IOT FACTORY

The importance of Indoor Air Quality (IAQ).

The Internet of Things Applied to Wellbeing and Business Performance

Lionel Anciaux @ IOT Factory (lionel@iotfactory.eu) V1 - FEB-2018

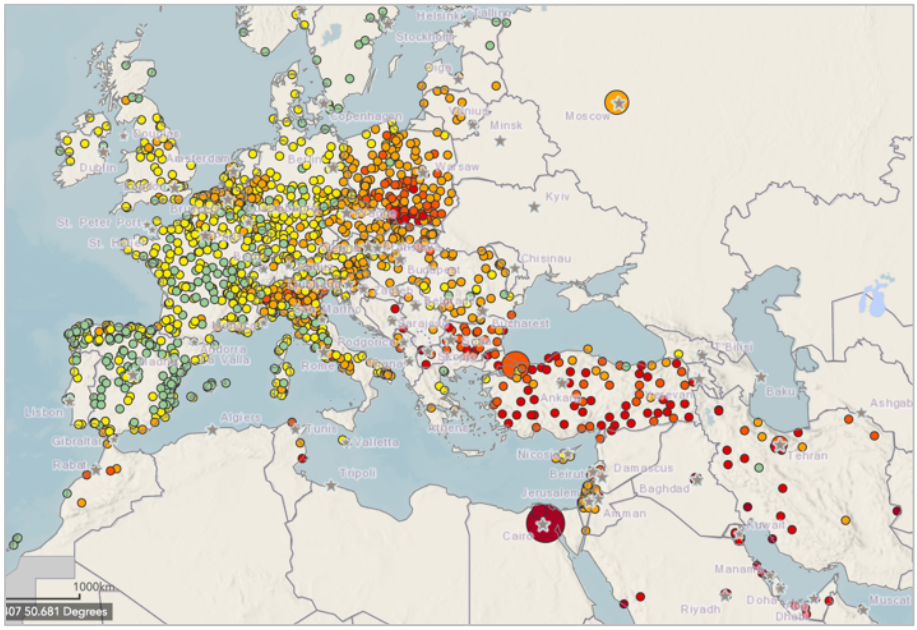
Indoor air quality has a significant impact on workers' productivity, and acts in terms of both their health and their sense of well-being. All studies demonstrate the direct influence of **temperature**, **humidity** and **CO2** levels, representative of ambient air pollution, on the occupants of indoor locations. Whether at the workplace, in schools, nurseries ... or at home.

This report explains the issue of Indoor Air Quality, and shows how the **Internet of Things** can very concretely work for a significant **improvement of the productivity in Enterprise**, and the **well-being in the public and private places**.

6.5 Million deaths a year in the world!

According to the World Health Organization (WHO), no less than 6.5 million people die from the combined effect of indoor air pollution and indoor air (home, office, places public). Globally, 92% of the population lives in ambient air that exceeds the limits set by WHO. Another way of presenting the problem, according to WHO, is to say that every European citizen is deprived, on average, of 8.6 months of life!

This map, focused on Europe, the Middle East and Russia, shows the concentration of microparticles (less than 2.5 microns) in micrograms per m3.



If it is not possible at the individual or company level to influence the quality of the ambient air (outside), it is quite possible to improve the quality of the air. inside, be it in a company, in a public place or in a residential space.

Improving indoor air quality means contributing to better health for workers in the workplace, children in school or day nursery, sportsmen in their gym, and in general the entire population in their home. home and other places of life.

Indoor Pollution (Indoor Air Quality)

All studies show that poor indoor air quality has a direct impact on health and well-being. When we know that a European spends more than 90% of his time indoors, we understand the importance of measuring air quality, and putting in place appropriate measures to improve it.

Poor indoor air quality causes:

- Loss of concentration
- Nausea
- Headache
- Nasal irritation
- Difficult breathing (dyspnea)
- Dryness in the throat

For the Enterprise, this means lost productivity and sick leave. At school and in kindergarten, this can have a direct impact on children's health.

Sick Building Syndrome (SBS)

The symptoms measured due to poor quality of indoor air has a name: The Sick Building Syndrome, describes a combination of unexplained symptoms or diseases associated with a place built. It is one of the emerging diseases, a problem increasingly treated in occupational medicine. Hypersensitivity problems to chemical pollutants are intimately associated!

Beyond the mechanical symptoms (irritation, headaches, nausea), certain psychological consequences could also be explained by Sick Building Syndrome: increased anxiety or some collective hysteria.

Sources of indoor air pollution

There are many sources of indoor air pollutants:

- **Building materials and interior supplies**. Beyond the internal organization of the building, materials used for construction, as well as those used for interior supplies can be a generator of air pollution. Volatile organic components, formaldehyde often appear in new builds, or in renovations. Phenomenon aggravated by the tightness of the current buildings for the sake of thermal insulation.

- **Human emissions**: Breathing produces CO2 that pollutes the air, but there are other human factors, such as perfumes, or intestinal gas, bacteria and other viruses produced by sneezing, or dead skin , hair loss that contribute to the dust present in the air.

- **Equipment**: markers for boards, paper, computers, photocopiers and printers produce many volatile components that spread in the ambient air Solvents, degreasing agents, release agents ...

- **Cleaning products**: cleaning agents can contaminate indoor air for long periods of time and may contain preservatives, disinfectants (aldehydes), solvents (glycols, isopropanol), organic acids, perfumes ...

- **Combustion**: Kitchens, tobacco, open fires ...

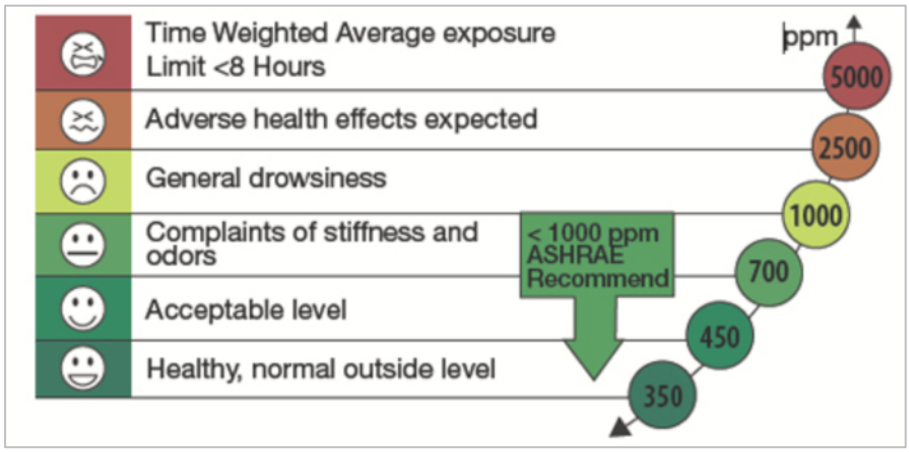
- **Outside sources**: vehicle exhaust gases, produced by factories, from agriculture or pollen, spores or gas from the soil.

What to do ?

It is not within the objectives of this article to describe all the chemical and biological agents at the source of poor indoor air quality (CO2, CO, volatile organic compounds, formaldehyde, radon, microbial pollutants, particles in suspension ...).

On the other hand, **studies show that a good general measure of indoor air quality can be obtained through the proportion of CO2 present in this indoor air.** Carbon dioxide (CO2), produced by human respiration, is directly proportional to the number of people in an indoor area. The increase of the CO2 level is globally proportional to the increase of odorous substances.

The natural level of carbon dioxide (CO2) is around 400 ppm (parts per million) in the outdoor environment. A value of 1000 ppm for indoor CO2 (1800 mg / m3) is generally considered as a reference value in many European countries. Concentrations above 1000 ppm are likely to cause feelings of discomfort, such as fatigue, loss of concentration or headaches.

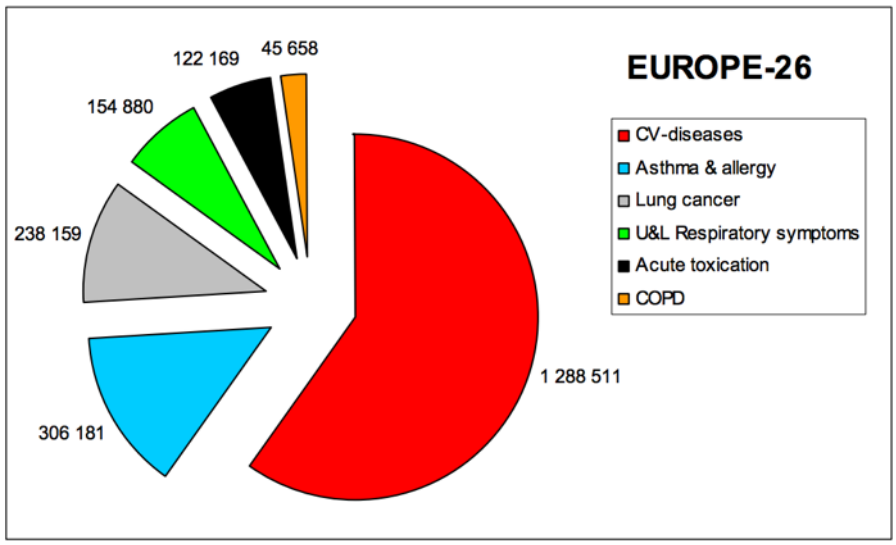


Relationship between CO2 level (in ppm) and well-being

Temperature measurement, relative humidity and CO2 level

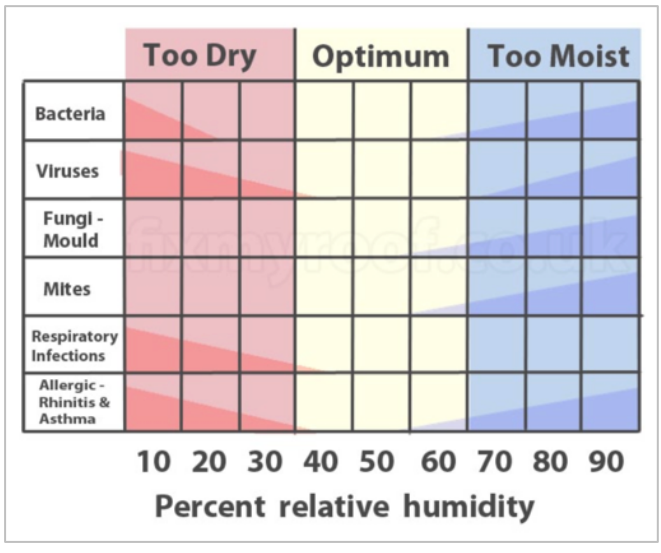
The temperature, the relative humidity and the rate of CO2 in the indoor air makes it possible to obtain a good first approximation of the quality of the indoor air. The regular, automated measurement of these 3 parameters helps to limit the negative impact - on health, well-being and productivity - of people living or working in a given area.

A report from Europe, 2011 - Promoting Actions for Indoor Healthy Air (IAIAQ) - estimates that **2 million people suffer from diseases related to poor indoor air quality**.



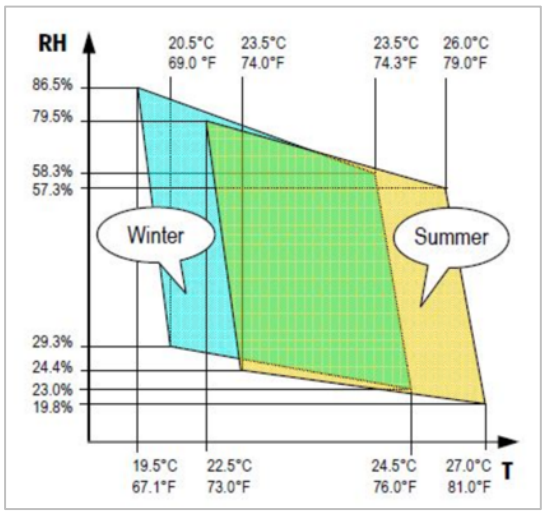
Humidity

Too dry air (<25% relative humidity) is synonymous with discomfort. Mucous and dry skin, chapped skin and irritations. Too dry air also increases static electricity, which can cause discomfort and electrical problems (computers ...). Too much humidity causes condensation in the structures, but also the development of germs and fungi, and therefore the development of bacteria and the proliferation of diseases. **The American standard ASHRAE recommends a relative humidity between 25% and 65%.** Canadians recommend a rate of 35% in winter and 50% in summer.



Temperature

The ideal temperature depends on the type of activity involved in the building obviously, or the room in the building. But it is mostly related to the humidity of the air, because the temperature felt depends on the humidity of the room. And so the ideal temperature-humidity pair (comfort) will be different in summer and winter.



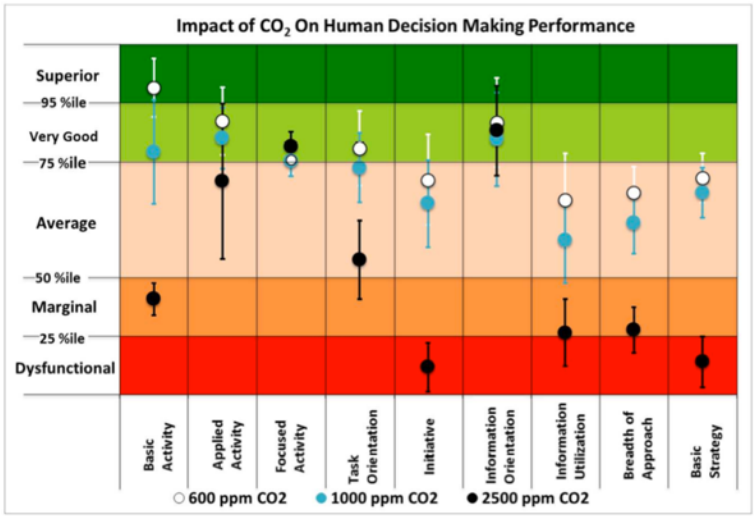
Another important element is to avoid excessive differentials, for example, between the lower and upper stages. In general, no more than 3 degrees of difference.

Carbon dioxide (CO2)

The level of Carbon Dioxide in the ambient air (outside) typically ranges from 250 to 400 ppm (parts per million). The level of CO2 in an indoor environment is obviously higher. It is estimated that up to 1000ppm, the indoor air quality is correct. Beyond that, an impact on the well-being and the health appears following a prolonged exposure.

Indoor air CO2 is a good measure of overall indoor air quality. Therefore, below 1000 ppm, we consider the quality of the indoor air as good. Above 1000 ppm, the impact on health and well-being can be felt. This quality of air is not only affected by the level of CO2, but by all the other volatile substances found in the air: solvents, formaldehyde, bacteria, pollen ...

A study from a Berkeley laboratory showed the direct impact of CO2 on business decision-making performance. Challenging !



.

Continuous measurement of temperature, humidity and CO2 level

These 3 parameters evolve permanently in the day, and in the year!

Seasons, climate and human activity directly influence humidity and indoor temperature. The CO2 level is directly related to human activity: number of people, frequency of meetings, ... In general, the air quality will decrease rapidly with the increase in human activity. The current social organization, with the generalization of open office plateaus, co-working, nurseries, schools. All places where human activity is variable over time, with peaks of intensity. And therefore peaks of indoor air pollution!

How to measure?

IOT Factory has developed a specific solution to measure the quality of indoor air, composed of dedicated sensors, connected - through any type of communications network - to a web and mobile application. This solution allows:

- Real-time monitoring of temperature, relative humidity and CO2 levels, measured in different rooms / buildings,
- The visualization on geographical map, or on plan of a building, of the measurement points
- The consultation of historical data (in order to understand and anticipate the future),
- The generation of alerts when thresholds are exceeded.

Temperature, Humidity and CO2 sensor
On Sector. WIFI, 3G and Sigfox networks

Temperature, Humidity and CO2 sensor
On battery. LoRa Network

What can be done to reduce indoor air pollution?

It may of course be interesting to verify that the building, by the construction materials used, the interior equipment, the cleaning products used ..., does not generate too much pollution. For the remainder, the measurement of the 3 parameters (temperature, humidity, CO2), must make it possible to give a good indication on the thermal needs, of humidification (or dehumidification) and of ventilation (adjustment of the conditioned air, opening of windows , ...).

In winter, we tend to humidify the air. In the summer to want to dry it. An additional problem, in winter, is the reluctance to ventilate (cold ...), and therefore a fall in the quality of indoor air.

Conclusion

Continuous measurement of indoor air quality is more than just a gadget.

In the company, this measure makes it possible to increase the productivity of employees and to reduce absences for illness. It helps to increase well-being in the office.

In public places, such as hospitals, schools, nurseries, sports centers, it is a safe bet that states and Europe will quickly legislate to set acceptable thresholds, and impose the measurement of CO2, temperature and energy. humidity to ensure compliance with regulations. We are talking about 2 million Europeans who are sick due to poor indoor air quality ...

As for homes, the control of air quality must be able to fight like diseases and mortality related to poor indoor air quality.

The Internet of Things, through the implementation of dedicated sensors, connected to a monitoring and notification software through communication networks such as LoRa, SigFox, WIFI or 3G, makes it possible to contribute seriously to the increase of the indoor air quality.

The content of this report is extracted from an "IOT Business Training" training for Companies that plan - strategically or operationally - to deploy solutions related to the Internet of Things. This training covers all aspects of the Internet of Things: use cases, business models, IOT networks, security, sensors, project management ...

About the Author

Lionel Anciaux

linkedin.com/in/lionelanciaux
twitter.com/lionelanciaux

Expert, Consultant & Trainer IOT. Founder of IOT Factory.

Active for over 15 years in deploying M2M and IOT solutions in business. Fleet Management, Workforce Management, Industry 4.0, Smart Metering.