

PERFECTION – Performance Indicators for Health, Comfort  
and Safety of the Indoor Environment  
FP7 Grant Number 212998

# *D1.5 A Generic Framework for Key Indoor Performance Indicators*

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## CONTENTS

1.	<i>Introduction</i>	4
2.	<i>Overview and structure of KIPI framework</i>	5
2.1.	T1.3 Health and comfort	7
2.2.	T1.4 Feeling of safety and positive stimulation	8
2.3.	T1.5 Accessibility and Functionality	9
3.	<i>Building information</i>	10
4.	<i>KIPI framework indicators</i>	12
4.1.	Health and comfort KIPIs	12
4.1.1.	Indoor air quality	12
4.1.1.1.	Effective temperature	13
4.1.1.2.	Effective ventilation/ CO2	15
4.1.1.3.	Combustion sources / infiltration	17
4.1.1.4.	Odour acceptance	19
4.1.1.5.	Particulate matter	21
4.1.2.	Water quality	23
4.1.2.1.	Drinking water quality	24
4.1.2.2.	Rain/re-use water quality	26
4.1.3.	Thermal comfort	28
4.1.3.1.	Operative temperature	29
4.1.4.	Visual comfort	31
4.1.4.1.	Illuminance	32
4.1.4.2.	Daylight factor	34
4.1.5.	Acoustic comfort	36
4.1.5.1.	Background noise level	37
4.1.5.2.	Reverberation time	39
4.2.	Feeling of safety and positive stimulation KIPIs	41
4.2.1.	Safety	41
4.2.1.1.	Safety in use	42
4.2.1.2.	Feeling of safety	44
4.2.1.3.	Meeting current regulation	46
4.2.1.4.	Cultural heritage protection	48
4.2.2.	Security	50
4.2.2.1.	Personal and material security	51
4.2.2.2.	Security of information	53
4.2.2.3.	Protection against terrorism	55
4.2.3.	Positive stimulation	57
4.2.3.1.	View to outside	58
4.2.3.2.	Architectural design	60
4.2.3.3.	Visual stimulation	62
4.2.3.4.	Feelings and sensations	64
4.2.3.5.	Quality of support places	66
4.3.	Accessibility and Functionality KIPIs	68
4.3.1.	Usability	68
4.3.1.1.	Access to building	69
4.3.1.2.	Orientation	71
4.3.1.3.	Adjustability	73
4.3.2.	Adaptability	75
4.3.2.1.	Versatility and protection	76

4.3.2.2.	Technical service life	78
4.3.2.3.	Adaptability to climate change	80
4.3.3.	Serviceability	82
4.3.3.1.	Image, branding and cultural heritage	83
4.3.3.2.	Availability of services in the building	85
4.3.3.3.	Cleanliness	87
4.3.3.4.	Maintainability	89
5.	<i>Weights of KIPIs</i>	91
5.1.	Background	91
5.2.	General weights of KIPIs	93
5.3.	Sensitivity analysis	94
6.	<i>Conclusion</i>	95
7.	<i>References</i>	97
<i>D1.5 ANNEX A: ACCESSIBILITY AND FUNCTIONALITY</i>		98
<i>D1.5 ANNEX B: ASSESSMENT METHODS OF HEALTH AND COMFORT KIPIs</i>		98

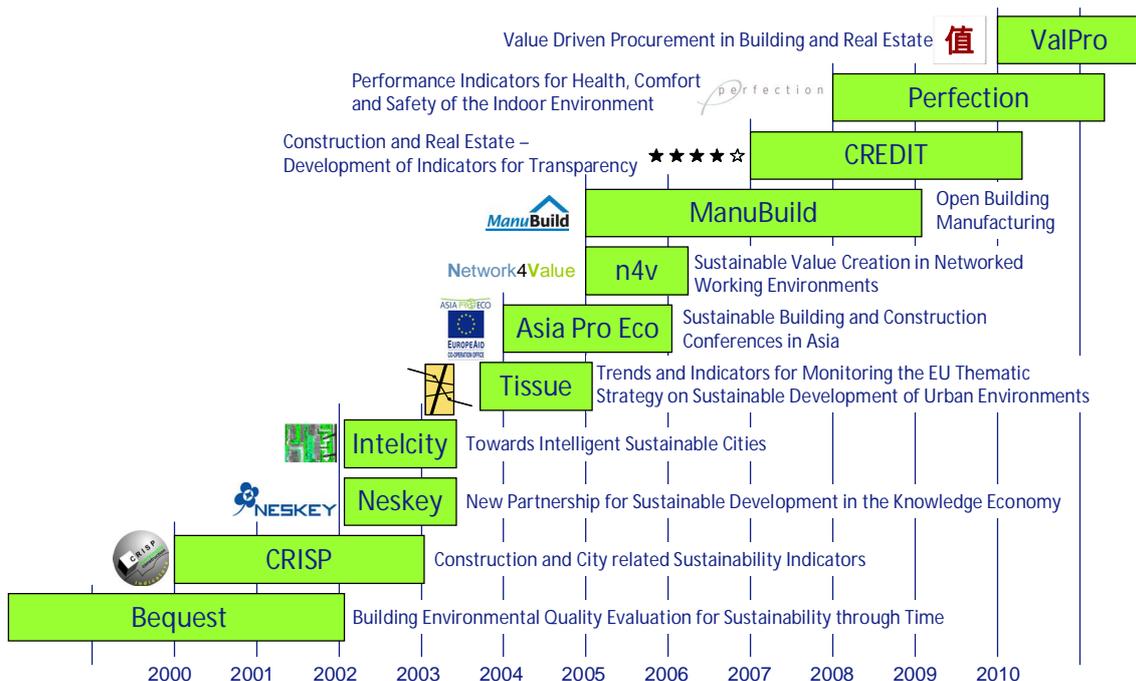
# 1. INTRODUCTION

The objective of PERFECTION Workpackage 1 is to investigate current performance indicators, standards, regulations, guidelines, research activities and policies used in design and construction of the built environment. This report describes a generic framework for Key Indoor Performance Indicator (KIPI) framework as developed in Task 1.5 based on the work done also in other WP1 tasks.

Perfection KIPI framework is used for the assessment of the indoor performance of buildings. Project participants will test the developed framework and proposed indicators in Perfection Case studies addressing multiple building types including offices, schools, housing, hospitals and exhibition buildings. Environmental, social and cultural, and economic impacts of the indicators will also be mapped. The importance of the selected indicators is planned to be assessed as well.

The developed framework is also used in Perfection WP2 where a specific tool for the management of KIPIs is under development. This tool is based on open source solutions in web environment and provides very user friendly access for both end users and members from the industry.

Previous European research projects have served as a baseline of the framework development. Some of those that have increased understanding on indicator frameworks and tools are listed below: CREDIT 2007-09 (Construction and Real Estate - Development of Indicators for Transparency), ManuBuild 2005-09 (Open Building Manufacturing), Value4Network 2005-06 (Sustainable Value Creation in Networked Working Environments), Asia Pro Eco 2004-06 (Sustainable Building and Construction Conferences in Asia), Tissue 2004-05 (Trends and Indicators for Monitoring the EU Thematic Strategy on Sustainable Development of Urban Environments), PeBBu 2002-05 (Performance Based Building), Crisp 2000-03 (Construction and City related Sustainability Indicators), and Bequest 1998-02 (Building Environmental Quality Evaluation for Sustainability through Time).



## 2. OVERVIEW AND STRUCTURE OF KIPI FRAMEWORK

The selected KIPI framework contains indicators under the categories presented in Figure 1:

- Health and comfort
- Feeling of safety and positive stimulation
- Accessibility and functionality

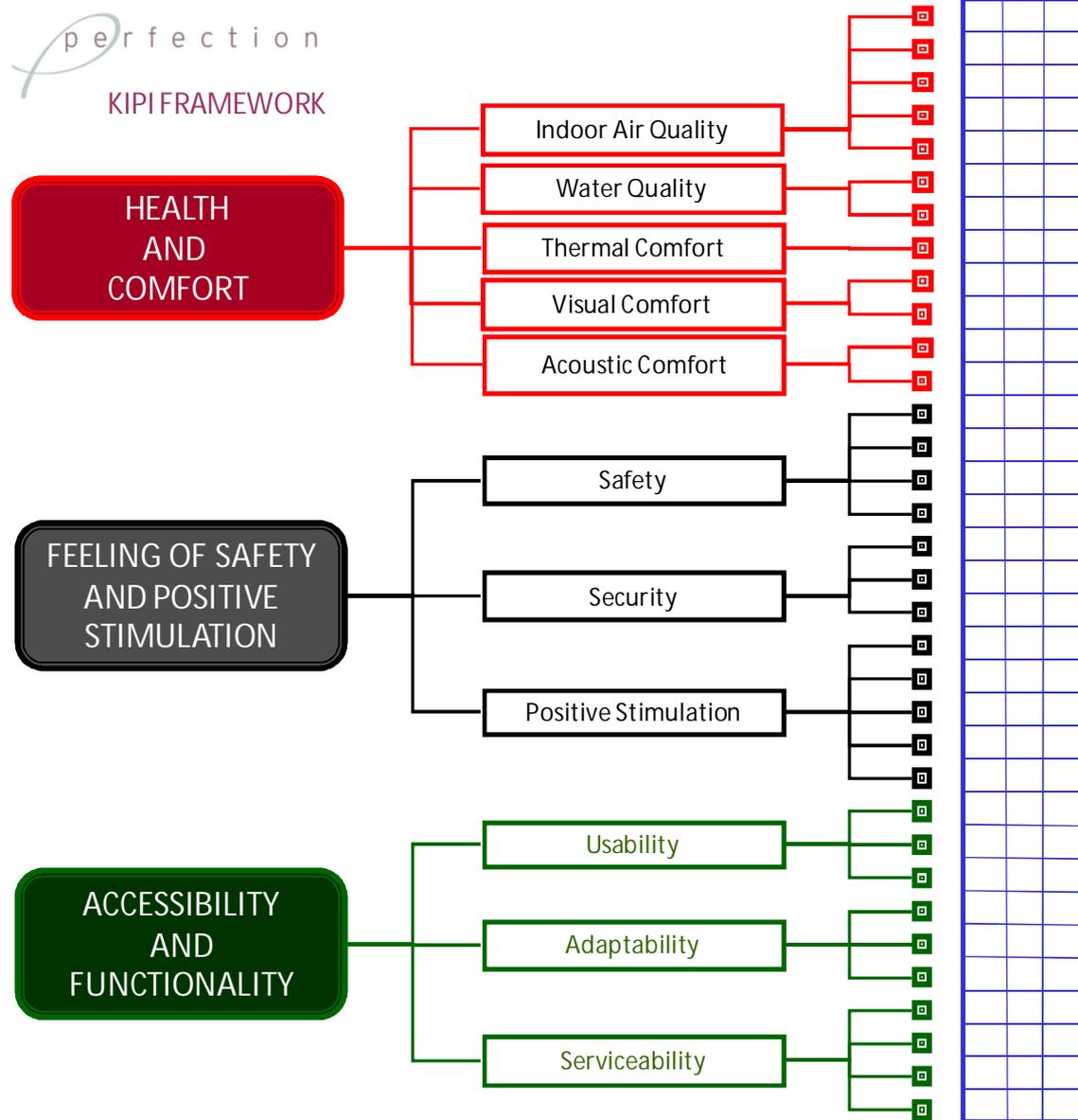


Figure 1: KIPI framework for 34 Key Indoor Performance Indicators.

KIPI framework combines the work undertaken in Tasks 1.3 to T1.5 in PERFECTION. The KIPIs are selected from longer lists of indicators for “Health and comfort” (D1.3), “Safety, security, accessibility and positive stimulation” (D1.4) and other Indoor performance indicators (D1.5 Annex A: “Accessibility and functionality”).

In this framework, overlapping of indicators and categories has been tried to be avoided. The framework contains indicators that may be relevant only in some building types. Perfection KIPIs can be used for setting the objectives, assessing the state and for monitoring the progress of the Indoor performance of facilities of different building types. Annex A of this document (“Accessibility and functionality”) presents a long list of indoor performance indicators not treated in T1.3 and T1.4. They relate to usability, adaptability and serviceability. The assessment methods of Health and Comfort -KIPIs are explained in detail in Annex B.

## 2.1. T1.3 Health and comfort

T1.3 report presents a review of the health and comfort indicators for indoor environment in buildings. Its objective is to provide an overview and a complete list of performance indicators for health and comfort, which can be applicable in a performance indicator framework for the assessment of building performance, see Figure 2.

Task 1.3 provided a review of health and comfort indicators related to acoustic comfort, visual comfort, indoor air quality, water quality, and thermal comfort. The indicators are reviewed focusing on the implementation of an indicator framework for buildings' indoor performance assessment.

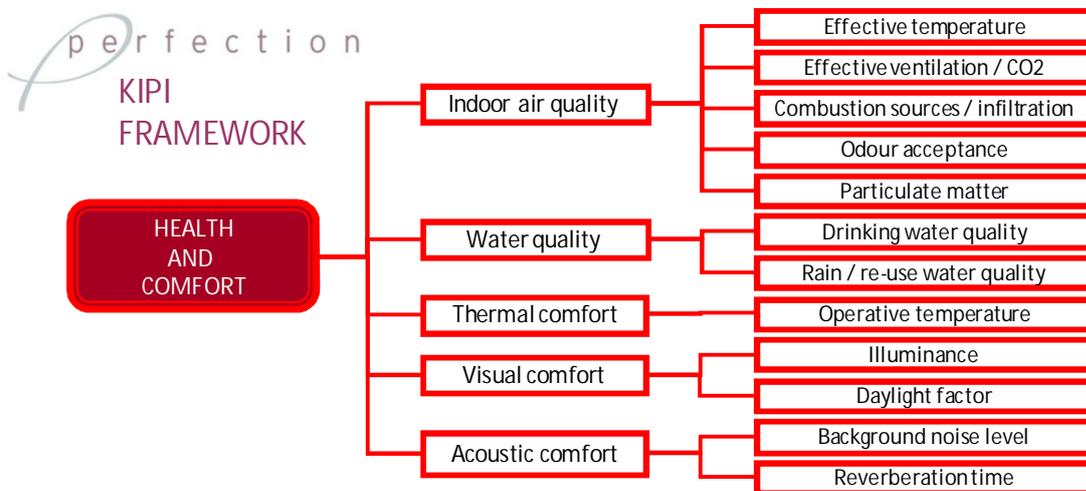


Figure 2: Perfection framework for 12 Health and Comfort indicators.

## 2.2. T1.4 Feeling of safety and positive stimulation

T1.4 report gives a review of the safety, security, accessibility and positive stimulation indicators. The approach adopted in this review is the definition of three levels of indicators: a high (abstract) level of indicator which we will name a core indicator, a set of lower level indicators (performance indicators) which describes the core indicator. Finally, a third level is defined. This lowest level consists of specific indicators and parameters (see Figure 3).

Keeping in mind that this deliverable should be usable for the development of a more general indicator framework, we adopted the same modular approach as the one followed by the authors of the deliverable 1.3 "Performance Indicators for Health and Comfort". This "levelled" and segmented approach of the indicator review will also be useful for the implementation of the framework into a tool which will be released by the work package 2.

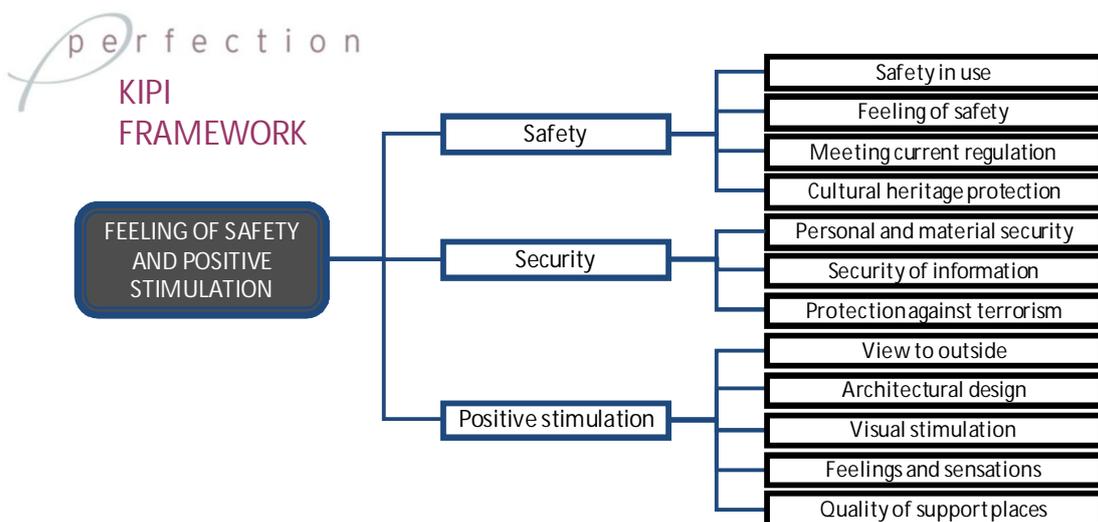


Figure 3: Perfection framework for 12 Feeling of Safety and Positive Stimulation indicators.

### 2.3. T1.5 Accessibility and Functionality

Other important indoor performance indicators, not belonging to T1.3 or T1.4, are considered in the third branch of this framework (“Accessibility and Functionality”). A complete set of such indicators is described in the Annex A of this report. This chapter describes Accessibility and Functionality indicators, partly originating from T1.4, see Figure 4.

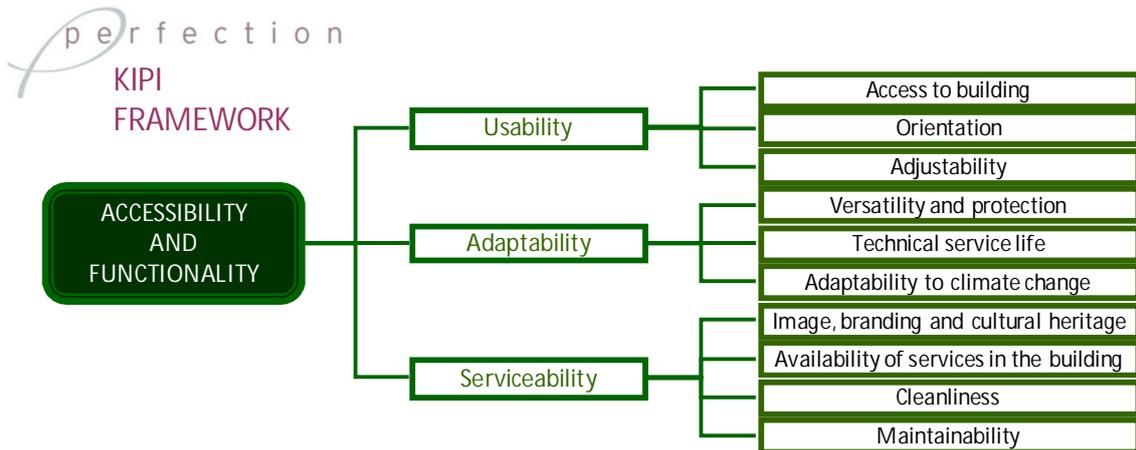


Figure 4: Perfection framework for 10 Accessibility and Functionality indicators.

### 3. BUILDING INFORMATION

When using KIPI framework in practice, general characteristics for the building should be collected. General information for the building under investigation is explained in Table 1.

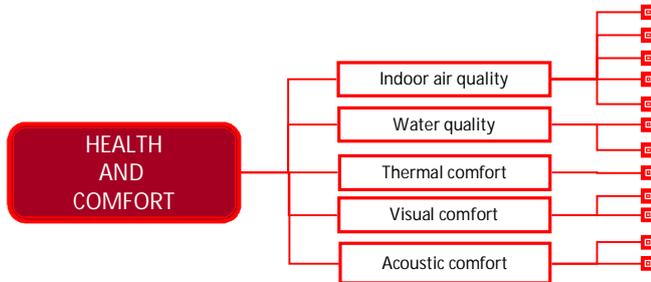
Table 1: General information for the building under investigation (two pages).

		Description	Unit / Hint	Value
<b>GENERAL INFORMATION</b>				PAGE 1/2
<b>Location</b>				
1	Name	Name of the building	<i>[Name used also in KIPI assessment sheet]</i>	Example building
2	Country	Country where facility is located	<i>[Country name]</i>	Finland
3	Address, postal code and city	Postal address to building site	<i>[e.g. road name and number, postal code, city]</i>	
4	Region	Region characteristics from the list	<i>[land scape / village / town / city / city centre]</i>	
5	Location coordinates	Google Earth/maps latitude and longitude values	<i>[e.g. 60°10'57.50"P 24°49'41.23"I]</i>	
<b>Project Participants</b>				
6	Owner	Owner name	<i>[Name and website]</i>	VTT, www.vtt.fi
7	Architect	Architect name	<i>[Name and website]</i>	
8	Main contractor	Main contractor name	<i>[Name and website]</i>	
9	Number of managers	Number of people managing the building	<i>[Number of persons]</i>	
10	Users	Users listed, quantities by personnel and/or floor area	<i>[List of quantities]</i>	
<b>Site</b>				
11	Size of the plot	Total area of the site	<i>[m2]</i>	
12	Building efficiency and density	Proportion of land used for building, calculation from building net floor area / size of the plot	<i>[e.g. 1,5]</i>	
13	Spatial quality of outdoor spaces	Way building is placed and formed in relation to the surrounding buildings, area or landscape and the spatial quality	<i>[excellent / good / satisfactory / unsatisfactory]</i>	
14	Available services in neighborhood	List of available services in the building proximity, select from list	<i>[daycare, post office, bank, health care, dentist, pharmacy, restaurant, cafeteria, fast food, grocery store, special stores, bakery, kiosk, laundry, maintenance services, shoemaker, barber, library, congregation, exercise, recreation, cinema, market, park, walking street]</i>	
<b>Building</b>				
15	Type of project	Select type of project	<i>[existing / extension / new]</i>	existing
16	Type of building	Main function of the building	<i>[office / school / housing / hospital / exhibition]</i>	office
17	Cultural Value	Does the building have a relevant cultural or historical value	<i>[yes / no]</i>	
18	Shape of building	Architectural quality of the building, consideration of the shape and form	<i>[unique / conventional / simple]</i>	
19	Number of storeys	Give number of storeys, average value used when required	<i>[number]</i>	
<b>GENERAL INFORMATION</b>				PAGE 1/2
		Description	Unit / Hint	Value

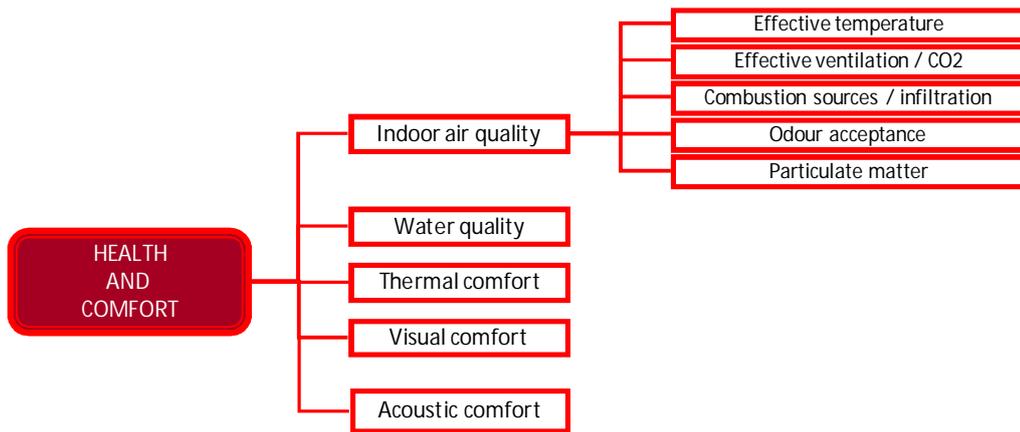
		Description	Unit / Hint	Value
<b>GENERAL INFORMATION</b>				<b>PAGE 2/2</b>
<b>Building</b>				
20	Build-up area	Area of building's footprint	[m2]	
21	Gross floor area	Total floor area of the building on all floors including exterior and interior walls	[m2]	5000
22	Net floor area	Total floor area of the building on all floors excluding exterior and interior walls	[m2]	
23	Building volume	Total volume (area and height) of the building	[m3]	
24	Number of main space groups	Define number main space groups and quantities of individual types in the building	[number]	
25	Main space group quantities	Define names and quantities of main space groups	[type name and gross floor m2]	
26	Water consumption	Annual total consumption of water per person	[l/person/a]	
27	Heating energy consumption	Annual consumption of heating energy per gross area square meter	[kWh/m2/a (gross area)]	
28	Electricity consumption	Annual consumption of electricity per gross area square meter	[kWh/m2/a (gross area)]	
29	Carbon footprint	Carbon footprint calculation has been implemented	[yes / no]	
30	Number of occupiers	Amount of persons that use the building	[Number of persons]	
31	Vacancy rate	Proportion of the vacancy in the building	[% of area]	
32	Construction year	Year when building has been constructed	[year]	1976
33	Renovation year	Year when building has been renovated or parts added to existing building	[year]	
34	Project finished	status whether project is finished or ongoing	[yes / no]	
35	Ventilation system	Write short description	[e.g. Mechanical balanced ventilation + heat recovery, chilled beams in office spaces]	
36	Heating system	Write short description	[e.g. Water convectors, air supply units]	
37	HVAC Monitoring system	Write short description	[e.g. Automated continuous monitoring, direct reporting on energy, costs and operations to owner and manager]	
38	User satisfaction survey	Has user satisfaction survey been made	[yes / no]	
<b>GENERAL INFORMATION</b>				<b>PAGE 2/2</b>
		Description	Unit / Hint	Value

## 4. KIPI FRAMEWORK INDICATORS

### 4.1. Health and comfort KIPIs



#### 4.1.1. Indoor air quality



4.1.1.1. *Effective temperature*

1. Framework position:

Indoor air quality

2. Indicator name:

Effective temperature

3. Indicator unit:

[-]

4. Indicator description:

Temperature [°C] and relative humidity [%RH] are combined into one indicator called effective temperature. The indicator can be assessed with respect to the conditions on the surface of a building component or with respect to the indoor environmental conditions.

5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

Assessment description in design:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

Assessment description in operation:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

Assessment description in design:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

Assessment description in operation:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

9. Example:

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**10. References:**

Information on the specific assessment methods applied to evaluate the indicator is provided in Annex B.  ASHRAE 55-2004R, 2004, <i>Thermal Environmental Conditions for Human Occupancy</i> , American Society of Heating, Refrigerating and Air-Conditioning Engineers, Atlanta, GA.
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**Comments:**

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4.1.1.2. *Effective ventilation/ CO2*

1. Framework position:

Indoor air quality

2. Indicator name:

Effective ventilation – CO2

3. Indicator unit:

ppm

4. Indicator description:

The effective ventilation of a space is characterized by the carbon dioxide concentration in a room. Carbon dioxide is considered as an appropriate air quality measurement not because of its potential to be a contaminant, although it can be, but because of its potential to predict the amount of outdoor air supplied to a space. Natural background levels range from 350 to 500 ppm. ASHRAE suggests that a level of 1000 ppm or 650 ppm above ambient levels would be equivalent to a delivery rate of 10 l/s per person of outside air. This delivery rate would be acceptable for most applications in the institution (ASHRAE 62-2007 2007).

5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

Assessment description in design:

- A: Excellent
- B: Good
- C: Adequate
- D: Poor
- E: Bad
- Not selected.

Assessment description in operation:

- A: Excellent
- B: Good
- C: Adequate
- D: Poor
- E: Bad
- Not selected.

7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

Assessment description in design:

- A: Excellent
- B: Good
- C: Adequate
- D: Poor
- E: Bad
- Not selected.

Assessment description in operation:

- A: Excellent
- B: Good
- C: Adequate
- D: Poor
- E: Bad
- Not selected.

### 9. Example:

### 10. References:

Information on the specific assessment methods applied to evaluate the indicator is provided in Annex B.

ASHRAE 55-2004R, 2004, *Thermal Environmental Conditions for Human Occupancy*, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Atlanta, GA.

Schuh, C.K., 2000, *Performance Indicators for Indoor Air Quality*, Ph.D. thesis, University of Calgary

Finnish Society of Indoor Quality and Climate (FISIAQ) 2008, *Classification of Indoor Environment 2008, Target Values, Design Guidance, and Product Requirements*, Finnish Society of Indoor Quality and Climate (FISIAQ), Helsinki, Finland.

### Comments:

4.1.1.3. *Combustion sources / infiltration*

1. Framework position:

Indoor air quality

2. Indicator name:

Combustion sources/infiltration

3. Indicator unit:

ppm

4. Indicator description:

Carbon monoxide is an appropriate air quality measure because of the significance of the health effects and associated risk and liability of this contaminant. Sources of carbon monoxide are carbon based heat sources. Additionally, if there are other potential sources of carbon monoxide within the buildings, such as smoking areas and heating systems, e.g. gas firing (source of NO<sub>x</sub>, too) or fireplace, a carbon monoxide indicator assists in identifying any IAQ problems in these areas.

5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

Assessment description in design:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

Assessment description in operation:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

Assessment description in design:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

Assessment description in operation:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

9. Example:

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**10. References:**

<p>Information on the specific assessment methods applied to evaluate the indicator is provided in Annex B.</p> <p>ASHRAE 62-2007 2007, <i>Ventilation for Acceptable Indoor Air Quality</i>, American Society of Heating, Refrigerating, and Air-Conditioning Engineers.</p> <p>ASHRAE 2009, <i>Performance Measurement Protocols for Commercial Buildings</i>, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE), U.S. Green Building Council (USGBC), Chartered Institute of Building Services Engineers (CIBSE).</p> <p>EN 13779, 2007, <i>Ventilation for non-residential buildings, Performance requirements for ventilation and room-conditioning systems</i></p>
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**Comments:**

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4.1.1.4. *Odour acceptance*

1. Framework position:

Indoor air quality

2. Indicator name:

Odour acceptance

3. Indicator unit:

[-]

4. Indicator description:

The judgement of odours is a valuable tool for diagnosing potential IAQ problems. Many times, odour is the first indication of an IAQ problem. Odours can not always be assessed by measuring chemicals concentrations.

5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

Assessment description in design:

A: Excellent  
 B: Good  
 C: Adequate  
 D: Poor  
 E: Bad  
 Not selected.

Assessment description in operation:

A: Excellent  
 B: Good  
 C: Adequate  
 D: Poor  
 E: Bad  
 Not selected.

7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

Assessment description in design:

A: Excellent  
 B: Good  
 C: Adequate  
 D: Poor  
 E: Bad  
 Not selected.

Assessment description in operation:

A: Excellent  
 B: Good  
 C: Adequate  
 D: Poor  
 E: Bad  
 Not selected.

9. Example:

## 10. References:

Information on the specific assessment methods applied to evaluate the indicator is provided in Annex B.

The Building Information Foundation (Rakennustieto) 2008, Classification of Indoor Climate, Indoor Environmental target values, design guidelines and requirements for product.

Ministry of the Environment, buildings, indoor climate and ventilation regulations and guidelines 2010, D2 Building Code of Finland.

ECA-IAQ (European Collaborative Action, Urban Air, Indoor Environment and Human Exposure) 2005, Harmonisation of indoor material emissions labelling systems in the EU Inventory of existing schemes, Office for Official Publications of the European Communities, Luxembourg.

## Comments:

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4.1.1.5. *Particulate matter*

1. Framework position:

Indoor air quality

2. Indicator name:

Particulate matter (P<2.5 µm)

3. Indicator unit:

[µg/m<sup>3</sup>]

4. Indicator description:

Particulates are defined as suspended mixtures of solid or liquid particles. They include microbes, asbestos, silica dust, coal dust, bioaerosols, smoke and fumes. The toxicity of particles is related to the size and nature of the particle. Early diagnosis of mould growth could be detected by increasing particulate load (spores).

5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

Assessment description in design:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

Assessment description in operation:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

Assessment description in design:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

Assessment description in operation:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

9. Example:

## 10. References:

Information on the specific assessment methods applied to evaluate the indicator is provided in Annex B.

ASHRAE 62-2007 2007, *Ventilation for Acceptable Indoor Air Quality*, American Society of Heating, Refrigerating, and Air-Conditioning Engineers.

The Building Information Foundation (Rakennustieto) 2008, Classification of Indoor Climate, Indoor Environmental target values, design guidelines and requirements for product.

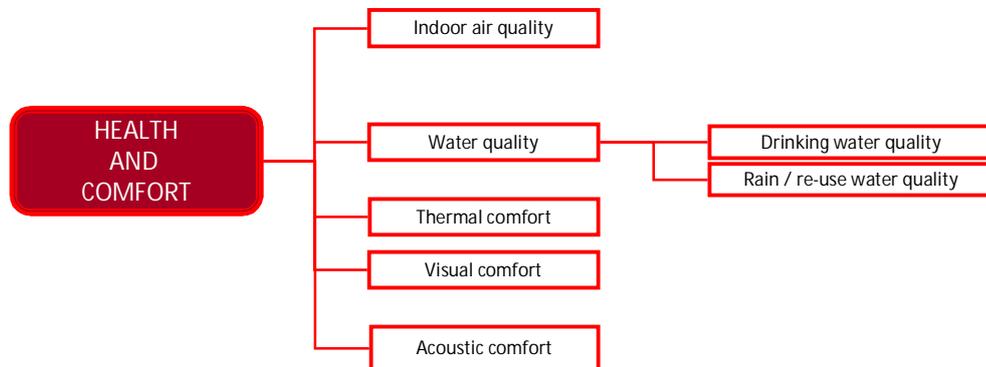
Ministry of the Environment, buildings, indoor climate and ventilation regulations and guidelines 2010, D2 Building Code of Finland.

ECA-IAQ (European Collaborative Action, Urban Air, Indoor Environment and Human Exposure) 2005, Harmonisation of indoor material emissions labelling systems in the EU Inventory of existing schemes, Office for Official Publications of the European Communities, Luxembourg.

## Comments:

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### 4.1.2. Water quality



#### 4.1.2.1. Drinking water quality

##### 1. Framework position:

Water quality
---------------

##### 2. Indicator name:

Drinking water quality
------------------------

##### 3. Indicator unit:

[-]
-----

##### 4. Indicator description:

<p>The quality of drinking water in a building is mainly determined by maintenance protocols, regular cleaning, temperature management and maintenance of a disinfectant residual, which are within the responsibility of the drinking water supplier. However, responsibility for many actions essential to the control of drinking-water quality in buildings is outside the responsibility of the drinking-water supplier. The ingress of microbial contamination, proliferation and dispersal of bacteria growing in and on water contact surfaces (especially legionella) and addition of chemical substances from piping, jointing and plumbing materials (World Health Organization (WHO) 2008) are the principal hazards that may accrue in the drinking-water systems of (large) buildings.</p> <p>The drinking water quality in a building is maintained by the availability and implementation of a water safety plan prescribing preventive measures against these principal hazards.</p>
---

##### 5. Applied in building types: (select)

##### 6. Impacts of indicator: (select)

<input checked="" type="checkbox"/> Offices	<input checked="" type="checkbox"/> Social and cultural impacts
<input checked="" type="checkbox"/> Schools	<input type="checkbox"/> Environmental impacts
<input checked="" type="checkbox"/> Housing	<input type="checkbox"/> Economic impacts
<input checked="" type="checkbox"/> Hospitals	
<input checked="" type="checkbox"/> Exhibition	
<input checked="" type="checkbox"/> Other	

##### 7a. Simple assessment in design:

##### 8a. Simple assessment in operation:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)	<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)	<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list	<input type="checkbox"/> Select from the list

##### Assessment description in design:

##### Assessment description in operation:

<p>A: A water safety plan is available and implemented                  B: -                  C: -                  D: -                  E: A water safety plan is not available and implemented                  Not selected.</p>	<p>A: A water safety plan is available and implemented                  B: -                  C: -                  E: A water safety plan is not available and implemented                  Not selected.</p>
--	--

##### 7b. Detailed assessment in design:

##### 8b. Detailed assessment in operation:

<input checked="" type="checkbox"/> Measurement (quantitative value)	<input checked="" type="checkbox"/> Measurement (quantitative value)
<input type="checkbox"/> Calculated or simulated value	<input type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list	<input type="checkbox"/> Select from the list

##### Assessment description in design:

##### Assessment description in operation:

<p>A: A water safety plan is available and implemented.                  B: -                  C: -                  D: -</p>	<p>A: Good                  B: -                  C: -                  D: -</p>
---	--

E: A water safety plan is not available and implemented Not selected.	E: Bad Not selected.
--	-------------------------

9. Example:

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10. References:

<p>Information on the specific assessment methods applied to evaluate the indicator is provided in Annex B.</p> <p>World Health Organization (WHO), 2008, <i>Guidelines for Drinking-water Quality</i>. World Health Organization, Geneva.</p> <p>World Health Organization (WHO) 2007, <i>Legionella and the prevention of legionellosis</i>. World Health Organization, Geneva.</p>
---

Comments:

<p>Water ideally should be available at any time of the day. However, in certain dry areas of Europe water availability may be sometimes a problem. Providing water in these areas is a major concern for policy makers and authorities. Taken together with climate change, it is even possible that problem may be getting worse over time if no appropriate measures are taken.</p>
--

#### 4.1.2.2. Rain/re-use water quality

##### 1. Framework position:

Water quality
---------------

##### 2. Indicator name:

Rain/re-use water quality
---------------------------

##### 3. Indicator unit:

[-]
-----

##### 4. Indicator description:

The grey water and rain water in a building which is intended to be reused should be hygienically/microbiologically safe, colourless and almost free from suspended matter. Even following several days of storage, no odour emissions from the process water should occur. If the intended use of grey water and rainwater is the non-potable use for toilet flushing and laundry activities, the water quality is characterized the presence (total number) of biological organisms and of the chemical constituents based the guidelines provided by the German Association for Rainwater Harvesting and Water Utilisation (FBR (Fachvereinigung Betriebs- und Regenwassernutzung e.V., Association for Rainwater Harvesting and Water Utilisation) 2005). Rain/re-use water quality is maintained by the availability and implementation of a water safety plan prescribing preventive measures against these principal hazards.
--

##### 5. Applied in building types: (select)

<input checked="" type="checkbox"/> Offices
<input checked="" type="checkbox"/> Schools
<input checked="" type="checkbox"/> Housing
<input checked="" type="checkbox"/> Hospitals
<input checked="" type="checkbox"/> Exhibition
<input checked="" type="checkbox"/> Other

##### 6. Impacts of indicator: (select)

<input checked="" type="checkbox"/> Social and cultural impacts
<input type="checkbox"/> Environmental impacts
<input type="checkbox"/> Economic impacts

##### 7a. Simple assessment in design:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

##### 8a. Simple assessment in operation:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

##### Assessment description in design:

A: A water safety plan is available and implemented B: - C: - D: - E: A water safety plan is not available and implemented Not selected.
---

##### Assessment description in operation:

A: A water safety plan is available and implemented B: - C: - D: - E: A water safety plan is not available and implemented Not selected.
---

##### 7b. Detailed assessment in design:

<input checked="" type="checkbox"/> Measurement (quantitative value)
<input type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list

##### 8b. Detailed assessment in operation:

<input checked="" type="checkbox"/> Measurement (quantitative value)
<input type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list

##### Assessment description in design:

A: A water safety plan is available and implemented B: - C: - D: - E: A water safety plan is not available and implemented
--

##### Assessment description in operation:

A: Good B: - C: - D: - E: Bad
---

Not selected.	Not selected.
---------------	---------------

9. Example:

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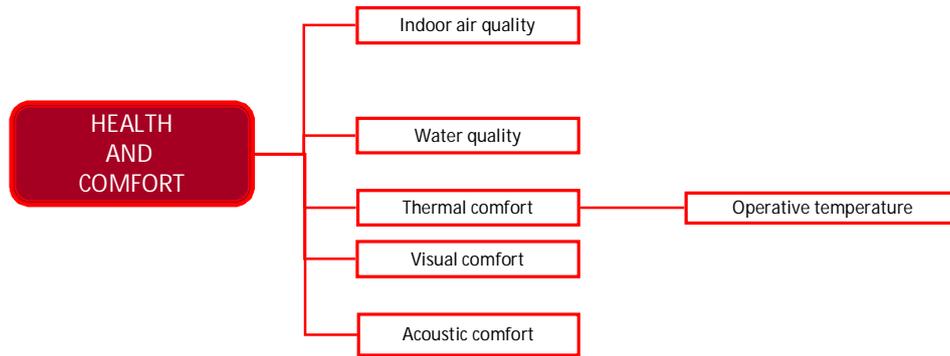
10. References:

<p>Information on the specific assessment methods applied to evaluate the indicator is provided in Annex B.</p> <p>World Health Organization (WHO) 2006, <i>WHO guidelines for the safe use of wastewater, excreta and greywater</i>, World Health Organisation, Geneva.</p> <p>FBR (Fachvereinigung Betriebs- und Regenwassernutzung e.V., Association for Rainwater Harvesting and Water Utilisation) 2005, <i>Greywater recycling: planning fundamentals and operation information</i>, FBR, Darmstadt, Germany.</p> <p>EU-Directive for Bathing Water 1975, <i>Council Directive of 8 December 1975 concerning the Quality of Bathing Water</i>.</p>
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Comments:

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### 4.1.3. Thermal comfort



#### 4.1.3.1. Operative temperature

##### 1. Framework position:

Thermal comfort

##### 2. Indicator name:

Operative temperature/PPD

##### 3. Indicator unit:

[°C]

##### 4. Indicator description:

The operative temperature is defined as the uniform temperature of an imaginary black enclosure in which an occupant would exchange the same amount of heat by radiation and convection as in the actual non-uniform environment. The optimal operative temperature in a room can be expressed as a function of the activity and clothing. For a given space, an optimum operative temperature corresponding to predicted mean vote equal to zero (PMV=0) (ISO 7730-2005 2005). For additional information regarding the optimal operative temperature for the three comfort categories, the reader is referred to ISO 7730-2005 (ISO 7730-2005 2005).

##### 5. Applied in building types: (select)

<input checked="" type="checkbox"/> Offices
<input checked="" type="checkbox"/> Schools
<input checked="" type="checkbox"/> Housing
<input checked="" type="checkbox"/> Hospitals
<input checked="" type="checkbox"/> Exhibition
<input checked="" type="checkbox"/> Other

##### 6. Impacts of indicator: (select)

<input checked="" type="checkbox"/> Social and cultural impacts
<input checked="" type="checkbox"/> Environmental impacts
<input checked="" type="checkbox"/> Economic impacts

##### 7a. Simple assessment in design:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

##### 8a. Simple assessment in operation:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input checked="" type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

##### Assessment description in design:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

##### Assessment description in operation:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

##### 7b. Detailed assessment in design:

<input type="checkbox"/> Measurement (quantitative value)
<input checked="" type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list

##### 8b. Detailed assessment in operation:

<input checked="" type="checkbox"/> Measurement (quantitative value)
<input type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list

##### Assessment description in design:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

##### Assessment description in operation:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

## 9. Example:

## 10. References:

Information on the specific assessment methods applied to evaluate the indicator is provided in Annex B.

Finnish Society of Indoor Quality and Climate (FISIAQ) 2008, *Classification of Indoor Environment 2008, Target Values, Design Guidance, and Product Requirements*, Finnish Society of Indoor Quality and Climate (FISIAQ), Helsinki, Finland.

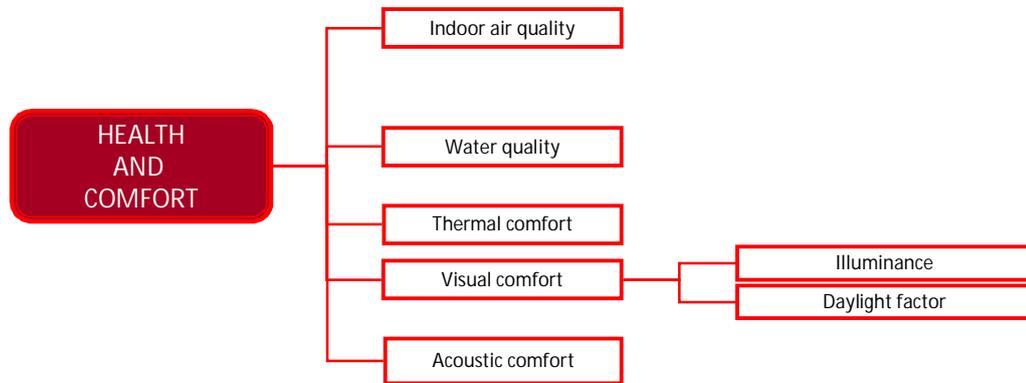
ISO 7730-2005, 2005, *Ergonomics of the thermal environment -- Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria*, International Standards Organization, Geneva.

ASHRAE 55-2004R, 2004, *Thermal Environmental Conditions for Human Occupancy*, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Atlanta, GA.

BS EN 15251-2007 2007, *Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics*.

## Comments:

#### 4.1.4. Visual comfort



#### 4.1.4.1. Illuminance

##### 1. Framework position:

Visual comfort

##### 2. Indicator name:

Illuminance

##### 3. Indicator unit:

[lux]

##### 4. Indicator description:

The main requirement for a satisfactory visual performance is a sufficient illuminance for the specific visual task(s) which is/are carried out in the room. The illuminance of a surface is defined as the luminous flux per unit area at any point on a surface exposed to incident (artificial) light.

##### 5. Applied in building types: (select)

<input checked="" type="checkbox"/> Offices	<input checked="" type="checkbox"/> Social and cultural impacts
<input checked="" type="checkbox"/> Schools	<input checked="" type="checkbox"/> Environmental impacts
<input type="checkbox"/> Housing	<input type="checkbox"/> Economic impacts
<input checked="" type="checkbox"/> Hospitals	
<input checked="" type="checkbox"/> Exhibition	
<input checked="" type="checkbox"/> Other	

##### 6. Impacts of indicator: (select)

##### 7a. Simple assessment in design:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

##### 8a. Simple assessment in operation:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

##### Assessment description in design:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

##### Assessment description in operation:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

##### 7b. Detailed assessment in design:

<input type="checkbox"/> Measurement (quantitative value)
<input checked="" type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list

##### 8b. Detailed assessment in operation:

<input checked="" type="checkbox"/> Measurement (quantitative value)
<input checked="" type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list

##### Assessment description in design:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

##### Assessment description in operation:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

##### 9. Example:

## 10. References:

Information on the specific assessment methods applied to evaluate the indicator is provided in Annex B.

BS EN 12464-1:2003 2003, *Light and lighting — Lighting of work places — Part 1: Indoor work places.*

Commission Internationale de l'Eclairage (CIE), 1983, *Discomfort glare in the interior working environment.* Vienna (Austria).

## Comments:

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4.1.4.2. Daylight factor

1. Framework position:

Visual comfort

2. Indicator name:

Daylight factor

3. Indicator unit:

[%]

4. Indicator description:

The daylight factor is the ratio of the illuminance from the skylight measured on a horizontal surface within the room to the illuminance from a CIE (Commission Internationale de l'Eclairage) overcast sky measured on a horizontal plane which has an unobstructed access to the hemisphere of the sky.

5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

Assessment description in design:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

Assessment description in operation:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

Assessment description in design:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

Assessment description in operation:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

9. Example:

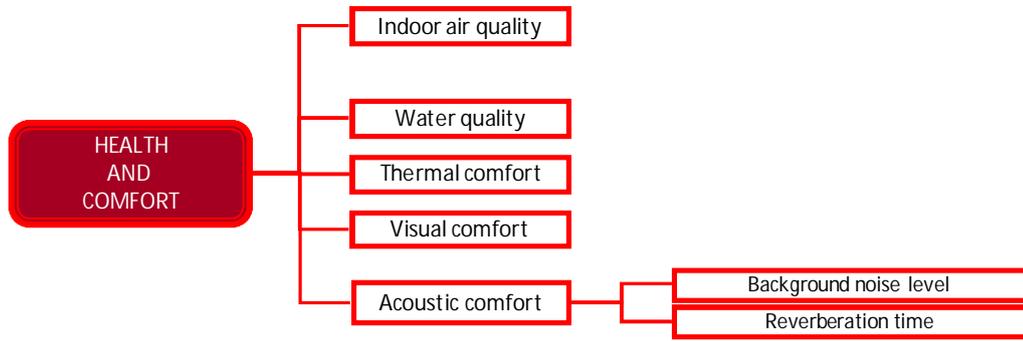
## 10. References:

BS EN 12464-1:2003 2003, Light and lighting — Lighting of work places — Part 1: Indoor work places.  
Commission Internationale de l'Eclairage (CIE), 1983, Discomfort glare in the interior working environment. Vienna (Austria).  
BS EN 15251-2007 2007, Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics.

## Comments:

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#### 4.1.5. Acoustic comfort



4.1.5.1. *Background noise level*

1. Framework position:

Acoustic Comfort

2. Indicator name:

Background noise level (L<sub>A</sub>)

3. Indicator unit:

[dB]

4. Indicator description:

The background noise level represents the average noise level over 30 minutes. The specified levels refer to the highest equivalent continuous A-weighted sound pressure level likely to occur during normal working hours. The levels due to external sources will depend on weather conditions, e.g. wind direction, and local activities. High noise levels due to exceptional events may be disregarded. The indoor ambient noise levels apply to finished but unoccupied and unfurnished spaces.

5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

Assessment description in design:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

Assessment description in operation:

A: Excellent  
B: Good  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

Assessment description in design:

A: Excellent  
B: -  
C: Adequate  
D: Poor  
E: Bad  
Not selected.

Assessment description in operation:

A: Excellent  
B: -  
C: Adequate  
D: -  
E: Bad  
Not selected.

9. Example:

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**10. References:**

<p>ISO 140/IV – 1998, 1998, Acoustics - Measurement of sound insulation in buildings and of building elements - Part IV: Field measurements of airborne sound insulation between rooms, International Standards Organization, Geneva.</p> <p>ISO 717/I – 1996, 1996, Acoustics -- Rating of sound insulation in buildings and of building elements -- Part 1: Airborne sound insulation, International Standards Organization, Geneva.</p> <p>ISO 717/II - 1996 1996, Acoustics -- Rating of sound insulation in buildings and of building elements -- Part 2: Impact sound insulation, International Standards Organization, Geneva</p> <p>Finnish Society of Indoor Quality and Climate (FISIAQ) 2008, Classification of Indoor Environment 2008, Target Values, Design Guidance, and Product Requirements, Finnish Society of Indoor Quality and Climate (FISIAQ), Helsinki, Finland.</p> <p>ISO 3382/1 - 2009, Acoustics - Measurement of room acoustic parameters - Part 1: Performance spaces, International Standards Organization, Geneva.</p> <p>BS EN 15251-2007 2007, Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics.</p>
---

**Comments:**

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4.1.5.2. Reverberation time

1. Framework position:

Acoustic comfort

2. Indicator name:

Reverberation time (T)

3. Indicator unit:

[s]

4. Indicator description:

The reverberation time,  $T$  [s], of a room is defined as the time required for the sound pressure level to decrease by 60 dB, at a rate of decay given by the least-squares regression of the measured decay curve from a level of 5 dB below the initial level to 35 dB below the initial level.

5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

Assessment description in design:

A: Excellent  
 B: Good  
 C: Adequate  
 D: Poor  
 E: Bad  
 Not selected.

Assessment description in operation:

A: Excellent  
 B: Good  
 C: Adequate  
 D: Poor  
 E: Bad  
 Not selected.

7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

Assessment description in design:

A: Excellent  
 B: -  
 C: -  
 D: -  
 E: Bad  
 Not selected.

Assessment description in operation:

A: Excellent  
 B: -  
 C: -  
 D: -  
 E: Bad  
 Not selected.

9. Example:

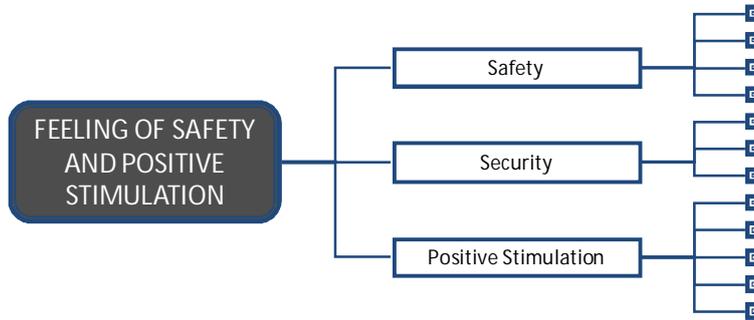
## 10. References:

ISO 3382/II – 2008, 2008, Acoustics - Measurement of the reverberation time of rooms with reference to other acoustical parameters, International Standards Organization, Geneva.  
BS EN 15251-2007 2007, Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics.

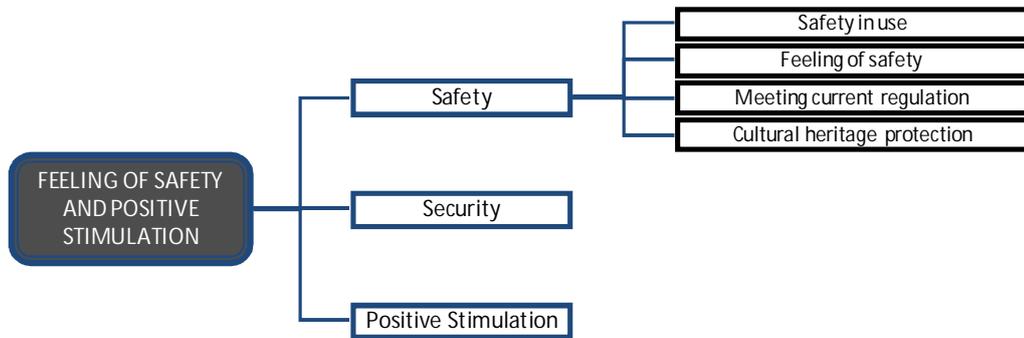
## Comments:

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## 4.2. Feeling of safety and positive stimulation KIPIs



### 4.2.1. Safety



4.2.1.1. *Safety in use*

1. Framework position:

Safety

2. Indicator name:

Safety in use

3. Indicator unit:

Qualitative

4. Indicator description:

This indicator concerns the safety issues linked to 4 categories of risks:

- Glazing
- Slips, trips and falls (STF)
- Collision or entrapment with building features
- Falling objects in and around buildings

This indicator evaluates if the building is safe in regard to these risks.

5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

Assessment description in design:

A: No risk at all for every category  
 B: Existence of a risk at least in one category  
 C: Existence of a risk at least in two categories  
 D: Existence of a risk at least in three categories  
 E: Existence of a risk in four categories  
 Not selected.

Assessment description in operation:

A: No risk at all for every category  
 B: Existence of a risk at least in one category  
 C: Existence of a risk at least in two categories  
 D: Existence of a risk at least in three categories  
 E: Existence of a risk in four categories  
 Not selected.

7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

Assessment description in design:

A: No risk at all for every category  
 B: Existence of a risk at least in one category  
 C: Existence of a risk at least in two categories  
 D: Existence of a risk at least in three categories  
 E: Existence of a risk in four categories  
 Not selected.

Assessment description in operation:

A: No risk at all for every category  
 B: Existence of a risk at least in one category  
 C: Existence of a risk at least in two categories  
 D: Existence of a risk at least in three categories  
 E: Existence of a risk in four categories  
 Not selected.

Detailed assessment consists in the review of "basic design indicators" listed in the Deliverable 1.4. for each risk category.	Detailed assessment consists in the review of "basic design indicators" listed in the Deliverable 1.4. for each risk category.
--	--

9. Example:

--

10. References:

for more details, see deliverable 1.4.
--

Comments:

--

4.2.1.2. *Feeling of safety*

1. Framework position:

Safety

2. Indicator name:

Feeling of safety

3. Indicator unit:

Qualitative

4. Indicator description:

Feeling of safety is the human feeling of safety. In operation phase it is measured by post occupancy evaluation method (POE).

5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

Assessment description in design:

Expert predicted values:  
 A: at least 95 % of users should feel safe  
 B: at least 85% of users should feel safe  
 C: at least 75% of users should feel safe  
 D: at least 60% of users should feel safe  
 E: less than 60% of users will feel safe  
 Not selected.

Assessment description in operation:

A: at least 95 % of users feel safe  
 B: at least 85% of users feel safe  
 C: at least 75% of users feel safe  
 D: at least 60% of users feel safe  
 E: less than 60% of users feel safe  
 Not selected.

7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

Assessment description in design:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

Assessment description in operation:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

9. Example:

10. References:

Comments:

### 4.2.1.3. Meeting current regulation

#### 1. Framework position:

Safety

#### 2. Indicator name:

Meeting current regulation

#### 3. Indicator unit:

Qualitative

#### 4. Indicator description:

This indicator checks if current regulation has been respected in relation to the following six categories:

- Fire safety
- Structural safety
- Electrical safety
- Magnetic fields safety
- Non ionizing electromagnetic fields safety
- Radioactivity safety

Regulation is often dependent on the building type, and this has to be taken into account in the assessment. If there is no regulation available in some category for the building type in question, it is counted in the assessment as if the regulation was respected in that category.

In order to evaluate this indicator properly, use will be made of expert opinions delivered by recognised experts, expert bodies, control agencies or inspection bodies.

#### 5. Applied in building types: (select)

<input checked="" type="checkbox"/> Offices
<input checked="" type="checkbox"/> Schools
<input checked="" type="checkbox"/> Housing
<input checked="" type="checkbox"/> Hospitals
<input checked="" type="checkbox"/> Exhibition
<input checked="" type="checkbox"/> Other

#### 6. Impacts of indicator: (select)

<input type="checkbox"/> Social and cultural impacts
<input checked="" type="checkbox"/> Environmental impacts
<input checked="" type="checkbox"/> Economic impacts

#### 7a. Simple assessment in design:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

#### 8a. Simple assessment in operation:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

#### Assessment description in design:

A: National regulation has been respected in all 6 categories and the regulatory level is clearly exceeded in some category.  
 B: National regulation has been respected in all 6 categories.  
 C: National regulation has been respected in 5 categories.  
 D: National regulation has been respected in 4 categories.  
 E: National regulation has been respected in less than 4 categories.  
 Not selected.

#### Assessment description in operation:

A: National regulation has been respected in all 6 categories and the regulatory level is clearly exceeded in some category.  
 B: National regulation has been respected in all 6 categories.  
 C: National regulation has been respected in 5 categories.  
 D: National regulation has been respected in 4 categories.  
 E: National regulation has been respected in less than 4 categories.  
 Not selected.

#### 7b. Detailed assessment in design:

<input checked="" type="checkbox"/> Measurement (quantitative value)
<input type="checkbox"/> Calculated or simulated value

#### 8b. Detailed assessment in operation:

<input checked="" type="checkbox"/> Measurement (quantitative value)
<input type="checkbox"/> Calculated or simulated value

<input type="checkbox"/> Select from the list	<input type="checkbox"/> Select from the list
---	---

**Assessment description in design:**

**Assessment description in operation:**

<p>A: National regulation has been respected in all 6 categories and the regulatory level is clearly exceeded in some category.</p> <p>B: National regulation has been respected in all 6 categories.</p> <p>C: National regulation has been respected in 5 categories.</p> <p>D: National regulation has been respected in 4 categories.</p> <p>E: National regulation has been respected in less than 4 categories.</p> <p>Not selected.</p>	<p>A: National regulation has been respected in all 6 categories and the regulatory level is clearly exceeded in some category.</p> <p>B: National regulation has been respected in all 6 categories.</p> <p>C: National regulation has been respected in 5 categories.</p> <p>D: National regulation has been respected in 4 categories.</p> <p>E: National regulation has been respected in less than 4 categories.</p> <p>Not selected.</p>
--	--

**9. Example:**

**10. References:**

See deliverable 1.4.

**Comments:**

4.2.1.4. *Cultural heritage protection*

1. Framework position:

Safety

2. Indicator name:

Cultural heritage protection

3. Indicator unit:

Qualitative

4. Indicator description:

Suitability of the indoor environment to host artworks, analyzing physical and chemical parameters (temperature, relative humidity, presence of gases, vibrations) and use of equipments to protect objects from physical, chemical and biological degradation.

5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

Assessment description in design:

A: The designed areas are suitable to host artworks  
 B: -  
 C: Some minor adjustment is needed to improve the suitability for artworks  
 D: -  
 E: A lot of changes are needed in order to create an environment suitable to host artworks  
 Not selected (No artworks expected in the building)

Assessment description in operation:

A: No visible sign of degradation for all cultural heritage objects  
 B: -  
 C: Some objects present a visible indication of degradation  
 D: -  
 E: A lot of objects has visible signs of degradation  
 Not selected (No artworks in the building)

7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

Assessment description in design:

A: Perfect conditions  
 B: Good conditions for a limited number of artwork types  
 C: Equipment needed for some artwork types  
 D: New environmental control systems required  
 E: Unsuitable for artworks  
 Not selected.

Assessment description in operation:

A: Perfect conditions  
 B: Good conditions for a limited number of artwork types  
 C: Equipment needed for some artwork types  
 D: New environmental control systems required  
 E: Unsuitable for artworks  
 Not selected.

9. Example:

A simple assessment permit to identify: warped paintings, cracks on statues, loss of plaster, etc.  
 Paintings have strict requirements in terms of temperature and relative humidity.  
 Stone statues have strict requirements for vibrations.

#### 10. References:

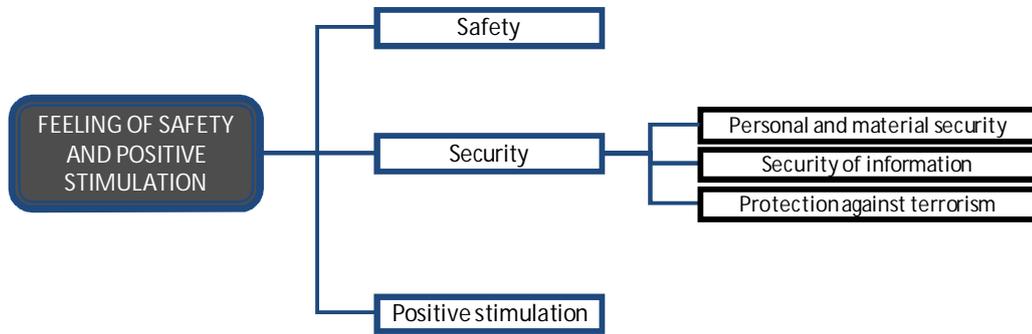
2007 ASHRAE Handbook – HVAC Applications

#### Comments:

A simple assessment could be done through a visual inspection of artworks (hopefully made by an expert) to detect degradation signs as artworks degradation is a visible effect of bad environment conditions. However, when degradation is visible the artwork conservation is already compromised. It could be necessary to proceed with a detailed assessment based on the evaluation of physical, chemical and biological parameters and the adoption of methods and tools to control the indoor environment is recommended.

In the design phase, the assessment is performed by analyzing the areas that will host artworks.

### 4.2.2. Security



4.2.2.1. Personal and material security

1. Framework position:

Security

2. Indicator name:

Personal and material security

3. Indicator unit:

Qualitative

4. Indicator description:

This indicator checks if the adequate protection measure are taken against criminality.

5. Applied in building types: (select)

<input checked="" type="checkbox"/> Offices
<input checked="" type="checkbox"/> Schools
<input checked="" type="checkbox"/> Housing
<input checked="" type="checkbox"/> Hospitals
<input checked="" type="checkbox"/> Exhibition
<input checked="" type="checkbox"/> Other

6. Impacts of indicator: (select)

<input checked="" type="checkbox"/> Social and cultural impacts
<input checked="" type="checkbox"/> Environmental impacts
<input checked="" type="checkbox"/> Economic impacts
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

7a. Simple assessment in design:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

8a. Simple assessment in operation:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

Assessment description in design:

A: Entrance doors and windows are burglar-proof. There are an alarm and a monitoring system linked to a police office or security firm.  
 B: Entrance doors and windows are burglar-proof. Presence of an alarm system.  
 C: Entrance doors and windows are burglar-proof.  
 D: Entrance doors are burglar-proof.  
 E: Nothing done for security.  
 Not selected.

Assessment description in operation:

A: Entrance doors and windows are burglar-proof. There are an alarm and a monitoring system linked to a police office or security firm.  
 B: Entrance doors and windows are burglar-proof. Presence of an alarm system.  
 C: Entrance doors and windows are burglar-proof.  
 D: Entrance doors are burglar-proof.  
 E: Nothing done for security.  
 Not selected.

7b. Detailed assessment in design:

<input checked="" type="checkbox"/> Measurement (quantitative value)
<input type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list

8b. Detailed assessment in operation:

<input checked="" type="checkbox"/> Measurement (quantitative value)
<input type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list

Assessment description in design:

A: a risk analysis has been realised and the security measures taken are higher than what is required by the risk analysis.  
 B: a risk analysis has been realised and the security measures taken are adequate for the estimated risk  
 C: a risk analysis has been realised and some security measures are taken  
 D: some security measures taken  
 E: no security risk report or measures taken

Assessment description in operation:

A: a risk analysis has been realised and the security measures taken are higher than what is required by the risk analysis.  
 B: a risk analysis has been realised and the security measures taken are adequate for the estimated risk  
 C: a risk analysis has been realised and some security measures are taken  
 D: some security measures taken  
 E: no security risk report or measures taken

Not selected.	Not selected.
---------------	---------------

9. Example:

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10. References:

<p>CEN TS 14383-3: Prevention of crime - Urban planning and building design - Part 3 : Dwellings.          CEN TS 14383-4: Prevention of crime - Urban planning and building design - Part 4 : Shops and offices</p>
--

Comments:

<p>NOTE:          Concerning the detailed assessment method, in a quick evaluation the expert only has to check if measures and/or risk analysis has been done, in accord which what is described in the A to E levels.          In the detailed thorough assessment for dwellings, offices and shops, the assessment should be done following the CEN TS 14383: Prevention of crime - Urban planning and building design - part 3 and part 4. For the other kind of buildings, this has to be realised by an expert (risk analysis and measures to take).</p>
--

#### 4.2.2.2. Security of information

##### 1. Framework position:

Security
----------

##### 2. Indicator name:

Security of information
-------------------------

##### 3. Indicator unit:

Qualitative
-------------

##### 4. Indicator description:

The indicator aims at evaluating the security of information, by analyzing the compliance with international standards related to the management of sensible data. A particular reference is given to the ISO 27000 standard family, which is related to requirements and code of practice for information security management and could be applied to all systems dedicated to data management and information sharing.
--

##### 5. Applied in building types: (select)

- |   |
|---|
| <input checked="" type="checkbox"/> Offices   |
| <input checked="" type="checkbox"/> Schools   |
| <input type="checkbox"/> Housing              |
| <input checked="" type="checkbox"/> Hospitals |
| <input type="checkbox"/> Exhibition           |
| <input type="checkbox"/> Other                |

##### 6. Impacts of indicator: (select)

- |   |
|---|
| <input checked="" type="checkbox"/> Social and cultural impacts |
| <input type="checkbox"/> Environmental impacts                  |
| <input checked="" type="checkbox"/> Economic impacts            |
|   |
|   |
|   |

##### 7a. Simple assessment in design:

- |   |
|---|
| <input checked="" type="checkbox"/> Expert review (subjective specialist judgement)               |
| <input type="checkbox"/> Survey (asked from e.g. user such as POE)                                |
| <input checked="" type="checkbox"/> Select from the list (List of controls provided in ISO 27002) |

##### 8a. Simple assessment in operation:

- |   |
|---|
| <input checked="" type="checkbox"/> Expert review (subjective specialist judgement)               |
| <input type="checkbox"/> Survey (asked from e.g. user such as POE)                                |
| <input checked="" type="checkbox"/> Select from the list (List of controls provided in ISO 27002) |

##### Assessment description in design:

A: All security controls are effectively designed B: at least 80% of security controls are effectively designed C: at least 60% of security controls are effectively designed D: at least 40% of security controls are effectively designed E: at least 20% of security controls are effectively designed Not selected.
--

##### Assessment description in operation:

A: All security controls are effectively implemented B: at least 80% of security controls are effectively implemented C: at least 60% of security controls are effectively implemented D: at least 40% of security controls are effectively implemented E: at least 20% of security controls are effectively implemented Not selected.
---

##### 7b. Detailed assessment in design:

- |   |
|---|
| <input type="checkbox"/> Measurement (quantitative value) |
| <input type="checkbox"/> Calculated or simulated value    |
| <input type="checkbox"/> Select from the list             |

##### 8b. Detailed assessment in operation:

- |   |
|---|
| <input type="checkbox"/> Measurement (quantitative value) |
| <input type="checkbox"/> Calculated or simulated value    |
| <input type="checkbox"/> Select from the list             |

##### Assessment description in design:

A: B: C: D: E:
----------------------------

##### Assessment description in operation:

A: B: C: D: E:
----------------------------

Not selected.	Not selected.
---------------	---------------

**9. Example:**

Use and maintenance of strong authentication methods (password, cryptographic key)  
 Definition of user behaviour to guarantee security of information  
 Effective implementation of backup and restore of critical data

**10. References:**

ISO/IEC 27001: Information technology – Security techniques – Information security management systems – Requirements  
 ISO/IEC 27002: Information technology – Security techniques – Code of practice for information security management

**Comments:**

During the design phase, the assessment of this indicator could be done through an expert review that evaluates if designers have identified solutions to apply the security controls identified in the standard.  
 During the assessment in operation the expert review aims at verifying whether the security controls are effectively implemented or not.

4.2.2.3. Protection against terrorism

1. Framework position:

Security
----------

2. Indicator name:

Protection against terrorism
------------------------------

3. Indicator unit:

Qualitative
-------------

4. Indicator description:

The acts of terrorism may destroy the building structure and components and are a vital security risk for building's users. Terrorism may change building's technical service life but buildings can be protected to some extent against e.g. explosions. This indicator evaluates the measures taken against such a risk.
--

5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

Assessment description in design:

A: Both building and its users are protected against terrorism according to a risk assessment plan. B: Considerable measures (monitoring, training) are taken to improve protection against terrorism from the building and its users' point of view. C: Some measures are taken (surveillance, evacuation, stability) to improve protection against terrorism. D: Protection against terrorism exceeds the regulatory level. E: Neither building nor its users are protected against terrorism. Not selected.
---

Assessment description in operation:

A: Both building and its users are protected against terrorism according to a risk assessment plan. B: Considerable measures (monitoring, training) are taken to improve protection against terrorism from the building and its users' point of view. C: Some measures are taken (surveillance, evacuation, stability) to improve protection against terrorism. D: Protection against terrorism exceeds the regulatory level. E: Neither building nor its users are protected against terrorism. Not selected.
---

7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

Assessment description in design:

A: B: C: D: E:
----------------------------

Assessment description in operation:

A: B: C: D: E:
----------------------------

Not selected.	Not selected.
---------------	---------------

9. Example:

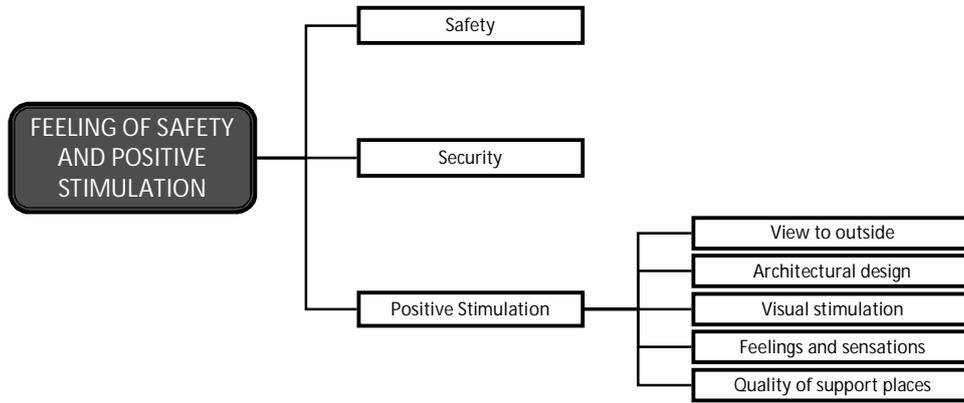
If the risk of terrorism is considered not at all relevant in the region, this indicator does not need to be selected.

10. References:

Comments:

Protection of building concerns mainly the building structure.

### 4.2.3. Positive stimulation



4.2.3.1. *View to outside*

1. Framework position:

Positive stimulation

2. Indicator name:

View to outside

3. Indicator unit:

Qualitative

4. Indicator description:

The aim is to evaluate the average view to the outside from the perspective of a number of focal spaces in the building. This indicator addresses especially views to nature and the built environment that are supposed to have a positive influence on people. The view should be pleasant and “alive”, i.e. for instance with the change of the seasons or the movement of people.

5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

Assessment description in design:

A: Pleasant view to nature (e.g. trees, animals, shoreline).  
 B: Pleasant view (e.g. park, city, buildings).  
 C: No stimulating view.  
 D: Restricted view.  
 E: No view.  
 Not selected.

Assessment description in operation:

A: Pleasant view to nature (e.g. trees, animals, shoreline).  
 B: Pleasant view (e.g. park, city, buildings).  
 C: No stimulating view.  
 D: Restricted view.  
 E: No view.  
 Not selected.

7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

Assessment description in design:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

Assessment description in operation:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

9. Example:

In housing for elderly people the focal space groups may be living room and dining room.  
In hospitals the relaxing outside view has positive impact on average hospitalisation time (time spent for treatments).

10. References:

Comments:

#### 4.2.3.2. Architectural design

##### 1. Framework position:

Positive stimulation

##### 2. Indicator name:

Architectural design

##### 3. Indicator unit:

Qualitative

##### 4. Indicator description:

This indicator describes the aesthetic quality of the building with help of the following criteria:

- The integration and harmony of the building with the surroundings
- The impact of the new building or renovation of an existing building on the cultural value of a site, neighbourhood, local heritage and built environment
- The design qualities of the indoor environment and furniture

Assessment is based on the judgement of space solutions, spatial relations and forms, and quality impression of fittings and surfaces.

##### 5. Applied in building types: (select)

##### 6. Impacts of indicator: (select)

<input checked="" type="checkbox"/> Offices	<input checked="" type="checkbox"/> Social and cultural impacts
<input checked="" type="checkbox"/> Schools	<input type="checkbox"/> Environmental impacts
<input checked="" type="checkbox"/> Housing	<input type="checkbox"/> Economic impacts
<input checked="" type="checkbox"/> Hospitals	
<input checked="" type="checkbox"/> Exhibition	
<input checked="" type="checkbox"/> Other	

##### 7a. Simple assessment in design:

##### 8a. Simple assessment in operation:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)	<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)	<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list	<input type="checkbox"/> Select from the list

##### Assessment description in design:

##### Assessment description in operation:

A: Iconic. B: Unique. C: Conventional. D: Simple. E: Satisfactory. Not selected.	A: Iconic. B: Unique. C: Conventional. D: Simple. E: Satisfactory. Not selected.
---	---

##### 7b. Detailed assessment in design:

##### 8b. Detailed assessment in operation:

<input type="checkbox"/> Measurement (quantitative value)	<input type="checkbox"/> Measurement (quantitative value)
<input type="checkbox"/> Calculated or simulated value	<input type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list	<input type="checkbox"/> Select from the list

##### Assessment description in design:

##### Assessment description in operation:

A: B: C: D: E: Not selected.	A: B: C: D: E: Not selected.
---	---

### 9. Example:

In order to give the judgement “iconic” or “unique” the building needs to differ positively from other buildings. An example from an iconic building is a palace from 16<sup>th</sup> century and Calatrava or Gehry from 21<sup>st</sup> century.

### 10. References:

Samples from architect Santiago Calatrava <http://www.calatrava.com/>  
Samples from architect Frank Gehry <http://www.gehrytechnologies.com/>  
ISO/AWI 21929, 2010. Sustainability in building construction – Sustainability indicators - Part 1 - Framework for the development of indicators for buildings and core indicators – Draft version of 4 February 2010

### Comments:

4.2.3.3. *Visual stimulation*

1. Framework position:

Positive stimulation

2. Indicator name:

Visual stimulation

3. Indicator unit:

Qualitative

4. Indicator description:

This indicator gives information about visual positive stimulation means applied in the indoor environment.

5. Applied in building types: (select)

<input checked="" type="checkbox"/> Offices
<input checked="" type="checkbox"/> Schools
<input checked="" type="checkbox"/> Housing
<input checked="" type="checkbox"/> Hospitals
<input checked="" type="checkbox"/> Exhibition
<input checked="" type="checkbox"/> Other

6. Impacts of indicator: (select)

<input checked="" type="checkbox"/> Social and cultural impacts
<input type="checkbox"/> Environmental impacts
<input type="checkbox"/> Economic impacts

7a. Simple assessment in design:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

8a. Simple assessment in operation:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

Assessment description in design:

A: Presence of at least four element of visual positive stimulation  
 B: Presence of at least three element of visual positive stimulation  
 C: Presence of at least two element of visual positive stimulation  
 D: Presence of at least one element of visual positive stimulation  
 E: No attempts to use positive stimulation.  
 Not selected.

Assessment description in operation:

A: Presence of at least four element of visual positive stimulation  
 B: Presence of at least three element of visual positive stimulation  
 C: Presence of at least two element of visual positive stimulation  
 D: Presence of at least one element of visual positive stimulation  
 E: No attempts to use positive stimulation.  
 Not selected.

7b. Detailed assessment in design:

<input type="checkbox"/> Measurement (quantitative value)
<input type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list

8b. Detailed assessment in operation:

<input type="checkbox"/> Measurement (quantitative value)
<input type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list

Assessment description in design:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

Assessment description in operation:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

9. Example:

--

**10. References:**

Visual stimulation features are described in the deliverable 1.4.
---

**Comments:**

<p>A short (non exhaustive) list of visual positive stimulation means is given here:</p> <ul style="list-style-type: none"> <li>• Circadian lighting</li> <li>• View to nature</li> <li>• Use of natural elements (plants) indoor</li> <li>• Special stress reduction colour schemes</li> <li>• Use of special lamps to improve the attractiveness of products</li> <li>• Use of fractal artwork</li> <li>• Use of visual appeal in shops</li> <li>• Existence of visual privacy</li> <li>• Clear visual signal for wayfinding (e.g. one colour per service and/or level)</li> </ul>
--

#### 4.2.3.4. Feelings and sensations

##### 1. Framework position:

Positive stimulation

##### 2. Indicator name:

Feelings and sensations

##### 3. Indicator unit:

Qualitative

##### 4. Indicator description:

This indicator gives information about positive stimulation linked to feelings and sensations, concerning e.g. stress reducing aspects and hearing and smelling senses.

##### 5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

##### 6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

##### 7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

##### 8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

##### Assessment description in design:

A: Presence of at least four elements of "feelings and sensations"  
 B: Presence of at least three elements of "feelings and sensations"  
 C: Presence of at least two elements of "feelings and sensations"  
 D: Presence of at least one element of "feelings and sensations"  
 E: No attempts to use element linked to "feelings and sensations"

##### Assessment description in operation:

A: Presence of at least four elements of "feelings and sensations"  
 B: Presence of at least three elements of "feelings and sensations"  
 C: Presence of at least two elements of "feelings and sensations"  
 D: Presence of at least one element of "feelings and sensations"  
 E: No attempts to use element linked to "feelings and sensations"

##### 7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

##### 8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

##### Assessment description in design:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected..

##### Assessment description in operation:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

### 9. Example:

### 10. References:

"Feelings and sensation" features are described in the deliverable 1.4.

### Comments:

A short list (non exhaustive) of some topics of "feeling and sensation" is given here:

- Release of fragrances
- Voice privacy
- Suppression of noise
- Presence of adapted music
- Stimulation to have a physical activity
- Presence of pets
- Social enhancement provision (family room, measures taken to improve social contacts, etc...)
- Spatial design to improve sales
- Etc...

#### 4.2.3.5. Quality of support places

##### 1. Framework position:

Positive stimulation

##### 2. Indicator name:

Quality of support spaces

##### 3. Indicator unit:

Qualitative

##### 4. Indicator description:

The purpose of this indicator is to evaluate the spaces supporting the core functions of the building. Besides the essential spaces a building needs, a building may offer other functions which enlarge its value to users. Examples can be found in offices in which sport facilities are available or in dwellings where you have a music making room or library. These support spaces offer comfort to the user, but have of course an economical and environmental cost.

##### 5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

##### 6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

##### 7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

##### 8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

##### Assessment description in design:

A: Supports strategic targets of space use.  
 B: Available and fits to use.  
 C: Some existing.  
 D: Not enough or applicable.  
 E: Not available.  
 Not selected.

##### Assessment description in operation:

A: Supports strategic targets of space use.  
 B: Available and fits to use.  
 C: Some existing.  
 D: Not enough or applicable.  
 E: Not available.  
 Not selected.

##### 7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

##### 8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

##### Assessment description in design:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

##### Assessment description in operation:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

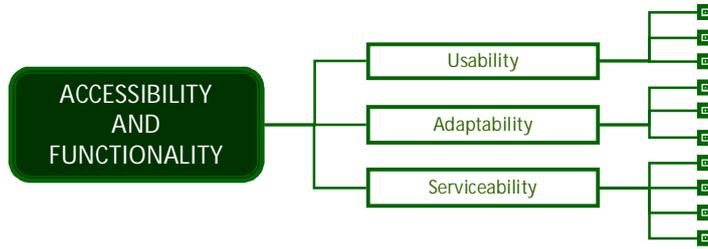
##### 9. Example:

In offices supporting spaces are rooms for social interactions such as breaks that have positive influence also to work efficiency and innovation. In housing supporting space instead mean places for storage, household and utilities. However, in hospitals support means social interaction between patient and staff or family and visitors.

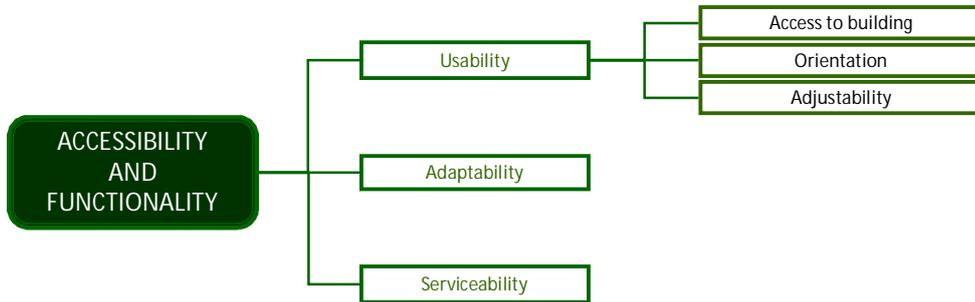
10. References:

Comments:

### 4.3. Accessibility and Functionality KIPIs



#### 4.3.1. Usability



#### 4.3.1.1. Access to building

##### 1. Framework position:

Usability

##### 2. Indicator name:

Access to building

##### 3. Indicator unit:

Qualitative

##### 4. Indicator description:

This indicator deals with the accessibility to the building and in the building. Only the immediate environment of the building, i.e. the environment surrounding the building and on the same building lot, is covered by this indicator. The public space such as roads and public infrastructure are not dealt within the scope of this project. Accessibility can be improved by interventions at the design phase and can be measured in the operation phase (hopefully with the aim to increase access afterwards). The overall aim should be to reach a design or building accessible to all, i.e. designed and built according to the rules of universal design. In order to get there, regulations valid at the place of use and standards should be applied as a reference. In most parts of Europe, the regulations define a minimum level and the standards offer a better quality. In some parts of Europe, recommendations or guidelines may offer directions to go even further in the direction of universal design.

##### 5. Applied in building types: (select)

<input checked="" type="checkbox"/> Offices
<input checked="" type="checkbox"/> Schools
<input checked="" type="checkbox"/> Housing
<input checked="" type="checkbox"/> Hospitals
<input checked="" type="checkbox"/> Exhibition
<input checked="" type="checkbox"/> Other

##### 6. Impacts of indicator: (select)

<input checked="" type="checkbox"/> Social and cultural impacts
<input type="checkbox"/> Environmental impacts
<input type="checkbox"/> Economic impacts

##### 7a. Simple assessment in design:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

##### 8a. Simple assessment in operation:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

##### Assessment description in design:

A: Fully accessible without help (building and services) – respects national guidelines  
 B: Respects national standards valid at the place of use  
 C: Respects national regulations with regard to accessibility  
 D: Respects national regulation, but in reality only accessible to a limited group of users  
 E: Major shortcomings with regard to accessibility  
 Not selected.

##### Assessment description in operation:

A: Fully accessible without help (building and services) – respects national guidelines  
 B: Respects national standards valid at the place of use  
 C: Respects national regulations with regard to accessibility  
 D: Respects national regulation, but in reality only accessible to a limited group of users  
 E: Major shortcomings with regard to accessibility  
 Not selected.

##### 7b. Detailed assessment in design:

<input checked="" type="checkbox"/> Measurement (quantitative value)
<input type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list

##### 8b. Detailed assessment in operation:

<input checked="" type="checkbox"/> Measurement (quantitative value)
<input type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list

##### Assessment description in design:

##### Assessment description in operation:

<p>A: Fully accessible without help (building and services) – respects national guidelines</p> <p>B: Respects national standards valid at the place of use</p> <p>C: Respects national regulations with regard to accessibility</p> <p>D: Respects national regulation, but in reality only accessible to a limited group of users</p> <p>E: Major shortcomings with regard to accessibility</p> <p>Not selected.</p>	<p>A: Fully accessible without help (building and services) – respects national guidelines</p> <p>B: Respects national standards valid at the place of use</p> <p>C: Respects national regulations with regard to accessibility</p> <p>D: Respects national regulation, but in reality only accessible to a limited group of users</p> <p>E: Major shortcomings with regard to accessibility</p> <p>Not selected..</p>
---	--

9. Example:

10. References:

Part M of the Building Regulations.  
 CWATUP Walloon Region, Brussels Capital Region Legislation on Urban Development and Accessibility, Flemish Decree on Accessibility (2009)  
 BS8300:2009 and many other national standards, such as NEN 1814, ...

Comments:

The assessment should be done following the criterion defined in D1.4. In the simple assessment method, only a short expert advice should be enough to qualify the accessibility. For the detailed assessment method, the assessor should measure the building element by evaluating (in accord the rules defined in D1.4 or in BS8300) the accessibility of the following elements:

- Approach to the building
- Entrance to the building
- Movement inside the building
- Facilities in the building
- Communication in the building.

#### 4.3.1.2. Orientation

##### 1. Framework position:

Usability
-----------

##### 2. Indicator name:

Orientation
-------------

##### 3. Indicator unit:

Qualitative
-------------

##### 4. Indicator description:

Evaluation of building use without unnecessary assistance. Consider suitability of layouts in entrances, the use of colours and contrasts, the presence of signage and way finding utilities in the building and certainly in the main lobby, the main corridors and on elevations and stairs. The needs of disabled, visually impaired, mentally impaired, ageing people and children should be considered in any case.
--

##### 5. Applied in building types: (select)

<input checked="" type="checkbox"/> Offices
<input checked="" type="checkbox"/> Schools
<input checked="" type="checkbox"/> Housing
<input checked="" type="checkbox"/> Hospitals
<input checked="" type="checkbox"/> Exhibition
<input checked="" type="checkbox"/> Other

##### 6. Impacts of indicator: (select)

<input checked="" type="checkbox"/> Social and cultural impacts
<input type="checkbox"/> Environmental impacts
<input checked="" type="checkbox"/> Economic impacts

##### 7a. Simple assessment in design:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

##### 8a. Simple assessment in operation:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

##### Assessment description in design:

A: Building has excellent orientation. Lighting and contrasts help disabled and impaired people to navigate. B: Building has good orientation. C: Assistance is required but help is available. D: Assistance is required. E: Building is not easy to navigate. Not selected.
--

##### Assessment description in operation:

A: Building has excellent orientation. Lighting and contrasts help disabled and impaired people to navigate. B: Building has good orientation. C: Assistance is required but help is available. D: Assistance is required. E: Building is not easy to navigate. Not selected.
--

##### 7b. Detailed assessment in design:

<input type="checkbox"/> Measurement (quantitative value)
<input type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list

##### 8b. Detailed assessment in operation:

<input type="checkbox"/> Measurement (quantitative value)
<input type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list

##### Assessment description in design:

A: B: C: D: E: Not selected.
---

##### Assessment description in operation:

A: B: C: D: E: Not selected.
---

##### 9. Example:

Easiness of orientation is important in buildings not visited daily by the users, e.g. in hospitals. Better orientation decreases the need for assistance, especially with disabled and impaired people.

10. References:

ASTM 2009, Standards for whole building – functionality and serviceability

Comments:

### 4.3.1.3. Adjustability

#### 1. Framework position:

Usability

#### 2. Indicator name:

Adjustability

#### 3. Indicator unit:

Qualitative

#### 4. Indicator description:

Evaluation of easiness to use and control indoor conditions (temperature, humidity, air-conditioning, lighting and natural light).

#### 5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

#### 6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

#### 7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

#### 8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

#### Assessment description in design:

A: Conditions are adjustable and controls are user-friendly.  
 B: Most of conditions are adjustable.  
 C: Main conditions are adjustable.  
 D: Few conditions adjustable.  
 E: User is not able to adjust conditions.  
 Not selected.

#### Assessment description in operation:

A: Conditions are adjustable and controls are user-friendly.  
 B: Most of conditions are adjustable.  
 C: Main conditions are adjustable.  
 D: Few conditions adjustable.  
 E: User is not able to adjust conditions.  
 Not selected.

#### 7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

#### 8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

#### Assessment description in design:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

#### Assessment description in operation:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

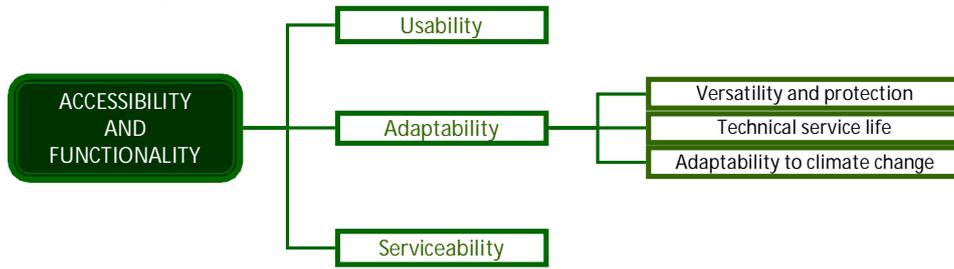
#### 9. Example:

Adjustability increases often personal satisfaction to spaces and e.g. increases productivity in offices. These conditions often require building automation systems (BAS).

10. References:

Comments:

### 4.3.2. Adaptability



4.3.2.1. *Versatility and protection*

1. Framework position:

Adaptability

2. Indicator name:

Versatility and protection

3. Indicator unit:

Qualitative

4. Indicator description:

Review the capability of the building to adapt to changing needs and use of the building; especially evaluate entrances, lobbies, corridors and zoning. The flexibility of the building is considered also from technical perspective.

5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

Assessment description in design:

A: Versatile building with alternative use scenarios considered or has cultural value and is protected.  
 B: Versatile building, flexible solutions.  
 C: Renovation has been considered.  
 D: Renovation partly considered.  
 E: Not considered.  
 Not selected.

Assessment description in operation:

A: Versatile building with alternative use scenarios considered or has cultural value and is protected.  
 B: Versatile building, flexible solutions.  
 C: Renovation has been considered.  
 D: Renovation partly considered.  
 E: Not considered.  
 Not selected.

7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

Assessment description in design:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

Assessment description in operation:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

9. Example:

Versatility is a significant criterion for value, especially for the owner. Sometimes use of the building changes in renovation

and alternative use scenarios may have been considered earlier. However, historical buildings are often protected by regulations and thus their adaptability to changing needs is restricted.

10. References:

Comments:

4.3.2.2. *Technical service life*

1. Framework position:

Adaptability

2. Indicator name:

Technical service life

3. Indicator unit:

years

4. Indicator description:

Evaluate technical service life of building load bearing structures, systems, and components. Technical service life is defined as the period for which a structure can actually perform according to the structural requirements based on its intended purpose with necessary maintenance but without major repairs.

5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

Assessment description in design:

A: Over 100 years.  
 B: 75-100 years.  
 C: 50-75 years.  
 D: 25-50 years.  
 E: 0-25 years.  
 Not selected.

Assessment description in operation:

A: Over 100 years.  
 B: 75-100 years.  
 C: 50-75 years.  
 D: 25-50 years.  
 E: 0-25 years.  
 Not selected.

7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

Assessment description in design:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

Assessment description in operation:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

9. Example:

Technical service life of building may be 100 years for housing and 60 years for schools. In addition, there are also

expensive and difficult to replace components with shorter service life, such as 30 years to ventilation and 20 years to building automation systems.

#### 10. References:

Blok et al. 2003, Service life and life cycle of building structures  
ASTM 2009, Standards for whole building – functionality and serviceability

#### Comments:

### 4.3.2.3. Adaptability to climate change

#### 1. Framework position:

Adaptability

#### 2. Indicator name:

Adaptability to climate change

#### 3. Indicator unit:

Qualitative

#### 4. Indicator description:

Estimate how the building is protected against or may reduce the impacts of climate change causing rainstorms, flooding, earthquakes, storms, avalanches, mud flows and tornados.

#### 5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

#### 6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

#### 7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

#### 8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

#### Assessment description in design:

A: Well protected.  
 B: Most of aspects covered.  
 C: Many aspects covered.  
 D: Some aspects covered.  
 E: No protection.  
 Not selected.

#### Assessment description in operation:

A: Well protected.  
 B: Most of aspects covered.  
 C: Many aspects covered.  
 D: Some aspects covered.  
 E: No protection.  
 Not selected.

#### 7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

#### 8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

#### Assessment description in design:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

#### Assessment description in operation:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

#### 9. Example:

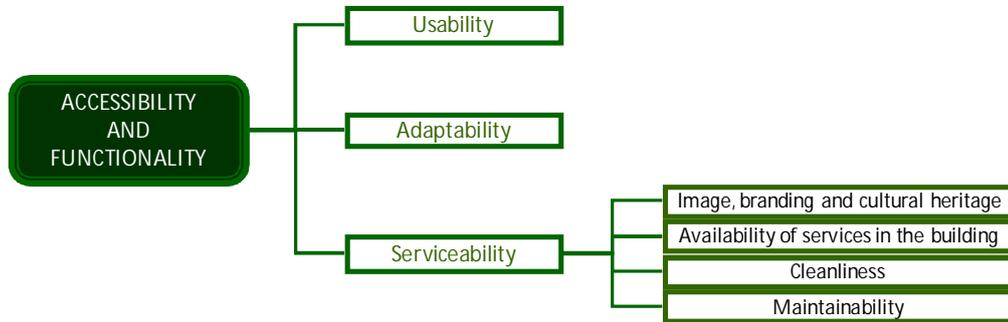
In the future it is important that buildings are protected against climate change. Building's location, for example top of the hill, may influence its durability e.g. against flooding.

## 10. References:

ISO/AWI 21929, 2010. Sustainability in building construction – Sustainability indicators - Part 1 - Framework for the development of indicators for buildings and core indicators – Draft version of 4 February 2010

## Comments:

### 4.3.3. Serviceability



#### 4.3.3.1. Image, branding and cultural heritage

##### 1. Framework position:

Serviceability

##### 2. Indicator name:

Image, branding and cultural heritage

##### 3. Indicator unit:

Qualitative

##### 4. Indicator description:

Evaluation of entrance, lobby and general appearance of spaces in terms of appearance and spaciousness for image and branding. Also exterior appearance is considered. Image and branding may support positively the use function and the building may be compared to the neighbourhood and other buildings. Building may also have cultural value, such as being landmark of a style, time or country. Another way to communicate a message to the public is rating systems and certificates (such as energy efficiency or indoor climate).

##### 5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

##### 6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

##### 7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

##### 8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

##### Assessment description in design:

A: Strong brand or retains cultural heritage.  
 B: Positive image.  
 C: No added branding value.  
 D: Equal or slightly negative image compared to the neighbourhood.  
 E: Poor image and culturally not important.  
 Not selected.

##### Assessment description in operation:

A: Strong brand or retains cultural heritage.  
 B: Positive image.  
 C: No added branding value.  
 D: Equal or slightly negative image compared to the neighbourhood.  
 E: Poor image and culturally not important.  
 Not selected.

##### 7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

##### 8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

##### Assessment description in design:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

##### Assessment description in operation:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

9. Example:

Good image is often connected to good quality and may be converted into money. Some examples of well-known rating certificates are BREEAM, LEED, CASBEE, PromisE, SBA, Energy label and Green office.

10. References:

ASTM 2009, Standards for whole building – functionality and serviceability

Comments:

4.3.3.2. Availability of services in the building

1. Framework position:

Serviceability

2. Indicator name:

Availability of services in the building

3. Indicator unit:

Quantitative

4. Indicator description:

Review of services in the building or facility and its immediate surroundings that are available to users. The range of relevant services depends highly on the type of building. It is essential that mandatory services are available and services are also considering disabled and impaired people.

5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

Assessment description in design:

Assessment description in operation:

List of available services, please consider relevance to building type: e.g. "daycare, post office, bank, health care, dentist, pharmacy, restaurant, cafeteria, fast food, grocery store, special stores, bakery, kiosk, laundry, maintenance services, shoemaker, barber, library, congregation, exercise, recreation, cinema, market"

<p>A: Excellent service level.                  B: Good service level.                  C: Medium service level.                  D: Low service level.                  E: No services.                  Not selected.</p>	<p>A: Excellent service level.                  B: Good service level.                  C: Medium service level.                  D: Low service level.                  E: No services.                  Not selected.</p>
---	---

7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

Assessment description in design:

Assessment description in operation:

<p>A:                  B:                  C:                  D:                  E:                  Not selected.</p>	<p>A:                  B:                  C:                  D:                  E:                  Not selected.</p>
--	--

9. Example:

The availability of services can have an impact on user satisfaction. In office buildings services are also combined to economic value of the property and may have an environmental impact decreasing the need for transportation.

10. References:

Comments:

#### 4.3.3.3. Cleanliness

##### 1. Framework position:

Serviceability

##### 2. Indicator name:

Cleanliness

##### 3. Indicator unit:

Qualitative

##### 4. Indicator description:

Review the durability of materials, the easiness of cleaning during design and the standard of cleaning in terms of work resources allocated to the cleaning during building operation.

##### 5. Applied in building types: (select)

<input checked="" type="checkbox"/> Offices
<input checked="" type="checkbox"/> Schools
<input type="checkbox"/> Housing
<input checked="" type="checkbox"/> Hospitals
<input checked="" type="checkbox"/> Exhibition
<input checked="" type="checkbox"/> Other

##### 6. Impacts of indicator: (select)

<input checked="" type="checkbox"/> Social and cultural impacts
<input type="checkbox"/> Environmental impacts
<input checked="" type="checkbox"/> Economic impacts

##### 7a. Simple assessment in design:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

##### 8a. Simple assessment in operation:

<input checked="" type="checkbox"/> Expert review (subjective specialist judgement)
<input type="checkbox"/> Survey (asked from e.g. user such as POE)
<input type="checkbox"/> Select from the list

##### Assessment description in design:

A: All materials durable and easy to clean.  
 B: Most materials durable and easy to clean.  
 C: Some materials durable and easy to clean.  
 D: Durability and easiness of cleaning has been considered.  
 E: Durability and easiness of cleaning not considered.  
 Not selected.

##### Assessment description in operation:

A: High cleaning level reached, special environment.  
 B: Cleaning level above standard reached.  
 C: Standard level in cleaning reached.  
 D: Standard level in cleaning nearly reached.  
 E: Required level not fulfilled.  
 Not selected.

##### 7b. Detailed assessment in design:

<input type="checkbox"/> Measurement (quantitative value)
<input type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list

##### 8b. Detailed assessment in operation:

<input type="checkbox"/> Measurement (quantitative value)
<input type="checkbox"/> Calculated or simulated value
<input type="checkbox"/> Select from the list

##### Assessment description in design:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

##### Assessment description in operation:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

##### 9. Example:

It is important that cleaning manual exists and required level of quality is described. This is especially important in environments that are operated 24/7 such as hospitals, where required cleanliness level is higher.

10. References:

ASTM 2009, Standards for whole building – functionality and serviceability

Comments:

#### 4.3.3.4. Maintainability

##### 1. Framework position:

Serviceability

##### 2. Indicator name:

Maintainability

##### 3. Indicator unit:

Qualitative

##### 4. Indicator description:

Maintainability is the ability of a building to be retained in a state in which it can perform its required functions or to be restored to such a state when a fault occurs. This indicator considers easiness of maintenance such as replaceable parts, quality of solutions and surfaces in terms of maintenance.

##### 5. Applied in building types: (select)

- Offices
- Schools
- Housing
- Hospitals
- Exhibition
- Other

##### 6. Impacts of indicator: (select)

- Social and cultural impacts
- Environmental impacts
- Economic impacts

##### 7a. Simple assessment in design:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

##### 8a. Simple assessment in operation:

- Expert review (subjective specialist judgement)
- Survey (asked from e.g. user such as POE)
- Select from the list

##### Assessment description in design:

A: Extensive maintenance plan with strategy and program.  
 B: Good maintenance plan exists.  
 C: Maintenance plan exists.  
 D: Insufficient maintenance plan exists.  
 E: Not considered.  
 Not selected.

##### Assessment description in operation:

A: Extensive maintenance plan with strategy and program.  
 Has been updated during operation period.  
 B: Good maintenance plan exists, partly updated during operation period.  
 C: Maintenance plan exists.  
 D: Insufficient maintenance plan exists.  
 E: Not considered.  
 Not selected.

##### 7b. Detailed assessment in design:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

##### 8b. Detailed assessment in operation:

- Measurement (quantitative value)
- Calculated or simulated value
- Select from the list

##### Assessment description in design:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

##### Assessment description in operation:

A:  
 B:  
 C:  
 D:  
 E:  
 Not selected.

##### 9. Example:

Easier maintenance decreases substantially amount of money spent for annual running costs. Typically these actions are covered in maintenance manual.

#### 10. References:

ISO/AWI 21929, 2010. Sustainability in building construction – Sustainability indicators - Part 1 - Framework for the development of indicators for buildings and core indicators – Draft version of 4 February 2010  
ASTM 2009, Standards for whole building – functionality and serviceability

#### Comments:

## 5. WEIGHTS OF KIPIS

### 5.1. Background

The weighting of KIPi is based on the theory of Multi-Criteria Decision Analysis, and more particularly value tree analysis. The aim of decision analysis is to provide a structured way to think about decisions and support and develop subjective judgements about decisions.

In decision analysis three parties are identified: decision makers, decision analysts and stakeholders. Value tree analysis consists of four main phases: problem structuring, preference elicitation, decision recommendation and sensitivity analysis. The first and most important phase – problem structuring – is divided into decision context definition, identification of objectives, generation and identification of decision alternatives, creation of hierarchical model of the objectives and specification of attributes. (HUT, 2002)

There are many tools for decision analysis. One list of them is presented by Maxwell (2000). One of the public sites is Decisionarium (<http://www.decisionarium.hut.fi>) which offers tools for individual decision making and group collaboration. One example of decision support tools is Web-HIPRE software (<http://www.hipre.hut.fi/>; Hämäläinen et al. 1998; Mustajoki et al. 2000) which can be used in different phases of multi-criteria decision analysis process: modelling the problem, weighting of attributes, evaluation of alternatives and analysis of the results (e.g. sensitivity analysis). Supported weighting methods are direct, SMART, SWING, SMARTER and AHP.

In this case the value tree (KIPi framework) is modelled and the weighting is carried out with Web-HIPRE. See figure 5.

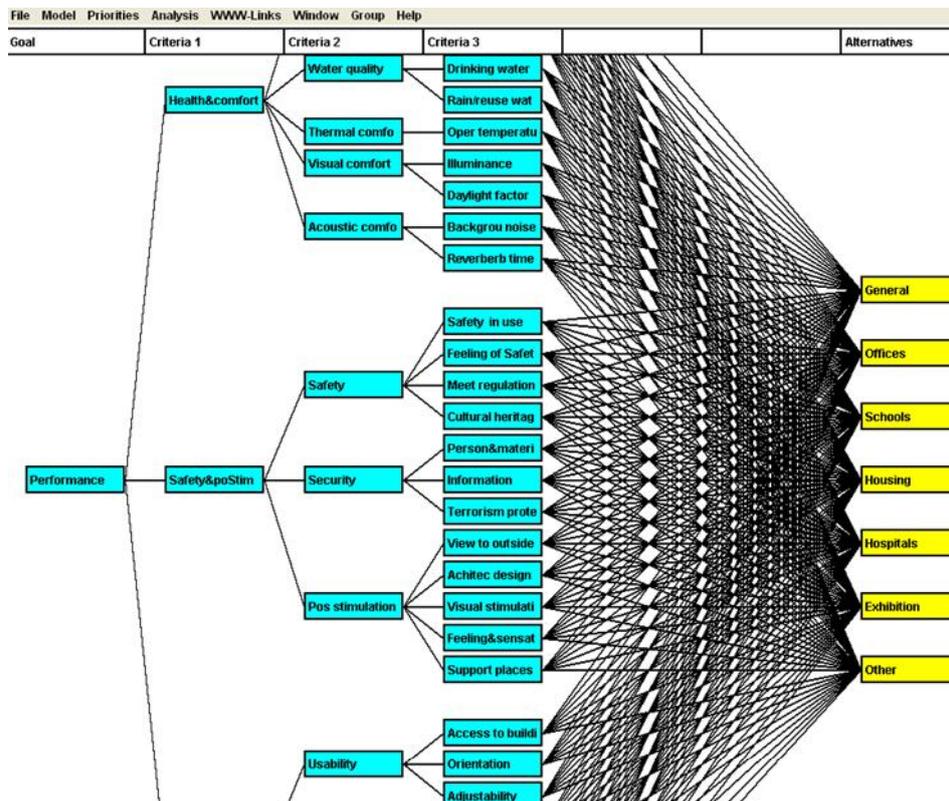


Figure 5: KIPi framework with Web-HIPRE

Weighting of the indicators is the preference elicitation phase in decision analysis. Under each node of the value tree (see figure 5) there are 1 to 5 indicators (branches). The indicators are valued with weights between 0 and 1 so that the sum of the weights under each node is 1 (the normalisation to 1 can be done automatically with Web-HIPRE). The weighting is done following the bottom up approach (first for all the indicators “Criteria 3”, then for “Criteria 2” and finally for “Criteria 1”). See figures 5 and 6.

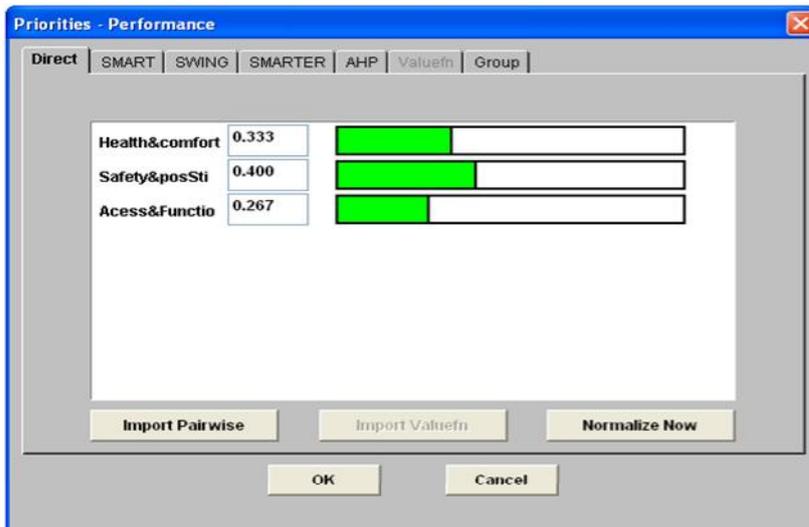


Figure 6: Weighting

When the weighting is done, the weights of different indicators can be compared (see figure 7). The influence of changes in individual weights on the whole model can be analysed in sensitivity analysis.

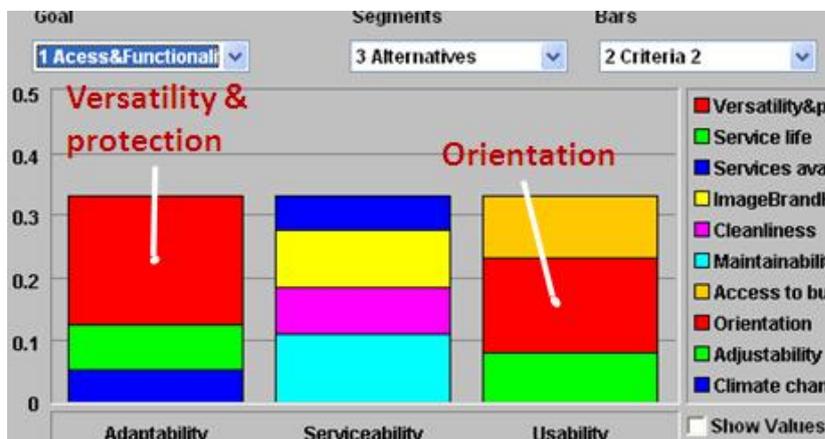


Figure 7: Comparison of weights

The structure of the model may influence the reliability of the results. One example is splitting bias (Hämäläinen and Alaja, 2008). It means that the number of attributes under one indicator may affect the weights. In this case, e.g. indoor air quality (IAQ) is split into five indicators while there is only one indicator for thermal comfort. There is the risk that the weight of operative temperature will be too high compared to the weights of some other IAQ indicators.

## 5.2. General weights of KIPIs

The weighting for general case was done by VTT team with Web-HIPRE multi-criteria decision-making tool. The resulting weights are presented in figure 8.

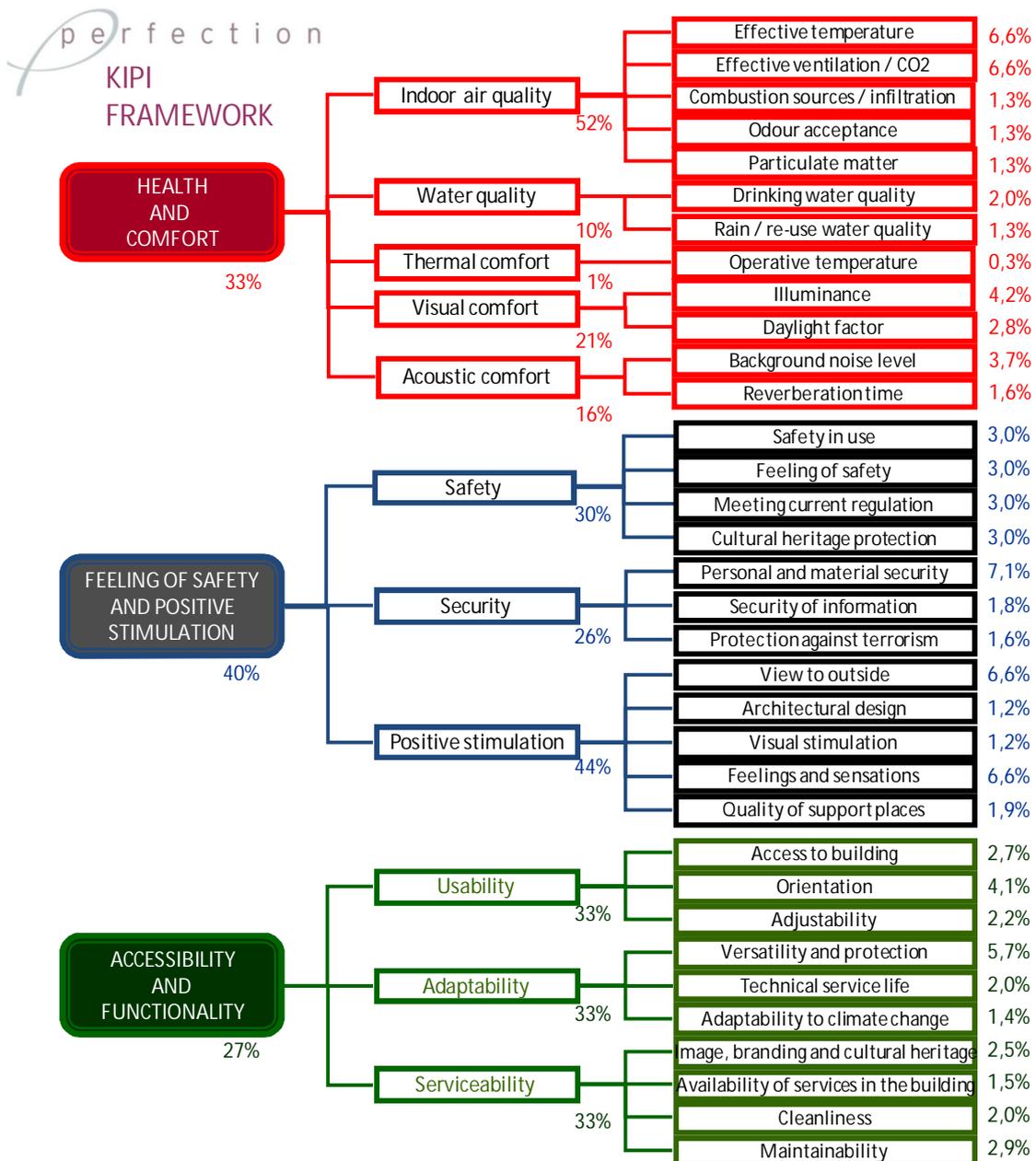


Figure 8: Weights for general case

### 5.3. Sensitivity analysis

One example of sensitivity analysis for visual comfort with Web-HIPRE is shown in Figure 9. Initially, the most important indicator is personal and material security with a weight of 7,1% (straw-coloured dashed line). If the weight of visual comfort in Health&comfort-category is augmented from 21% to 36%, Illuminance (blue line) becomes the most important (4,1% -> 7,2%). With an even bigger augmentation of visual comfort, daylight factor (yellow line) becomes second important.

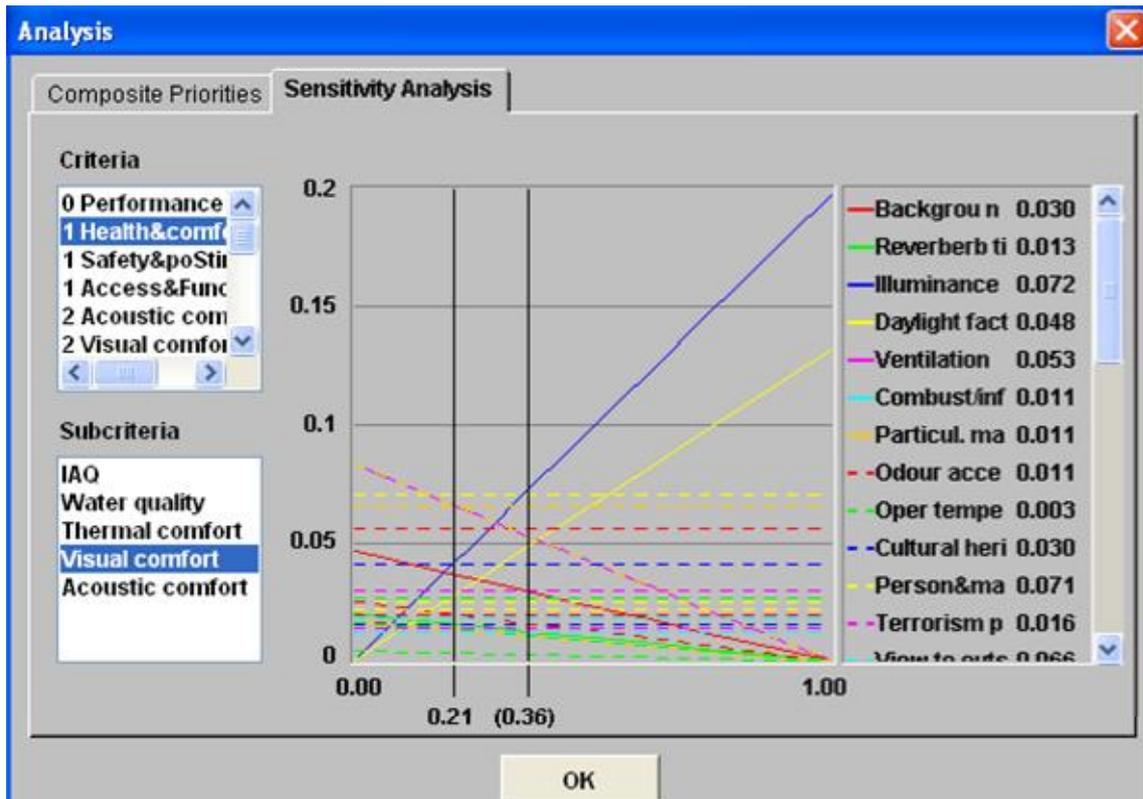


Figure 9: Sensitivity analysis

## 6. CONCLUSION

The objective of this task T1.5 was to develop a generic framework for Key Indoor Performance Indicators (KIPIs) based on the indicators from T1.3 (Health and Comfort) and T1.4 (Safety, Security, Accessibility and Positive stimulation). In addition, a study was carried out concerning other relevant indoor performance indicators. They are treated in detail in Annex A of this document (“Accessibility and Functionality”) relating to usability, adaptability and serviceability. A selection of KIPIs was done among them, too, and is included in the framework.

The resulting framework contains altogether 34 KIPIs from which 12 are related to Health and Comfort, 12 to Feeling of Safety and Positive Stimulation and 10 to Accessibility and Functionality. A uniform indicator template was developed for all the KIPIs containing a short description of the indicator, applicability to different building types (office, school, housing, hospital, exhibition, other), sustainability impacts (socio-cultural, environmental and/or economic), simple and detailed assessment methods for both design and operation phases as well as examples and references. For a more detailed description of the indicators the reader is referred to D1.3, D1.4, D1.5 Annex A and D1.5 Annex B.

However at this stage, there are still some differences in the thoroughness of the KIPI descriptions. The assessment methods of Health and Comfort related KIPIs are explained in detail in Annex B for simple and detailed evaluation in both design and operation phases. For most of the other KIPI descriptions only simple assessment is described – and that in a general, descriptive and really unsophisticated way. To some extent these differences seem normal because of the different nature of the indicators. However, one can ask if the Health and Comfort descriptions are too sophisticated for the assessors in case studies, or if, on the other hand, more information should be given about the other KIPIs.

The idea is to collect experiences from the Phase I of the case studies and, after that, reconsider again the framework as well as the relevance of the KIPIs. The experiences will then be used to harmonize and perfect the framework and KIPI descriptions for Phase II and T1.6 (Autumn 2010). Also another issue, related to the uniformity of the KIPI templates, was raised: is it reasonable to strictly hold to the agreed assessment method alternatives (only three possible in the template) and thus, eventually, reduce the applicability of the framework/indicators? The case studies will certainly give an answer to this question, too.

Weighting is one manner to evaluate the relevance of the indicators. In this document, one example is given for a general case. It revealed to be difficult because many indicators are relevant for only/specially some building types. However, the method presented in Chapter 5 can be used later for specific cases.

The framework, divided in three parts originating from three documents (D1.3, D1.4 and D1.5 Annex A), has been restructured a little bit. Accessibility (from D1.4) is treated in usability. The safety concerns related to the climate change are considered in adaptability. Different aspects related to buildings having cultural heritage value (originally in one adaptability KIPI) are treated in safety (protection), adaptability (protection restricting adaptability) and serviceability (image). The building type “historical buildings” has been replaced with “exhibition”, and from now on the eventual existence of historical value will be considered for all the buildings regardless of their type.

Finally, other propositions come up but not (yet) effectuated are presented in the following list:

- Separation of internal and external sources for the indoor air quality KIPIs
- Consideration of only one/some selected particle types in IAQ-section (e.g. formaldehyde) instead of the “particulate matter concentration”-KIPI because the measurement of “all kind of particles” may reveal to be difficult and not practical in case studies
- Separation of temperature and humidity (PPD and measured) in thermal comfort instead of effective temperature (combination of temperature and humidity in IAQ) and operative temperature (in thermal comfort)

Also these questions will be reconsidered after Phase I.

## 7. REFERENCES

HUT 2002. Value Tree Analysis. Report published by Systems Analysis Laboratory in Helsinki University of Technology (30th April 2002). 74 p.  
[http://www.mcda.hut.fi/value\\_tree/theory/theory.pdf](http://www.mcda.hut.fi/value_tree/theory/theory.pdf)

Hämäläinen R. P. and Mustajoki J. 1998. Web-HIPRE – Java applet for Value Tree and AHP Analysis. Computer Software. Helsinki University of Technology, Systems Analysis Laboratory.  
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## D1.5 ANNEX A: ACCESSIBILITY AND FUNCTIONALITY

See D1.5 Annex A.

## D1.5 ANNEX B: ASSESSMENT METHODS OF HEALTH AND COMFORT KIPIS

See D1.5 Annex B.