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Editorial by J. Desmyter, BBRI

"PERFECTION" stands for a European Coordination Action on performance indicators for health, comfort and safety of the indoor environment. The goal of this FP7 coordination action is to help enable the application of new design and technologies that improve the impact of the indoor built environment on health, comfort, feeling of safety and positive stimulation. In order to monitor and report on the performance of the indoor environment, a set of key performance indicators is a real necessity.

The project concept consists of the following components:

- (i) an inventory of standards, regulations, technologies, research activities and policies related with the indoor environment;
- (ii) analysis of current indoor performance indicators and their applicability positioned within a generic framework, and identifying areas where new indicators for health and safety should be developed;
- (iii) experiences from use cases of building design and technologies exploiting the indicators in different building types;
- (iv) identification of incentives and barriers for the wide use of performance indicators;



- (v) a roadmap and recommendations for building design and technologies, and support for policies;
- (vi) a wide dissemination of findings.

The project was introduced in the FP7-ENV 2007-1 call, started on the 1st January 2009 and will run for 3 years. It is coordinated by the Belgian Building Research Institute and involves 10 other participants (VTT, Apintech, CTU, Armines, Kornadt, ICTAF, SiTI, TUE, ASM and BRE).

At the start of the project, a European-wide network of experts and stakeholders has been set up, enabling an extensive knowledge of European and national practices related to the

indoor environment. With their help a database holding standards, regulations, policies and research activities from 27 countries has been created. Work continues with regard to the search for new and emerging technologies enhancing the indoor environment of buildings (see p. 2).

A concise report on our past and future activities can be found in this newsletter. If you are interested to know more, feel free to contact us. Two open live workshops as well as a webinar have already been organized, but at least 3 other events are scheduled to take place in the next 18 months. A next event focusing on policy-related issues is scheduled for Paris on 23 November 2010.



PERFECTION is supported by the EC within the 7th Framework Programme (FP7 - ENVIRONMENT)

Coordinator: Belgian Building Research Institute - Grant Agreement N°: FP7-212998

Start date: 1 January 2009 - Duration: 36 months



Technologies for the Indoor Environment

by A. Lupisek, CTU

Within the first months of the PERFECTION project an inventory of standards, regulations, policies and research activities was established. At this stage, work continues and focuses on new and emerging technologies. It is indeed true that technological development in recent years has brought a lot of tools and knowledge enhancing sustainability of the built environment and the quality of the indoor environment.

The most discussed today are without doubt those related to clean energy sources and energy efficiency measures, such as combined heat and power generating units, low energy and passive cooling systems, heat recovery, multifunction ventilation systems, high-tech insulations,



etc. Parallel to this energy "mainstream", there is a lot of other remarkable related technologies improving comfort and efficiency of the buildings.

New technologies enable advanced monitoring and controllability of healthy indoor conditions. Compact sets of wireless sensor networks can be used for data collection and more efficient real-time building operation management. The information flows can be used to increase safety of the building. Monitoring camera systems equipped with face recognition can help with security provision (on the other hand, the feeling of safety and privacy may suffer).

Individually controlled micro-environments in workplaces or private rooms may increase productivity and social activities or gives the occupants, such as ageing people, positive stimulations. The comfort of the indoor environment may be improved by intelligent light gathering and new energy efficient lighting systems.

Software-tools are helpful for building simulation and design, life cycle performance monitoring, analysis and efficient facility management. An issue attracting much attention nowadays is the utilization of BIMs (Building Information Models) in design processes as well as in the opera-

tional phase. The search for a multidisciplinary suitable common standard should ease an integrated design process.

As buildings become more sophisticated, in some ways they can become less robust, more dependent on specialized technologies and vulnerable to privacy violation or cyber attacks. Hand in hand with the accuracy of design and production, the complexity of building technologies and the associated sophisticated control systems comes the need for highly skilled professionals in programming, information technologies and sensors engineering. These skills and knowledge will be essential for more comfortable and sustainable buildings.

One of the Perfection goals is to provide a roadmap including incentives and barriers for the application of building design and technologies to improve the quality of indoor environments. During the summer and early autumn, PERFECTION will organize a Europe-wide survey with the aim to collect information on new and emerging technologies enhancing the indoor environment of buildings. The database will be later on accessible on the PERFECTION project website (<http://www.ca-perfection.eu>). *If you are interested in participating in this survey, please let us know by e-mail at perfectionsurvey@gmail.com.*

Indicator Framework and Indicator Toolbox

by S. Olivero, SiTI and P. Huovila, VTT

One of the main goals of the PERFECTION project is the development of a framework with a set of performance indicators for the indoor performances, with regard to health, comfort, security, safety and other issues that could improve the well-being of people living, working or visiting a building.

The proposed indicator framework is structured in a hierarchical way. The Indicators are divided into three main categories:

Health and Comfort. This category includes the evaluation of the parameters

related to the healthiness of the indoor environment and the comfort of building users.

Feeling of Safety and Positive Stimulation. This category is mainly related to the building structures and equipments that could improve the security and safety perception of people and the objects and other parameters inside or around the building with a positive impact on the quality of life.

Accessibility and functionality. The last category includes the indicators related to the easiness in using the building by people, like the presence of services,

the accessibility to the structure, the easiness of movement inside the building, and so on.

Each category is composed by performance indicators, that are further characterized by specific technical indicators.

For each indicator, assessment methods will be provided both for the design phase and for the operational one. During the design phase, the assessment could be conducted by evaluating the plans through expert reviews and proper simulation tools. If the building is already existing, it is possible to conduct an on-site assess-

ment of the indoor performances. Firstly, a simple evaluation based on a site visit and users satisfaction surveys has to be done. Then, depending on the availability of data and on the importance of the specific indicator for the building under analysis, a more detailed assessment must be performed. Each indicator is evaluated against a scale of five performance levels, thus allowing the calculation of a performance score of the overall indoor environment.

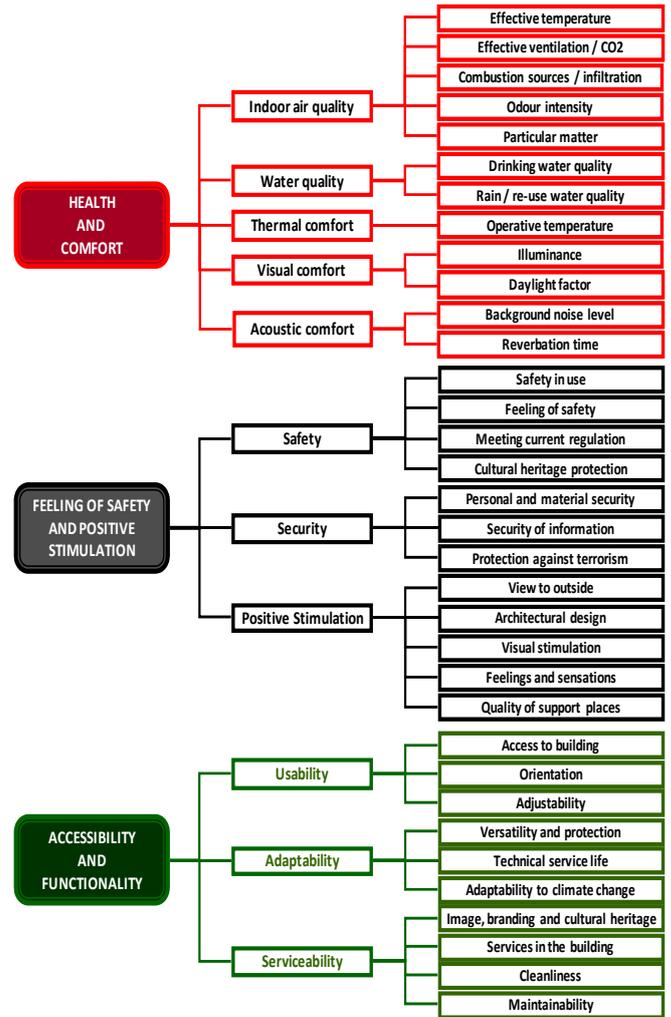
Some indicators defined in the framework may not be applied to all the building types, thus it's needed to detect which indicator is relevant to which building type. Based on the first case studies, the analysis focused on some specific building types (office, school, hospital, residential and exhibition places). It's possible to identify other building types, and the possibility of adding them to the framework will be further discussed in the project. However, in reality, it's quite impossible to find a building that is devoted to only one activity. In such cases, the assessment of the indoor performance must be separately performed for

each different area.

The toolbox will also help in the evaluation of the impact against social, environmental and economic sustainability. A first proposal of the estimated impact will be submitted in the following months to a stakeholder group, that will help in the sustainability analysis.

The toolbox contains a section that is strictly related to the evaluation of products. A database will be populated with useful information in order to help designers and building managers to make the right choice when selecting a product to improve the indoor performances. Each product will also be accompanied with links to technical datasheets and accreditations (with the indication of the body and the year of accreditation).

In the next months, the indicator framework will be implemented in a proper software tool, with a user-friendly interface and will be subject to a strong review process through specific case studies and interactions with stakeholders.



Review of Health and Comfort Indicators

by M. Loomans and P. Steskens, TU Eindhoven

Performance indicators for health and comfort, which have been documented in standards, regulations, guidelines, research activities and policies used in design and construction of the built environment have been reviewed. It is the objective of the project 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. Focusing on the development of such a framework, the performance indicators have been grouped into five core indicators: acoustic comfort, visual comfort, indoor air quality, quality of drinking water, and thermal comfort. Each core indicator is described by several performance indicators. Within the project, a performance is defined as a property of a product, building component or building, which closely reflects or characterizes its performance (state or progress towards an objective) in relation to the performance requirement that has been set (Loomans et al. 2005). The indicator should be a quantitative, qualitative or descriptive parameter that can be readily assessed.

Acoustic comfort

The overall objective of the performance indicators regarding the acoustic comfort is to provide healthy and comfortable acoustic conditions in a building. The acoustic comfort can be characterized as follows: absence of unwanted sound, desired sounds with the right level

and quality, opportunities for activities without being heard by other people annoying them. The acoustic comfort is characterized by four performance indicators: background noise, reverberation time, speech intelligibility, and structural vibrations. Each performance indicator is described by one or several parameters.

Visual comfort

Generally, the function of lighting in a building can be subdivided in three domains: health and safety, visual performance, and aesthetics (Howarth, 2005). First of all, the lighting of an area should be adequate to ensure that people can live safely, and it should not in itself be a

health hazard. Second, the visual performance defines whether the lighting solution in a room is suitable for the performed task(s). Third, aesthetics defines the positive effects of the lighting in a room upon human well-being, both psychologically and biologically. The visual comfort has been characterized by seven performance indicators: illuminance, discomfort glare, disability glare and reflections, uniformity and contrast, flicker, color aspects: color rendering, color temperature, daylight.

Indoor air quality

The indoor air quality in a building is determined by chemical components which are present in the indoor environment. The most recent guidelines for indoor air quality in Europe (WHO, 2000) have been published by the World Health Organization in 2000. Furthermore, intensive studies, such as (Schuh, 2000), have been performed focusing on performance indicators for indoor air quality. In this project, five classes of indoor air pollutants (performance indicators) have been categorized: organic pollutants, inorganic pollutants, classical pollutants, indoor air pollutants, and bioaerosols. The performance indicators include one or several indoor air pollutants. Focusing on each indoor air pollutant, an exposure evaluation as well as a health risk evaluation has been carried out, and guidelines have been reviewed.

Incorporation of the list of performance indicators in a framework may result in a long and complex list of indicators/parameters, which may not be very practical and useful for building design and building management. It is recommended to use a relatively short and simple list of performance indicators to ensure that these indicators are applicable.

Water quality

The literature review showed that ingress of microbial contamination, proliferation and dispersal of bacteria growing on water contact surfaces (especially legionella) and addition of chemical substances from piping, jointing and plumbing

materials are the principal hazards that may accrue in the drinking-water systems of (large) buildings. The prevention and control of legionella in in-building water systems showed to be most critical with respect to the quality of drinking water. The research showed that the main performance indicator is the availability of a water safety plan, focusing on the prevention of legionella in the in-building water systems.

Thermal comfort

The thermal comfort in a building is determined by the influence of the indoor environmental parameters on human's thermal sensation. One of the most widely used indices in moderate thermal environments, the PMV index (predicted mean vote), predicts the mean value of the overall thermal sensation of a large group of persons as a function of activity (metabolic rate), clothing insulation, and the four environmental parameters: air temperature, mean radiant temperature, air velocity, and air humidity (ISO 7730-2005, Fanger, 1970). Alternatively, other methods for the assessment of moderate thermal environments could be used, such as the new effective temperature (ET) and the standard effective temperature (SET) (Nishi *et al.* 1977). Moreover, more advanced models are currently available that allow for the transient prediction of very detailed thermoregulatory parameters and, for some of the models, subjective responses to a wide range of environmental conditions (Nicol, 2001; Dear, 2009).

In this project, performance Indicators for the thermal comfort in a building are presented based on the models which are currently available. The thermal comfort is characterized by five performance indicators: operative temperature, Percentage of Dissatisfied (PPD), draught, vertical air temperature differences, radiant asymmetry.

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Accessibility, Safety and Positive Stimulation Indicators,

by J. Desmyter and P. H. Lefebvre, BBRI

Accessibility, safety and positive stimulation are important elements of the social component of sustainable construction. Buildings accessible to all kind of users and universally designed and built are also more comfortable in use. By their design, equipment and utilities buildings may stimulate building users to remain active, to have social contacts, to feel comfortable, to be productive or to more easily find their way. Positive stimulation may seem to be an abstract concept focussing on the user experience, but the concept has clearly a range of social and economic interesting consequences when introduced in the built environment. Finally, (the feeling of) safety and security are fundamental requirements for a high-quality indoor environment.

Accessibility and Universal Design

An accessible building is capable of being accessed and used by each kind of user (disabled, people with prams, older people, children, etc.). To be accessible, a user should be able to enter and make use of the building independently, or with the helping hand of a partner or assistant. Important is that the user is also able to egress the building in the event of fire or another emergency. Qualifying the accessibility level of a building may be realised by making reference to accessibility regulations, standards, guidelines or handbooks. In most cases use is made of checklists, design aids and professional advice. The final test of accessibility of new or renovated buildings is to be found in the user experience. In that regard, user satisfaction surveys are a powerful instrument to qualify accessibility.

In order to have an accessible building, one needs not only to concentrate on the indoor environment, but also on the immediate environment surrounding the building. As such, accessible design and buildings include:

- The approach to the building, including car parking, other transport stop off points and access routes
- The entrance to the building, including the steps, ramps and entrance doors
- The movement inside the building, including lobbies, corridors, surfaces, internal doors and vertical circulation
- The facilities, such as the access to sanitary accommodation.
- Signage, communication and way-finding aids may help to improve the usability and "readability" of a building, for instance for ageing, children, visually impaired or cognitive disabled.

Safety and Security

An indoor environment has to be safe and secure, and has to offer a feeling of safety and security. This introductory sentence immediately shows that safety and security is not only about facts and figures. Also here the user experience proves to be vital.

Within the 6 essential requirements defined in the Construction Products Directive safety was clearly considered to be an important issue. Five of them (Mechanical Resistance and Stability, Safety in case of Fire, Safety in Use and even Hygiene, Health and the Environment and Protection against Noise) refer clearly to safety-related aspects. The structural stability under normal exploitation charges is

clearly a first prerequisite for a safe and secure indoor environment. PERFECTION considered however also following topics:

- Stability against exceptional loadings, for instance because of earthquakes, explosions, heavy wind or storms
- Resistance against weather exposure and climate change (lightning, heavy rains, floods, etc.)
- Safety in case of Fire
- Mechanical safety with items such as glazing, slips, trips and falls, collision or entrapment and falling objects.
- Electrical and electro-magnetic safety and radio-activity
- Cyber security and privacy
- Security of users and resistance to attacks.

Positive Stimulation

The concept of positive stimulation was introduced above. In its work PERFECTION studied a series of designs and interventions in the commercial and working environment, in therapeutic environments and residential ones. Stimulating people to buy by using fragrances, visual and hearing sense stimulation and adapted indoor space arrangements are well known in commerce. Similar approaches have been used in working environments, to stimulate productivity or reduce stress, or in residential environments, to improve social interactions or to increase independence. The study shows that in this area a lot of progress and innovation is still possible. It is why positive stimulation is a key part of the PERFECTION KIPI Framework.

Future Policy related Activities, by P. Huovila, VTT

PERFECTION identifies incentives and barriers affecting the successful adoption of indoor performance indicators. Based on those and the technological needs and pri-

orities, recommendations are formulated for policies and these main findings will be described in a form of an indicator road-map.

A set of recommendations will be drawn to the EC and the Member States with regard to incentives and barriers to new designs and technologies resulting

from hindrances created by existing standards and regulations or by the practices in the sector. On the other hand, acceleration of the intake may be supported by incentives developed by the authorities, such as green public procurement or pilots at government associated buildings.

The EC, the Member States and Industry will be also provided recommendations on the needs and priorities of the future. Refer-

ence is essentially made to the urgent technological needs in the short and medium term, such as sensors, technologies and designs to make sure the indoor CO₂ concentration remains below the threshold values, as an example.

A Policy Support Paper will be produced with regard to the CPD, EPBD, EEHAP, public procurement, standards and regulations. This Paper will

amongst others deal with the lack of knowledge and the lack of uniformity around Europe. A set of interviews with some key innovation actors and user organizations, such as CEN, EOTA will be carried out, and still four Workshops will be arranged: one research oriented, one policy oriented, one business oriented, and one EC policy and official oriented.

User Engagement and Prototype Tool by N. Sakkas, Apintech

One core issue for the PERFECTION project is to ensure the important user engagement in terms of obtaining and using the achieved results. This target will be achieved mainly by reaching users, making them aware of the projects' result and attracting them to use the prototype tool that will be produced.

The wide range of users that PERFECTION project must reach, will be a main element for its success, as this will give the opportunity for maximum dissemination. The PERFECTION target groups (end users) have been defined and are the following:

1. Building industry stakeholders (engineers, designers, product/service developers, contractors, investors etc.).
2. Building users (building owners/managers & citizens).
3. Policy makers.

Engaging the previous groups means raising awareness to them and engaging them in order to elaborate the results by strong interaction and transfer of knowledge across the whole European Union. User engagement though

can't be achieved only by the development of the prototype tool itself, which is undoubtedly the most important method, but also actions need to be developed in order to support dissemination of the information about the portal and the whole project scope and outcomes.

The prototype tool we are referring to is a software system, that will implement the specification of the user experience of the building as it has been detected through the PERFECTION project and the work on the Indicator Framework and Toolbox. This tool is called the KIPI (Key Indoor Performance Indicators) tool. It's available at <http://www.indoorperformance.net/> and will meet six main objectives, namely:

- To allow building stakeholders to have their buildings, that have been evaluated against the KIPI model, published.
- To allow service and product providers to publish their products/services that have been at first evaluated against the KIPI model.
- To help building designers to

identify the critical points that need to be monitored in a building during the design phase.

- To help building designers to check and review the critical points that have been identified in the design phase.
- To help building designers & owners/managers in the initiation/design phase of the building to define requirements & good practice.
- To provide to citizens knowledge on aspect of indoor performance.

The KIPI tool also serves as a user interaction portal with the PERFECTION methodology. With that aim, additional attributes have been set-up, such as a FORUM, FAQ, user guides, etc. The engagement of the KIPI tool is a key factor for the PERFECTION success, as the mass of functionalities it supports can bring the discussion on the tool and consequently on the project's methodology in the mainstream of the construction business. To support this, the KIPI tool and Indicator Toolbox will be tested and demonstrated in a number of case studies, situated all over Europe.



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Upcoming Event
Perfection Policy related
Workshop
Paris, France,
23 November 2010

Next Issue
The next issue will be
published in December
2011

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Published on behalf of the CA for Performance Indicators for Health, Comfort and Safety of the Indoor Environment

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