	1,48	46
Cd (ng/m³/rok)		0,18	0,19	0,19	0,22	0,18	-	1,22	0,34	-	0,08	0,11	0,36	0,15	-	0,21	-	0,28	46
Cr (ng/m³/rok)		1,24	1,32	1,08	1,87	2,16	-	1,63	2,32	-	0,58	0,60	1,50	1,89	-	0,90	-	1,45	46
Mn (ng/m³/rok)		6,10	7,19	5,67	6,18	8,30	-	11,52	27,15	-	2,18	3,51	6,73	8,15	-	5,28	-	7,24	46
Ni (ng/m³/rok)		0,59	0,80	0,68	0,94	1,18	-	0,80	2,52	-	0,40	0,52	0,98	1,30	-	0,62	-	0,77	46
Pb (ng/m³/rok)		5,4	9,6	6,2	5,8	7,5	-	11,5	16,6	-	3,3	3,5	4,7	6,3	-	6,6	-	7,6	46
ČR - PM_{10} - odhad nárůstu předčasné úmrtnosti v %		*3,97*	*3,75*	*2,21*	*4,97*	*5,96*	*5,42*	*5,37*	-	*6,59*	*1,04*							*4,47*	
MSK - PM_{10} - odhad nárůstu předčasné úmrtnosti v %		*6,86*	*7,27*	*11,29*	*7,68*	*7,72*	-	*8,80*	*9,84*	-	*0,63*							*8,13*	
Celkové ILCR (Benzen, BaP, As, Cd, Ni)		*1,2E-04*	*1,2E-04*	*2,0E-04*	*9,6E-04*	*1,0E-04*	-	*3,1E-04*	*3,3E-04*	-	*5,1E-05*							*1,4E-04*	

Zpracovala NRL pro venkovní ovzduší, Centra zdraví a životního prostředí, Státní zdravotní ústav v Praze

were not included to this estimate due to the higher area burden compared with stations in other regions of the country, and they are evaluated separately.

For better understanding:

Categorization of measurement sites/zones according to NIPH

(Based on, and modifying 97/101/ES: Council Ruling of 27. 1. 1997, regarding the introduction of mutual exchange of information from networks and individual measuring stations monitoring outdoor air in member states, Official Journal L 035, 05/021997 P. 0014 – 0022)

Basic categories:

URBAN

1. Urban background (area without significant evaluable sources, without traffic – parks, sports grounds, bodies of water, unused land etc.).

URBAN RESIDENTIAL (housing estates, satellite towns, suburbs, shopping malls, hospital grounds, housing developments incl. small-scale service and manufacturing premises).

2. Urban residential zone with local sources only (suburbs, satellites, allotments, low-level traffic equivalent to 2 000 vehicles/24 hrs. and/or at a distance in excess of

150 m from a major highway or crossroads and/or on the shielded side of a building away from such a highway or crossroads) REZZO 2 local sources for heating in commercial, administrative and residential buildings – URBAN RESIDENTIAL LOCAL HEATING.

3. Urban residential zone without local sources of emission (housing estates heated by remote central sources, low-level traffic equivalent to 2 000 vehicles/24 hrs. and/or at a distance in excess of 150 m from a major highway or crossroads and/or on the shielded side of a building away from such a highway or crossroads) – public energy, remote heating URBAN RESIDENTIAL.
4. Urban residential zone with local and remote central sources of heating, traffic equivalent to 2 000 – 5 000 vehicles/24 hrs (urban category road network) and/or at a distance in excess of 150 m from a major highway or crossroads and/or on the shielded side of a building away from such a highway or crossroads) – URBAN RESIDENTIAL LOW TRAFFIC.
5. Urban residential zone with local and remote central sources of heating, traffic equivalent to 5 000 – 10 000 vehicles/24 hrs (urban category road network, major roads) and/or at a distance in excess of 150 m from a major highway or crossroads and/or on the shielded side of a building away from such a highway or crossroads) – URBAN RESIDENTIAL MEDIUM TRAFFIC.
6. Urban residential zone with local and remote central sources of heating, traffic in excess of 10 000 vehicles/24 hrs - open roads (buildings at a distance of at least 10 m from the road) – URBAN RESIDENTIAL TRAFFIC.
7. Urban residential zone with traffic in excess of 10 000 vehicles/24 hrs (enclosed roads, canyon shape) and transit roads with traffic in excess of 25 000 vehicles/24 hrs – URBAN RESIDENTIAL HEAVY TRAFFIC.

URBAN INDUSTRIAL

8. Urban industrial zone with greater load from technology than traffic (up to 10000 vehicles/24 hrs) on air quality.
9. Urban industrial zone with greater load from traffic than technology: includes railway junctions (stations, depots etc.).
10. Urban industrial zone with significantly greater load from traffic (in excess of 25 000 vehicles/24 hrs) than technology.

RURAL

11. Background – woodland, parks (non-urban), pastures, non-cultivated land, bodies of water, fields etc.)

12. Agricultural – effects of agricultural sources – cultivated land
13. Industrial – predominant effects of industry over traffic
14. Industrial with traffic load – predominant effects of traffic over industry
15. Residential zone with low level traffic (up to 2 000 vehicle/24 hrs)
16. Residential zone with middle traffic (2 000 – 10 000 vehicles/24 hrs)
17. Residential zone with heavy traffic (>10 000 vehicles/24 hrs)
18. Traffic load (>10 000 vehicles/24 hrs) without housing development (zones 1 and 2)

Notes:

1. For industrial zones the type of industry is not primarily evaluated. However, in terms of pollution the type of industry plays a more important role than volume of traffic – metallurgy, assembly shops, paint shops, breweries (without own heating sources), chimney height etc. Industrial sources were accordingly categorized as above.
2. For categories defined by use (industrial, urban or otherwise) the major sources of pollution are emphasized (e.g. one of three – traffic, industry, heating).
3. Rural zones are defined by a population of up to 2000 inhabitants in rural areas
4. Categorization necessitates taking into account the long-term load in a given locality.

Air quality data from year 2018 will be available in the form of outputs from measuring stations during June -July 2019. It applies also to data from the national air pollution network are regularly transmitted by the Czech Hydro meteorological to the AIRBASE network (http: //www.eea.europa.eu/data-and-maps/data/airbase-the-european-air-quality-database-7/en). NIPH runs the Oracle database, where the data are being processed and every year worked out annual report, which includes both basic evaluation and interpretation of measured values and evaluation of health risks from outdoor air

Actual annual report:

http://www.szu.cz/uploads/documents/chzp/odborne_zpravy/OZ_17/ovzdusi_2017.pdf).

Health Risk evaluation:

http://www.szu.cz/uploads/documents/chzp/ovzdusi/dokumenty_zdravi/rizika_CRi_2017.pdf

This assessment of health risks from outdoor air is also included in the report for the Czech Government.

3.6 SWOT Analysis

SWOT analysis is a method that can be used to evaluate the Strengths, Weaknesses, Opportunities, and Threats that exist in the case of indoor air quality (IAQ) in school buildings under the InAirQ project. To assess the school environment, SWOT analysis uses both internal and external factors that may have an impact on the IAQ. The internal factors (strengths and weaknesses) are present within the school environment, while external factors (opportunities and threats) are beyond the schools. These critical factors, that may influence decision-making process directed to improve the IAQ in the schools, have to be identified to use them as background to define the goals and objectives that have to be achieved in each PP country.

This SWOT was implemented according to a uniform methodology *Strategic planning definition and basic characteristics (according to Zaletel-Kragelj L. and Boţikov J., 2010)*.

It must be noted that the factors to be maintained are Strengths (internal positive attributes of the school environment that can facilitate activities aimed to improve the IAQ) and Opportunities (external conditions that may facilitate activities aimed to improve the IAQ in schools), while the factors to be addressed are the Weaknesses (internal attributes of the school environment that may hinder activities aimed to improve the IAQ) and Threats (external conditions that may complicate activities aimed to improve the IAQ in schools). The presence of weaknesses and threats proves the existing gaps that have to be addressed in strategic planning (please find the definition below) to avoid or minimalize their impact on the IAQ in the future. The absence of strengths and/or opportunities highlights the urgent need of further plans or developments before actions are taken to avoid weaknesses and threats.

Recommended procedure:

1. The internal analysis is performed.
   Internal analysis examines the advantages and drawbacks of school environment on the IAQ. This can be achieved by the analysis of the current state of school environment (Strengths and Weaknesses) and the impact of the school environment on the IAQ.

2. The external analysis is performed.
   External analysis examines the main relevant points in the analysis of the actual state of policy-related factors which are independent of the schools (e.g. legislation in force, financial environment). They are identified as Opportunities or Threats or obstacles to be addressed in future.

3. Collected information (according to points 1 and 2) are used to fill the SWOT analysis tool in (enclosed table).

4. Properly performed SWOT analysis is needed to elaborate the strategy that applies Strength and Opportunities to reduce Weaknesses and Threats and finally to achieve the goals and objectives of the InAirQ project (improvement of IAQ in school environment in Central European countries).

When performing the SWOT analysis for CR, we took into account the following parameters:

- education policy;
- legislation(s) in force;
- financial environment;
- stakeholders (including authorities) involvement;
- current state of the applied technology (including building technology, HVAC systems, building finishing and furnishings);
- possibility of modern technology development and innovation (including building technology, HVAC systems, building finishing and furnishings);
- dissemination of knowledge and increase of awareness of schools management regarding to ensure the good IAQ;
- trends in public health that may affect the IAQ.
-

Souhrně:

Za výhodu je považováno dosavadní rozmístění škol - většinou v pozaďových lokalitách, dobrý stav budov, nárůst používání nízkoemisních materiálů a skutečnost že zřizovatelem je převážně veřejná správa. Naopak za aktuální problémy jsou považovány finance, nízký počet pracovníků, nedostatek snahy o zlepšování stavu, nízká informovanost o rizicích, současném stavu a možnostech zlepšování a organizační nedostatky. Mezi potenciální „hrozby" patří neaktuální limity pro kvalitu vnitřního ovzduší, nepružná reakce legislativy i dozorového

orgánu na aktuální problémy, nedostatek financí, neregulovaný marketingový tlak a nezájem zřizovatelů a vedení škol o zlepšování kvality vnitřního prostředí nad rámec legislativních požadavků. Je zajímavé a trochu české, že některé body se vyskytují jak mezi výhodami, tak mezi potencionálními problémy.

3.7 CZ SWOT Analysis tool

Improvement of the Indoor Air Quality in the school environment

Identify Strengths, Weaknesses, Opportunities and Threats but limit the points to a maximum of ten under each heading (Zaletel-Kragelj L. and Boţikov J., 2010).

	Internal analysis	
SWOT analysis tool	**STRENGTHS** What has a positive impact on the school environment regarding IAQ? 1. *The location in the background sites, good building condition, increased use of low emission materials.* 2. *Classes are structurally separated from the changing rooms, dining room and gyms.* 3. *Education and availability of information on IAQ for school staff, interest in good IAQ.* 4. *Reasonable use of new technologies and materials.* 5. *The founder is predominantly public administration/municipality, schools have unified procedures and criteria for reconstruction and technology, communication and information transfer*	**WEAKNESSES** What has a negative impact on the school environment regarding IAQ? 1. *Lack of finance, lack of staff.* 2. *Lack of efforts to improve IAQ.* 3. *Insufficient air exchange - caused by inconsistent access of staff, by the influence of school surroundings (disturbing noise, transport), pressure on energy-saving measures including reconstruction, by insufficient air volume per pupil in the classroom/s.* 4. *Insufficient awareness of the risks, current status and possibilities of IAQ improvement.* 5. *High physical activity in the classroom (during breaks).* 6. *Organizational shortcomings*

	between schools and the founder.	7. *Individual conditions of individual schools (not applicable everywhere)*

External analysis	**OPPORTUNITIES** What are the opportunities to improve the IAQ in the school environment?	**Opportunity-Strength (OS) Strategies** How can we use Strengths to take advantage of Opportunities?	**Opportunity-Weakness (OW) Strategies** How can we overcome Weaknesses by taking advantage of Opportunities?
	1. *Legislative limits, follow-up supervision of Public Health Authorities, studies within the MZSO.* 2. *Capacity building, awareness-raising activities at the management and supervisory levels.* 3. *New technologies (HVAC, recuperation) and materials (cleaning agents, low emission materials) for schools. Possibility of IAQ control and management by schools (microclimate sensors, CO_2 ...).* 4. *Unification of practices and approaches to IAQ improvement, including regime measures, relevant use of funds.* 5. *Suitable placement of new school buildings, respecting the purpose of the building and IAQ requirements.*	1. *Using continuous legislative updates including requirements for materials for school facilities to improve the possibility of influencing air quality.* 2. *Supervision activity focused on real and current air quality problems not only within the framework of legislation.* 3. *Educate pupils, school staff and leadership in schools about IAQ and its influence on the health and attentions of children and teachers* 4. *Using modern technologies (such as sensors) to continually review IAQ status in schools.* 5. *Promote the interest of founders and school leadership in improving IAQ.* 6. *Continuous application of new and proven technologies*	1. *Reasonable updating of legislation and focusing on ongoing improvement in the framework of supervisory activities.* 2. *Faster reaction (awareness) of "marketing pressure on new technologies" and organizing educational seminars in schools for children, leadership and parents.* 3. *Detailed economic balance of possible measures with consideration and with respect to several factors (HVAC, recuperation), investment in sensors and personnel.* 4. *Educate school leaders and founders about the benefits and disadvantages of new technologies.* 5. *Individual approach to measures and design solutions for each school object.* 6. *Supporting pedagogical staff in the use of new methods and forms of education and training.*

External analysis	**THREATS** What are the threats that can negatively influence the IAQ in the school environment? 1. *Unregulated marketing pressure (cleaners, coatings, cleaning agents), unsubstantiated information on how to improve IAQ, the use of unverified technologies and products in schools.* 2. *Disinterest of founders and school management to improve IAQ beyond the legislative requirements.* 3. *Urban planning and construction regardless of the proximity of schools (transport, industry, etc.) - negative impact of changes (environmental pollution, noise, transport ...).* 4. *Outdated limits, slow response of legislation and public health authorities to actual issues.* 5. *More extensive reconstruction, comprehensive feasible concept, sufficient staffing capacity in schools.*	**Threat-Strength (TS) Strategies** How can we use Strengths to avoid Threats? 1. *Discussion platform for communication between schools, Public Health Authorities and professionals and for obtaining validated information.* 2. *Prohibition of using unverified technologies and inappropriate materials in schools* 3. *Ensuring capacities, technical assistance and resources for the necessary measures.* 4. *Updating legislation in cooperation with experts (and school representatives).* 5. *Define requirements for the placement of schools (support for and cooperation with grass-roots associations around schools).*	**Threat-Weakness (TW) Strategies** How can we minimize weaknesses and avoid Threats? 1. *Improve the level of awareness of staff and school founders - a discussion platform for communication between founders, schools, OECDs and professionals. The education of the founders of schools will increase the chances that they will understand the legitimacy of the requirements for the non-fulfillment of classes and staffing needs of schools.* 2. *Use all available options to improve IAQ (grants, funds ...).* 3. *Continuous evaluation of IAQ information.* 4. *Consistent application of the precautionary principle when introducing new technologies and products.* 5. *Call on policies on the significance of non-compliant IAQs in schools and on the need to secure funding for ongoing status monitoring / air quality monitoring in schools.* 6. *In projects, optimize the exchange of air for individual parts of the building. Improve school funding.*

4 Action plan:

The primary goal is to minimize the impact of the outdoor and indoor environment on pupils' health. The first step is to describe and assess the current state of the school environment and to identify potential problems.

It includes several basic intermingling parts:

4.1 Finance and grant titles

For ensuring necessary funds and grants are needed to create, at the professional and amateur level, the necessary pressure on the management of schools and public or municipality administration. (Presentation of outputs, publicizing issues, special seminars).

Task for: Expert Methodological Center, professional groups/chambers, ministries

4.2 Creating a National Methodology and Data Center (Platform)

The problem is on the fragmentation of activities, the non-acceptance of a unified methodical approach, the unavailability and the incomparability of existing data and experience. It is necessary to create expert methodological Headquarters / Center.

The task of this Expert Methodological Center is / will be the co-operation in the implementation of the activities and tasks arising from the implementation of the National action plan, its ongoing updating and paralelly management and inventory of obtained IAQ data.

Task for: Expert Methodological Center, professional groups/chambers, ministries

4.3 Education, training, seminars, building **capacities**

The problem is the general lack of awareness of the effects of polluted indoor air on the health of children and the causes of this condition.

- For all interested groupsI is advisable to increase the awareness of teachers, other staff, childs and parents about the importance of indoor air and the causes of its pollution, and discuss with them their role in ensuring IAQ quality.
- Create cross-sectoral working groups involving regional actors in the fields of education, health, the social area and the environment. The necessity is to involve stakeholders in the implementation of the action plan (to organize seminars and training events for school staff, school authorities, school units, discuss with architects, designers or builders, organize workshops, provide consultancy and methodological activities.) Extend publishing and presentation activities, including medialization of outputs.

Task for: Expert Methodological Center, professional groups/chambers

4.4 Continuous updating of related legislation

The aim is to ensure full (or at least sufficient) acceptance and application of the World Health Organization's requirements for indoor air quality in Czech legislation through cooperation with relevant public authorities / public health authorities, research institutions and professional chambers.

- Communication with supervisors (OOVZ = Public Health Authorities), with the concerned professional groups, universities …..
- Use of measurement data and problem cases (interconnection with the preparation of data and methodological platforms)
- Securing adequate inter-ministerial communications
- Update of recommended / reference and limit values, preparation of draft

Task for: Methodical management of hygiene services and OOVZ bodies

4.5 Unifying the methodologies for the measurement and evaluation of indoor environmental quality (surveillance aktivity)

1. **Continuous updating of the methodical guidelines for indoor air measurement and sampling**

The goal is always to ensure a comparable and representative measurement within the classroom and school and, of course, between the measurement groups. Require a recognized quality system (authorization, accreditation).

Task for: Expert Methodological Center

2. Characterization procedure of the current state of indoor air quality in a building (Quality)

When identifying the cause of indoor air pollution, it is always necessary to include both the description of the assessed area / building and the subjective perception of users.

This can only be ensured by following the approach below, which can be divided into two groups:

A. <u>The description of the factors influencing the indoor air of the building</u>

1. Outdoor air - outdoor sources

Air quality should be assessed on the basis of interpretation of data from the network of measuring stations operated by CHMI (ISKO). In a particular case, it is always necessary to evaluate and take into account:

a) Air pollution in the wider area, sources of pollution in the immediate vicinity of the building, e.g. main roads, parking, waste disposal facilities, industrial production, etc.
b) Soil beneath the building and surrounding (radon, old loads ..).

According to these parameters, place a specific school building into a type of urban site (estimate the level of outdoor load) or identify a potential radon load.

2. Indoor air - indoor sources in building

The source (cause of emissions) of some pollutants is / may be a school building itself, operating regime including cleaning regime, children's activities or internal

directive. One possible tool of description is the use of a questionnaire survey (see Appendix 2 and 3). Primarily it is necessary to focus on:

a) School building materials and equipment (eg building elements, occurrence of asbestos, insulating materials, wall and floor tiling, used paints and adhesives, room equipment - furniture, etc.).
   - Source processes in school buildings
   - incineration, heating, cooking
   - identification of regular school activities of children (sport, art, school mode, etc.)
b) activities of operators and other users (use of cleaning products, smoking, use of laser photocopiers, printers ...) - Emergencies (damage to the building due to eg heating, leakage, ...)
c) Other factors that affect the quality of the indoor environment - method of ensuring the exchange of air in the building - occurrence of moisture and mold.

The identification of resources around the school and in the school building itself (the class) then defines / predetermines possible corrective actions. When preparing questionnaires, please follow the "Protocol of data collection" (see Appendix 1).

B. The subjective evaluation of indoor air quality its users.

Subjective user reviews can be obtained through a simple questionnaire or by evaluating complaints if they exist. One of the possible tools for subjective environmental quality assessment in schools is the use of SWOT analysis.

The result of this step is an overview of potentially problematic environmental and resource related parameters.

The output is a quantification of the present state of indoor air quality in a building.

If non-compliant parameters are found, there is a need to proceed without delay to the next step, ie to propose remedies. In other cases, it is necessary to consider and gradually implement all the steps that could / should lead to further improvement of the indoor air quality and and minimizing existing burdens.

Task for: Methodical management of hygiene services and OOVZ bodies

4.6 Design, implementation and verification of the effectiveness of the implemented measures

This assumes:

1. Suggestions for corrective measures / actions that will improve the quality of the environment.

Measures may be:

a) Operational / mode, ie modifying the mode of some activities that can affect the quality of the indoor environment (eg increasing ventilation rate, limiting the number of people/childrens in the classroom, changing the cleaning period, ...)

b) Systemic, ie measures that will lead to removal of the source (eg replacement of floor coverings, prohibition of using some detergents, use of dust-free painting, ...).

The proposal must be accompanied by:

a) Economic estimation and feasibility assessment

b) Timetable for implementation of individual measures respecting potential health risks.

2. Implementation of remedial measures

On the basis of the draft, the measures will be implemented in accordance with the timetable of the individual steps.

a) In the case of regime measures, it is necessary to formulate new rules for the operation and maintenance of the building and to ensure that all concerned persons are informed about the change in progress and their reasons.

b) In case of systemic measures, it is necessary to check the correctness of their implementation (eg control of used materials, control of used detergents, ...)

c) At the same time, it is advisable to increase the awareness of teachers, other staff, teachers and parents about the importance of indoor air and the causes of its pollution, and discuss with them their role in ensuring IAQ quality.

3. Verification of the functionality of corrective actions

The functionality of corrective actions should preferably be verified by means of a control measurement or by a control subjective user assessment as a questionnaire.

Require a recognized quality system (authorization, accreditation).

Task for: Expert Methodological Center, professional groups/chambers

4.7 Support for drawing subsidies to solve existing problems (microclimate, dust, asbestos, materials / equipment certification …)

Obtaining the necessary funds / grants currently requires knowledge, time and experience. It is necessary to ensure at the decision-making level the simplification of access to subsidies and, at the same time, legal and economic assistance for the submission of applications.

a) Simplify and make clear the possibilities of drawing subsidy titles
b) Take advantage of the experience of drawing subsidies for solving identified problems and building new buildings (form: trainings, seminars, methodological and legal assistance)
c) Legislatively anchor the use of low-emission materials

Task for: Expert Methodological Center, professional groups/chambers, ministries

4.8 Support for science and research in the field of indoor environmental (air) quality

Create conditions for the development of research projects aimed at ensuring the quality of the indoor environment in school facilities (and other residential buildings).

Task for: Expert Methodological Center, professional groups/chambers, ministries

5 Annexes

5.1 Annex Nr. 1.

PROTOCOL OF DATA COLLECTION

NOTE: The protocol was prepared based on US-EPA, UK, EC funded projects, Sinphonie.
Requires amending by the checklists and questionnaire template

I. Professional partner contribution and field cooperation

1. In the preparation of the Data collection protocol, it is necessary to create a study team at the first level of each project. It should include experts in this area, staff responsible for the operation and management of schools and school staff themselves. It is instructed in detail about the objectives and rules concerning collection of data from schools included in the InAirQ project. The study team is responsible for coordination and leading data collection in scientific and technical manner, including indoor air quality (IAQ) on-spot measurements and cooperation the schools where the measurements are performed.

2. The national study team comprises 2-3 internal project staffs and appropriate school operative(s). The school operative team member is suggested to be school manager, teacher, school technician, regional/local official etc. Important that the school operative has full responsibility for ensuring the school on-spot measurements (e.g. provide place and time for measurements, operation of the mobile equipment).

3. The study team designates a study team leader, field team leader and analysis team leader. There is a possibility to assign more than one responsibilities for one person. The field team leader is responsible for instructing the members of study teams, coordination of the study team activities, timeliness as well as quality of the data collection / measurements and analysis of the collected data.

4. Study team leader contributes to the preparation of the report on data accessibility and compatibility and setting up and maintenance of the joint indoor air quality database and design the Virtual Health Repository. The study team encourages and fosters the establishment of the local Environment Quality Forum and also actively acts in the preparation of the Declaration of Schools.

II. Selection and recruitment of school buildings

1. School buildings chosen to collect exposure, ventilation and microclimatic factors and exhalation of harmful compounds are selected according to the *Criteria of schools selection and Categorization of Measurement Sites/Zones* based on documentations existing in the local authorities/schools networks/other schools management organizations. The schools initial and final selection in each project partner country is performed by the project partner study teams.

2. Each initially selected school is visited by the study team to confirm directly the compatibility of data from documentations and the actual state related to the parameters required by the objectives (according to the Rules on Schools Selection and Categorization of Measurement Sites/Zones). The visit also aims to confirm suitability of the school building for the further study and to select the proper classroom(s) for measurements (according to the Rules on Schools Selection and Categorization of Measurement Sites/Zones). During the visit the study team has opportunity to meet the school operative and other staffs of the schools.

III. Indoor air quality data measurements / collection

Characterization of the whole building and study areas (a questionnaire study).
Detailed information about each school related to building(s), classrooms selected for measurements, surrounding and possible specific sources of harmful agents (indoor and outdoor) that can affect and decrease IAQ including HVAC (Heating Ventilation Air Conditioning) is collected using the tools (checklists) jointly developed and accepted by all the participant of the study/project. The tools are prepared based on the checklists questionnaires developed under the previous studies and guidelines related to IAQ (US-EPA, UK, EC funded projects, Sinphonie). The questionnaire study are conducted in the language of each project partner country, all tools are translated into each project partner language.The checklists and questionnaires are filled in by the school management staff person and in consultation with the study teams during their visits to the school buildings and interviews performed with schools heads or other responsible persons indicated by them. This part of the study is conducted at the beginning of measurements.

Information gathered in each school building within a week after completion of each field studies put into, built for this purpose, Virtual Health Repository.

1. Measurements of indoor air quality

In each school selected according to point **II. Selection and recruitment of school buildings** measurements of temperature, relative humidity, $PM_{2.5}$ TVOC and CO_2 are performed using, for example, senzor device. During the measurements, the equipment is used only in the manner indicated and allowed in the user manual. The measurements are taken in the central point of each selected classroom (optimally) under the conditions such as those usually occurring during the lessons (e.g. heating, ventilation including open windows, air conditioning if available). To illustrate exposure of pupils/students as well as possible, the measurements are taken during all lessons in a week, on each workday of the week (from Monday to Friday). The measurements are performed not disturbing the lessons. Results of the measurements are entered into the VHR within a week after finishing each series.

Besides using senzor device devices each partner may carry out additional measurements of indoor air quality if feasible. But during the measurements and data collection the project partners have to make efforts to reach a minimum requirement to have a comparable project data set on IAQ.

2. Environmental monitoring (outdoor)

For each series of IAQ measurements, the same outdoor measurements are performed. The selected outdoor locations are as close as possible to fresh air in the school building. Outdoor measurements are performed simultaneously with IAQ measurements or data is taken from a nearby stationary measuring station that is representative for the closest neighborhood of the school (if any).

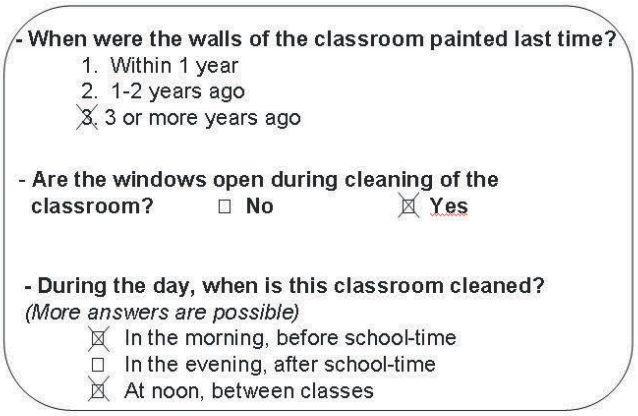
IV. Survey of the occurrence of symptoms in pupils/students

In the each school involved in the project a questionnaire study of the occurrence of symptoms in pupils/students is performed based on the tools accepted by all project partners. In order to obtain results of the highest quality this part of the study is conducted using a tool developed previously in the other project (Sinphonie). Students and their parents will be informed through a brochure with information about the project, a letter to parents asking for agreement to survey and questionnaire to be filled in by the parents along with instructions for completion - developed and validated in the SINPFONIE project (Annex Nr. 5).

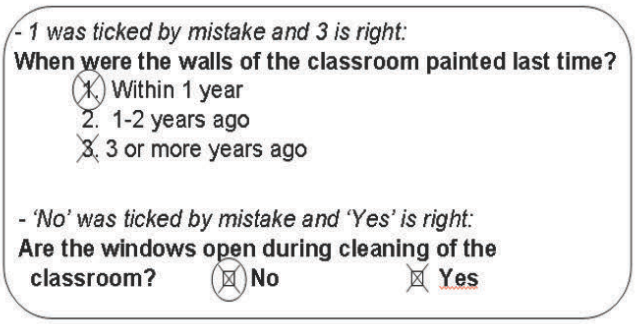
The questionnaire study is conducted in the language of each project partner country and all tools are translated into the each project partner language.

Instructions for completing the checklist and questionnaire (only one questionnaire for each classroom. It would be desirable that the questionnaire is completed with the cooperation of all teachers who use the classroom).

- When you are asked to write a text (e.g. name of the school/country/city, some specifications...), write clearly, if possible in capital letters, and in the space provided.
- Tick the box or cross out the number corresponding to your response option. Tick only one option unless otherwise instructed. Examples:



- If you make a mistake, circle the wrong answer and tick the right one. Examples:



5.2 Annex Nr. 2.

CHECKLIST AND QUESTIONNAIRE ABOUT THE CLASSROOM (EXAMPLE)

Code: ☐☐ ☐☐ ☐
Country School Classroom

C_Q1. **Date of investigation:** (*Day/Month/Year*) __/__/____

C_Q2. **Name of the School:** .....

C_Q3. **City/Town:** ..... *C_Q4*. **Country:** .....

C_Q5. **Class:** ..... *C_Q6*. **Number of pupils in the school :** .....

C_1. **On which floor is this classroom situated?** .....

C_2. **Floor surface of the classroom:** ..... m^2

C_3. **Ceiling height of the classroom:** ..... m

C_4. **Windows area:** ..... m^2

C_5. **Orientation of the classroom I.:**
1. Facing the street
2. Facing the yard or garden
3. Other *(Please, specify)* .....

C_6. **Orientation of the classroom II.:**
1. East
2. North
3. West
4. South

C_7. **The floor material is made of:**
1. Parquet
2. Laminate
3. Plastic (Please, specify) .....
4. Stone or concrete
5. Tiles
6. Stone or concrete covered with carpet
7. Other *(Please, specify)*.....

2

C_8. What is the main type of wall covering?

1. Whitewash
2. Water-soluble paint
3. Water-resistant paint
4. Wallpaper
5. Wood-panel
6. Other *(Please, specify)*.....

C_9. The ceiling is covered by:

1. Whitewash
2. Water-soluble paint
3. Water-resistant paint
4. Wall-paper
5. Wood-panel
6. Other *(Please, specify)*.....

C_10. When were the walls of the classroom painted last time?

___/____ (Month/Year)

C_11. Is there air conditioning (functioning) in the classroom?

- ▫ No
- ▫ Yes

C_12. Is there mechanical ventilation (functioning) in the classroom?

- ▫ No
- ▫ Yes

C_13. How frequently are the windows opened during a usual day in the heating period?

1. In every interclass break
2. 2-3 times a day
3. Once a day
4. Never (i.e. mechanical ventilation and not openable windows)

C_14. Is there any of the windows usually open during the classes in the heating period?

1. Yes (.....% of the windows)
2. No, it is not needed (mechanical ventilation)
3. No, because of the outside noise

C_15. How frequently is this classroom cleaned?

1. Twice a day
2. Once a day
3. Once a week
4. 2 or more times a week

C_16. During the day, when is this classroom cleaned? *(Please tick any which apply)*

- ▫ In the morning before the arrival of the pupils/students
- ▫ In the afternoon/evening after school-time
- ▫ Between classes

C_17. What is generally used for cleaning the floor of the classroom? *(Please tick any which apply)*

- ▫ Vacuum cleaner
- ▫ Broom
- ▫ Mop
- ▫ Mop with bleach
- ▫ Other *(Please, specify)*.....

C_18. Are the windows open during cleaning of the classroom?

- ▫ No
- ▫ Yes

C_19. When was the furniture in this classroom installed? ..... (Year)

C_20. What kind of board is used in this classroom?

1. Blackboard with chalk
2. Whiteboard with alcohol-based markers
3. Other *(Please, specify)* .....

C_21. What is the type of the window frame?

1. Metal
2. Wood
3. PVC
4. Aluminium
5. Other *(Please, specify)*.....

C_22. During school activities, do children use glue, paint, enamels or other products for artwork with an irritant smell?

▫ No ▫ Yes

↓

C_22.1. Where are they stored?

1. In an air-tight chest, into the classroom
2. In a normal chest or on the shelves, into the classroom
3. In an air-tight sealed chest, outside the classroom
4. In a normal chest or on the shelves, outside the classroom

C_22.2. What precautions are taken when they are used?

1. None
2. Windows are open
3. Used under a hood

C_23. **During the cold season, are there any days when it is very cold inside the classroom, so to be uncomfortable?**

1. Never 2. Rarely 3. Sometimes 4. Often

C_24. **During the cold season, are there any days when it is very hot inside the classroom, so to be uncomfortable, because the heating system is too high?**

1. Never 2. Rarely 3. Sometimes 4. Often

C_25. **During the cold season, are there any days when outside is cold and windows glasses become steamy?**

1. Never 2. Rarely 3. Sometimes 4. Often

C_26. **During the hot season, are there any days when it is so hot inside the classroom to be uncomfortable?**

1. Never 2. Rarely 3. Sometimes 4. Often

C_27. **In the classroom, does sunshine ever hit directly on some of the benches?**

▫ No ▫ Yes

C_28. **Have you ever noticed a mouldy/earthy or cellar-like odour inside the classroom?**

▫ No ▫ Yes

C_29. **Have there ever been visible signs of moisture damage such as damp stains or spots, deterioration or darkening of surface materials in the ceiling, walls, or floors, or signs of condensation of water on surfaces in the classroom?**

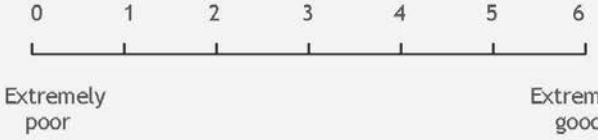
▫ No ▫ Yes

C_30. **How dusty is usually (frequently/often) the classroom?**

1. Not at all
2. Sometimes a little dusty
3. Usually a little dusty
4. Very dusty

MARK AN X ON A NUMBER OF THE SCALE FROM 0 TO 6:

C_31. **How do you perceive the natural illumination in the classroom?**



C_32. **How do you perceive <u>the artificial illumination in the classroom</u>?**

0 1 2 3 4 5 6

Extremely poor — Extremely good

C_33. **How do you perceive <u>the indoor air quality in your classroom</u>?**

0 1 2 3 4 5 6

Extremely poor — Extremely good

<u>If you think that indoor air quality is not good, try to explain why</u>:

.....

C_34. **How do you perceive <u>the noise level (outdoor source) in your classrooms</u>?**

0 1 2 3 4 5 6

Not noisy — Extremely noisy

C_35. **How do you perceive <u>the temperature in your classrooms</u>?**

0 1 2 3 4 5 6

Extremely bad — Extremely good
(e.g. cold during winter, warm during summer)

C_36. **How do you perceive <u>the cleanliness of your classrooms</u>?**

0 1 2 3 4 5 6

Extremely clean — Extremely dirty

6

C_37. **How do you perceive the decoration in your classroom?**

0 1 2 3 4 5 6

Extremely poor — Extremely good

C_38. **Overall, how do you perceive the acoustics of this classroom?** *(Namely, what is the quality of speech communication between teachers and students?)*

1. Very poor 2. Rather poor 3. Rather good 4. Very good

Why the acoustics is very/rather poor? *(Please tick any which apply)*

- ▫ The classroom is too reverberant for the speech sounds produced in it
- ▫ The classroom offers weak resistance to the penetration of noise from outside or from nearby rooms
- ▫ There is disturbing noise from ventilation system

C_39. **Overall, how comfortable is the classroom in your opinion?**

0 1 2 3 4 5 6

Very uncomfortable — Very comfortable

C_40. **How many children are generally in this classroom?** .....

C_41. **How much time usually they spend a day in this classroom?** .....hours

C_42. **Are there any nearby (within 50 m from classroom windows) potential sources of outdoor air pollution that might influence the indoor environment?**

Car park	▫ No	▫ Yes
Busy road	▫ No	▫ Yes
Industry (factory, plant)	▫ No	▫ Yes
Power plant	▫ No	▫ Yes
Incinerator	▫ No	▫ Yes

Waste storage site ▫ No ▫ Yes
Other polluting establishments ▫ No ▫ Yes *(Please, specify):*

.....

C_43. Is there visible mould growth in the classroom?
▫ No ▫ Yes

C_44. Are there damp spots on walls, ceilings or floors?
▫ No ▫ Yes

C_45. Are there any major indoor air pollution sources present?
1. No indoor air pollutant sources
2. Printers (number of printers: .....)
3. Air fresheners
4. Other *(Please, specify)* .....

C_46. Are there plants present?
▫ No ▫ Yes (number of plants: .....)

C_47. What is the material of the desks?
1. Wood
2. Plywood
3. Metal
4. Plastic laminate or composite
5. Other *(Please, specify)* .....

C_48. Are there window blinds present?
▫ No ▫ Yes

C_49. What is the position of the window blinds (if they are present)?
1. Outside
2. Inside
3. Both
4. Other *(Please, specify)* .....

C_50. What is the material of the window blinds in the classroom?
1. Window blinds are not present
2. Textile
3. Wood
4. Plastic
5. Metal
6. Other *(Please, specify)* .....

C_51. What is the material of the schoolyard?

5. Green space
6. Asphalt
7. Sand
8. Plastic material
9. Other *(Please, specify)* .....

C_52. Do pupils have meal in the classroom?

▫ No ▫ Yes

END - THANK YOU FOR YOUR COOPERATION!

5.3 Annex Nr. 3.

CHECKLIST AND QUESTIONNAIRE ABOUT THE SCHOOL

Instructions for completing the checklist and questionnaire (only one questionnaire for each school.

- When you are asked to write a text (e.g. name of the school/country/city, some specifications...), write clearly, if possible in capital letters, and in the space provided.
- Tick the box or cross out the number corresponding to your response option. Tick only one option unless otherwise instructed. Examples:

- Generally, what is the traffic density in the direct neighbourhood of the school (within 100 metres)?

1. Light
2. Medium
3. Heavy
4. Very heavy with trucks (lorries) as well

- Are kept any animals with furs or feathers (birds, cats, dogs, ferrets, guinea pig, mice, etc)?

☒ No ☐ Yes

- What kind of activities is the school yard adequate for? *(Please tick any which apply)*

☐ Sports
☒ Playing
☒ Resting

- If you make a mistake, circle the wrong answer and tick the right one. Examples:

- 3 was ticked by mistake and 2 is right:
Generally, what is the traffic density .....?

1. Light
2. Medium
3. Heavy
4. Very heavy with trucks (lorries) as well

- 'Yes' was ticked by mistake and 'No' is right :
In the school are kept any animals.....?

☒ No ☒ Yes

(EXAMPLE)

Code: ☐☐ ☐☐ ☐
Country School Classroom

S_Q1. Date of investigation: (*Day/Month/Year*) __/__/____

S_Q2. Name of the School: .....

S_Q3. City/Town: ..... **S_Q4. Country:** .....

S_Q5. Location: ..... ***(e.g., city center, suburban, town, village, industrial area, residential area, commercial area, mixed)***

S_1. Who is the Maintainer of the school:
1. Municipality
2. Foundation
3. Church
4. Private
5. Institution
6. Other (*Please, specify*) .....

S_2. When was the school building built? (*Year*) .....

S_3. What are the main building materials? (*Please tick any which apply*)
☐ Brick
☐ Concrete
☐ Wood
☐ Mud
☐ Other (*Please, specify*) .....

S_4. Was the school building built originally for being a school? ☐ No ☐ Yes

S_5. Number of storeys (occupied) .....

S_6. Was the school (as a whole) restored?
☐ No
☐ Yes **When?** (*Year*) .....

2

S_7. **During the last 5 years, were parts of the school restored?**
☐ No ☐ Yes

Which ones? *(Please tick any which apply)*
☐ Electric cables
☐ Lighting
☐ Water-system
☐ Classrooms
☐ Windows
☐ Insulation

S_8. **Generally, which is the traffic density in the direct neighbourhood of the school (within 100 metres)?**
1. Light 2. Medium
3. Heavy 4. Very heavy with trucks (lorries) as well

S_9. **Has the school got a yard?**
☐ No ☐ Yes IF "No" GO TO QUESTION S_12

S_10. **What kind of activities is the school yard adequate for?** *(Please tick any which apply)*
☐ Sports
☐ Playing
☐ Resting
☐ Other *(Please, specify)* .....

S_11. **When do the pupils use it?** *(Please tick any which apply)*
☐ In the breaks between classes
☐ Only in the morning long break
☐ After school-time
☐ Almost never, or very seldom
☐ It is used for other purposes (e.g. car park)

S_12. **Has the school got a green space around it? (sports-field, park, etc.)**
☐ No ☐ Yes

S_13. **Has the school got a gymnasium?**
☐ No ☐ Yes

S_14. **What kind of heating system is there in the school building?**
1. Central or district heating with radiators
2. Electric heating appliances
3. Gas heaters
4. Coal or wood-fired ovens

S_15. Is there air conditioning in the school building?

1. Yes, there is air conditioning in the whole building
2. Yes, there is air conditioning in some parts of the building
3. No, there is no air conditioning in any parts of the building

S_16. Is there mechanical ventilation in the school building?

1. Yes, there is mechanical ventilation in the whole building
2. Yes, there is mechanical ventilation installed in some parts of the building
3. No, there is no mechanical ventilation in any parts of the building

S_17. Are there any nearby (within 100 m) potential sources of outdoor air pollution that might influence the indoor environment?

Car park	☐ No	☐ Yes
Busy road	☐ No	☐ Yes
Industry (factory, plant)	☐ No	☐ Yes
Power plant	☐ No	☐ Yes
Incinerator	☐ No	☐ Yes
Waste storage site	☐ No	☐ Yes
Other polluting establishments	☐ No	☐ Yes *(If Yes, please, specify):*

.....

S_18. Are there any nearby (within 100 m) noise sources outside the building that might influence the indoor environment?

Car park	☐ No	☐ Yes
Busy road	☐ No	☐ Yes
Railway or station	☐ No	☐ Yes
Air traffic	☐ No	☐ Yes
Sea, river or canal traffic	☐ No	☐ Yes
Construction works	☐ No	☐ Yes
Factories	☐ No	☐ Yes
Community buildings (halls, churches, etc)	☐ No	☐ Yes
Other	☐ No	☐ Yes *(If Yes, please, specify):*

.....

S_19. Are kept any animals with furs or feathers (birds, cats, dogs, ferrets, guinea pig, mice, etc.) in the school?

☐ No ☐ Yes

S_20. While the children are in the school, are ever used paints, soaps, or other cleaning products with an irritant smell (such as chlorine)?

☐ No ☐ Yes

S_21. Are there places in the school with much dust?

☐ No ☐ Yes

If Yes: Which ones? *(Please tick any which apply)*

☐ Any classroom
☐ Bathrooms
☐ Gym
☐ Corridors
☐ Kitchen
☐ Canteen
☐ Basement
☐ Offices
☐ Other places *(Please, specify)* .....

S_22. Do you notice a mouldy/earthy or cellar-like odour inside the school?

☐ No ☐ Yes

Where? *(Please tick any which apply)*

☐ Any classroom
☐ Bathrooms
☐ Gym
☐ Corridors
☐ Kitchen
☐ Canteen
☐ Basement
☐ Offices
☐ Other places *(Please, specify)* .....

S_23. Is there a history of water damage such as leakage from water pipes or washing machines, boiler, refrigerator, freezer, or cooling of the ventilation system in the school building?

☐ No ☐ Yes

Where? *(Please tick any which apply and indicate the time of it (Month/Year))*

☐ Any classroom (___/____)
☐ Bathrooms (___/____)
☐ Gym (___/____)
☐ Corridors (___/____)
☐ Kitchen (___/____)
☐ Canteen (___/____)
☐ Basement (___/____)
☐ Offices (___/____)
☐ Other places *(Please, specify)* ..... (___/____)

S_24. Have there ever been visible signs of moisture damage such as damp stains or spots, deterioration or darkening of surface materials in the ceiling, walls, or floors, or signs of condensation of water on surfaces in the school?

☐ No ☐ Yes

Where? *(Please tick any which apply)*

☐ Any classroom
☐ Bathrooms
☐ Gym
☐ Corridors
☐ Kitchen
☐ Canteen
☐ Basement
☐ Offices
☐ Other places *(Please, specify)* ....

S_25. Have you ever seen cockroaches inside the school?

1. Never 2. Rarely 3. Sometimes 4. Often

S_26. Are the teachers allowed to smoke in the school building (including during school-sponsored events)?

1. Yes, without any restrictions
2. Yes, but only in designated spaces
3. No, not at all

S_27. Are there any people who smoke tobacco in the school building?

☐ No ☐ Yes

Where? *(Please tick any which apply)*

☐ Any classroom
☐ Bathrooms
☐ Gym
☐ Corridors
☐ Kitchen
☐ Canteen
☐ Basement
☐ Offices
☐ Other places *(Please, specify)* .....

S_28. Are there materials containing asbestos in the building?

1. Yes, flocculate
2. Yes, but compact
3. Yes, but sealed
4. No

If Yes:

S_29. Is there an asbestos management plan?
☐ No ☐ Yes

S_30. Are there any lead components in the building?
☐ No ☐ Yes

If Yes: What ones?
☐ Lead water pipes
☐ Lead paints
☐ Other (*Please, specify*) .....

S_31. Is the building located in a radon-affected area?
1. Not designated as a radon-affected area
2. Radon area
3. Don`t know

S_32. Does the building contain potential radon bearing construction materials (e.g. gypsum, alum shale, granites or volcanic tuffs)?
☐ No ☐ Yes

S_33. Has there been any reported case of the presence of Legionella in the water supply system in the last 3 years?
☐ No ☐ Yes

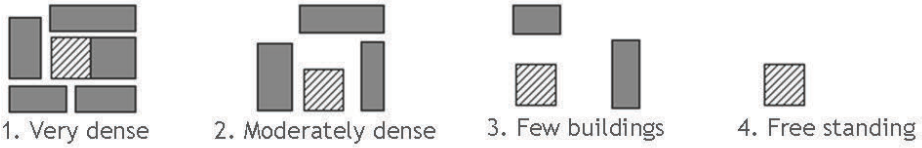
S_34. When generally are the classrooms cleaned?
1. In the morning before the arrival of the pupils/students
2. In the afternoon/evening after school-time
3. Between classes

S_35. How often does a deep clean of the classrooms take place?
1. Once a month or more often
2. Once every three months or more often
3. Once every six months or more often
4. Once every year or more often
5. Less often
6. Never

S_36. Are chemicals used for cleaning floors in the classrooms?
☐ No ☐ Yes

S_37. Are chemicals used for cleaning desks in the classrooms?
☐ No ☐ Yes

S_38. **What is the density of nearby obstructions?**



MARK AN X ON A NUMBER OF THE SCALE FROM 0 TO 6

S_39. **How do you perceive the natural illumination in your school?**
(If the natural illumination is varying, try to give an average rating)

0 1 2 3 4 5 6

Extremely poor — Extremely good

S_40. **How do you perceive the artificial illumination in your school?**
(If the artificial illumination is varying, try to give an average rating)

0 1 2 3 4 5 6

Extremely poor — Extremely good

S_41. **How do you perceive the indoor air quality in your school building?**
(If the air quality is varying, try to give an average rating)

0 1 2 3 4 5 6

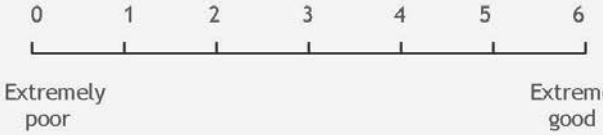
Extremely poor — Extremely good

If you think that indoor air quality is not good, try to explain why:

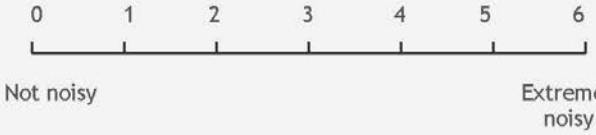
.....

8

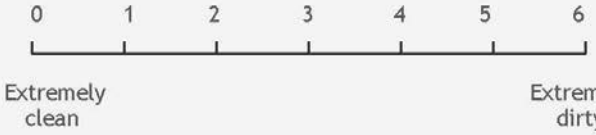
S_42. How do you perceive <u>the outdoor air quality outside your school</u>?
(If the air quality is varying, try to give an average rating)



S_43. How do you perceive <u>the noise level (outdoor source) in the classrooms</u>?
(If the noise level is varying, try to give an average rating)



S_44. How do you perceive <u>the cleanliness of the classrooms in your school</u>?
(If the cleanliness is varying, try to give an average rating)



S_45. How do you perceive <u>the decoration in the classrooms in your school</u>?
(If it is varying, try to give an average rating)

END - THANK YOU FOR YOUR COOPERATION!

5.4 Annex Nr. 4.

INDOOR AIR INDEX - CALCULATION PROCEDURE

Indoor air quality (IAQ) can be characterised by physical parameters (e.g. temperature, relative humidity, air exchange rate), chemical air pollutants (e.g., carbon dioxide, nitrogen dioxide, particulate matter, ozone, benzene, etc.) and biological agents (e.g., pollen, fungi). Due to the complexity of this issue, a simple Indoor Health Index has been developed to disseminate the results of the project among the public and stakeholders and to provide health relevant information about the IAQ.

The calculation of the Indoor Health Index is based different threshold values determined by the health effects of the air pollutants/physical parameters (recommendations of the WHO and/or EC and/or scientific papers).

We applied a five scale categorization of the most important and frequent chemical air pollutants using for the cut off points.

Table: The scale of Indoor Health Index.

category	benzene (µg/m^3)	formaldehyde (µg/m^3)	$PM_{2.5}$ (µg/m^3)
healthy	<1.7	<10	<10
moderate	1.7-4.99	10-19.9	10-24.9
unhealthy	5-7.5	20-50	25-49.9
very unhealthy	7.51-10	51-100	50-75
dangerous	**>10**	**>100**	**>75**

When applying the index in practice we characterize the actual air quality according to the worst category, indicating the pollutant.

The database in which the Indoor Health Index has been calculated is available upon request.

To characterize the thermal comfort, different cut-off points for two physical parameters, temperature and relative humidity, as well as for the concentration of carbon dioxide have been set (Table 2).

Table: Categories based on the measured temperature, relative humidity and carbon dioxide concentration values

Category	RH (%)	T (°C)	CO_2 (ppm)
healthy	43<RH<67	18.5<T<25.5	<1 200
moderate	37<RH<43; 67<RH<73	17.5<T<18.5	1 200-1 800
unhealthy (diskomfort)	RH<37 RH>73	T<17.5 T >25.5	>1 800