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Building automation is active health care

Four reasons why good air means "health care" and promotes productivity, and how building automation can help in this

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Building Automation is Preventive Healthcare

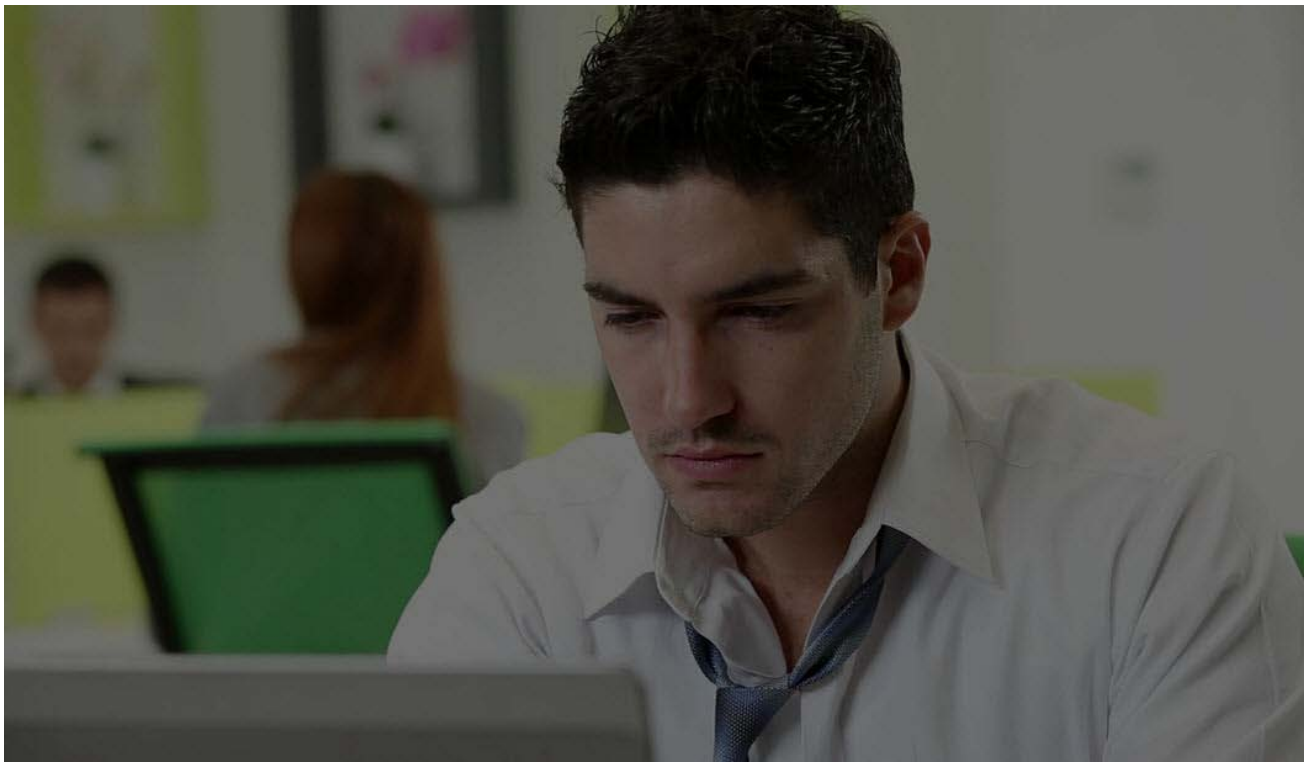
Four reasons why good air is “preventative healthcare”, fostering productivity, and how building automation can help

By Jan Prochnow, PhD, Head of Product Line Sensors, Siemens Building Technology

Today, there is a growing awareness that the quality of the air we breathe has a significant impact on our health and productivity. Companies such as Philips, Dyson or AL-KO are picking up this trend by marketing air humidifiers and purifiers. The global market of residential air purifiers was six million units in 2015 and is expected to grow by almost a factor of four by 2021 [1]. This trend is further fueled by car manufacturers integrating HEPA (High Efficiency Particulate Air) filters that keep the air in the passenger compartment clean. People wake up in the clean air of their homes, drive to work in their clean cars and also expect to breathe clean air in the office where they spend the larger part of their day. Commercial buildings are becoming clean in order to maintain the health of the people who live, work and play in them. Let’s have a closer look at why healthy air is so important and what can be done about it.

I. Stay productive in meetings

It is a familiar phenomenon: The room is packed with people, and the longer the meeting, the less dynamic its participants. What is happening is that the CO_2 exhaled by everyone reaches a concentration level that compromises people's productivity.



There is science behind this: The result of work by Usha Satish et al. published in 2012 [2] is illustrated in Figure 1. The productivity of students was tested for tasks that required different levels of involvement under various exposures to CO_2. It was found that even for simple tasks, such as listening and absorbing information, the performance of the students increased by a significant factor of 1.5 when the air quality was improved. For tasks requiring higher levels of involvements, such as taking initiative, the measured performance increased by a sheer factor of 10. Keep in mind that these high-value tasks are what make you stand out and advance your career, and are generally speaking what make a workforce more productive.

Imagine a system that brings in exactly the amount of fresh air that is needed to make sure you stay productive. This is what we call demand-controlled ventilation [3].

Natural light from dusk to dawn decreases depression and improves mood, energy, alertness and productivity [5]. Therefore, lighting systems that mimic the change of light temperature

(i.e. color) during the day are not just “nice to have” but a driver for productivity and occupants’ health.

Suppliers like Siemens support the productivity of occupants with their offerings for *Total Room Automation* (TRA): TRA takes room control to the next level by integrating advanced parameters such as CO_2 and light color, in an overall concept of HVAC and lighting control. TRA relies on highly accurate self-calibrating sensors to keep people productive and healthy.

Companies who know how to drive productivity get the most out of their people’s talent, produce fewer failures and bring better products and services to the market, which in turn drives revenue and profits.

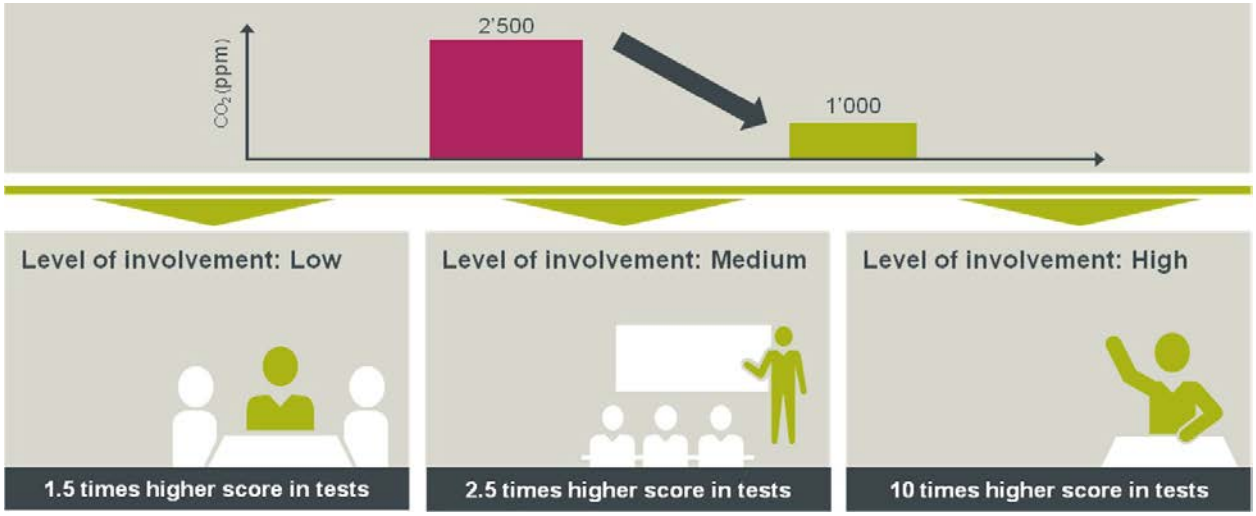


Figure 1: The schematic illustration shows the significant increase in people’s performance that can be achieved by reducing indoor CO_2 concentration from 2’500 to 1’000 ppm. The effect is shown as a factor of 1.5 for low levels of involvement (left) and increases up to a factor of 10 for high levels of involvement (right).

II. Stay healthy throughout the winter

Did you ever have the feeling that the air inside a building makes you ill? You may be correct: Heating systems often dry the air. It has been shown that dry air enhances the lifetime of viruses, resulting in a higher risk of catching an influenza virus [6]. In the U.S., influenza creates approximately $10.4 billion [7] in direct costs for hospitalizations and outpatient visits each year – and this does not yet include productivity losses due to sick leaves. Furthermore, people with allergies and respiratory diseases suffer when room air is dry.

Good temperature and humidity control greatly reduces the risk of falling ill while improving comfort significantly.

Conventional thermostats measure and control temperature. However, advanced hygrothermostats also capable of measuring and controlling the humidity in rooms could have the effect of an influenza vaccination that really works. The RDG165KN from Siemens is such a device and also supports the open KNX communications standard for integration into a building management station.

III. No “sick building syndrome”

Do you know buildings that give you a headache and/or irritation of eyes and throat? Potentially you are experiencing Sick Building Syndrome (SBS). One major cause of SBS is the out gassing from building materials such as carpets, paints or furniture. These gases are summarized as Volatile Organic Compounds (VOC). Recent laws on energy saving require well insulated and draught-proofed buildings to minimize the need for heating and cooling. The resulting air tightness of buildings, however, also keeps the VOC gasses inside, creating SBS among occupants.

Humid air as well can indirectly contribute to SBS by promoting the growth of fungi and mold. Besides devaluing the real estate, exposure to mold spores represents a hazardous health risk. Symptoms range from allergic reactions to poisoning by mycotoxins [8]. Today already, every second school child is experiencing sensitization to one or more allergens [9].

The number one measure to prevent SBS is proper ventilation [10]. In cases where HVAC is not fully automated, it is all about knowing when to open the window. We are increasingly getting used to what is called “quantified life”: We measure our heart rate, record the number of steps taken during the day and want to know the likelihood that it is going to rain today. Similarly, suppliers like Siemens offer web-based solutions for monitoring and quantifying remotely not

only the SBS indicators of VOC and humidity, but also temperature and CO_2 levels, by using one single flush-mounted multi-sensor device called AQR.

IV. Keep pollution at bay

According to the United States Environmental Protection Agency (EPA), indoor environments are two to five times more toxic than outdoor environments. This is a problem since people on average spend 90 percent of their time in buildings [4]. Let's take a closer look at fine dust[1], for example.

Even low concentrations of fine dust increase the risk of developing cancer. Developing countries experience high levels of fine dust concentration. Main sources are fossil power plants and cars. Fine dust concentrations are also high in large cities of the developed world, and awareness is growing. In Milan, Italy, for example, every second month the average fine dust concentration reaches a level that is categorized as unhealthy [11]. In 2016, French authorities

[1] Fine dust is particulate matter with less than 2.5 microns in diameter (short: PM2.5).

had to ban cars from the city of Paris to get pollution levels under control. Figure 2 shows that poor air quality is a global concern.

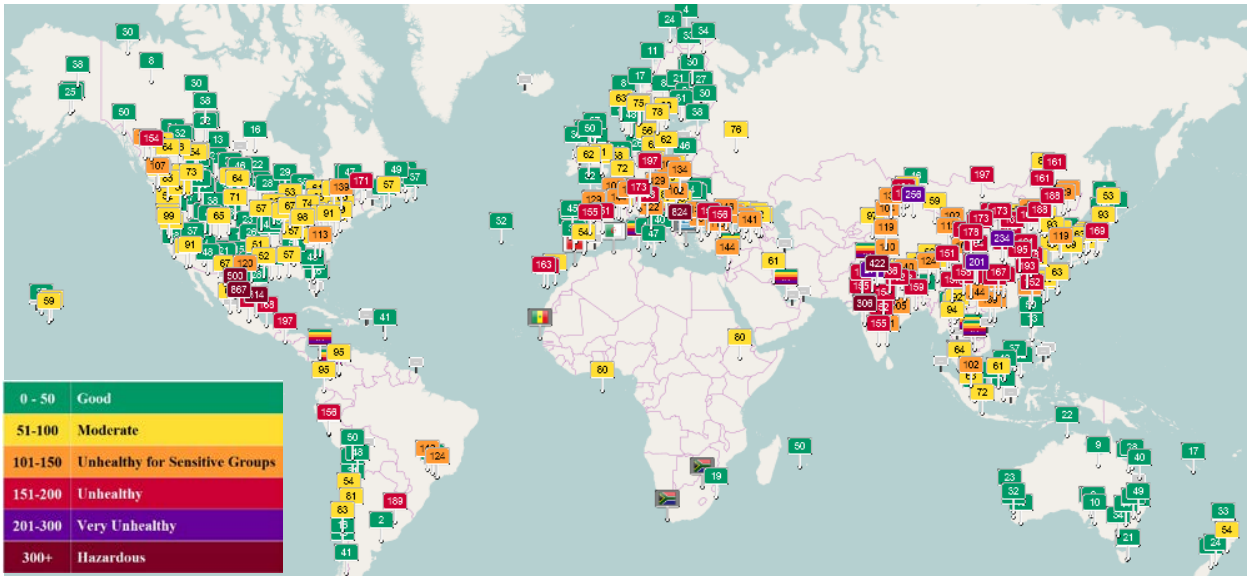


Figure 2: Map of the world with measurements according to the Air Quality Index. It can be seen that poor air quality is an issue in developing countries, while developed world regions are also affected [12].

This situation provides business opportunities: Business travelers are willing to pay premium hotel rates for fine dust free rooms in cities like Beijing, and corporations get an edge when hiring top talents or relocating expatriates if they provide offices with clean air.

The trend towards deploying air purification in commercial buildings is driven by consumer markets: In Japan, 60 percent of all urban households are equipped with mostly stand alone air purifiers [13]. This generates the expectation that also in commercial facilities such as office buildings and hotels the air is clean. However, today's commercial ventilation systems typically do not clean the air from pollutants, in fact they are often the main inlet for hazardous air.

Most purifiers still operate independently from the HVAC system and are controlled based on a local fine dust sensor measurement in the room.

Integrating purifiers into the HVAC system offers significant advantages: A purifier cleans the air by blowing it through a filter with a fan. A ventilation system creates an air flow anyway. Integrating the filter into this airflow allows significant overall efficiency gains. Also, while the primary HVAC is a potential inlet for fine dust and pollution, cleaning the air at the inlet means keeping the devil at bay. However, since fine dust also enters through many small holes in a

building and is not a gas that can be removed in one place by suction, there is also a need for local air purification and cleaning.

Studies suggest that next-generation HVAC control systems will incorporate measuring capabilities for pollution factors such as fine dust [14]. This enables a trade-off between providing fresh air (thus reducing indoor CO_2) and the introduction of pollution from outside. Smart algorithms also anticipate pollution based on weather forecast: A building is ventilated in the middle of the night, when pollution is typically low, or before an inversion weather situation occurs that typically comes with high fine dust concentration.

Such advanced control algorithms require a powerful and flexible controller like the Siemens PXC3 *Total Room Automation* controller. By taking as a basis the ready-made libraries provided by this controller, users can freely program customized or innovative solutions for optimizing the health of occupants.

V. Conclusion:

The air that we breathe has a significant impact on our health and productivity. Since we spend the majority of our time in buildings it is of great importance to make sure indoor air is clean and healthy. Sufficient ventilation helps to keep people productive and avoid what is called sick building syndrome. Controlling the relative humidity in buildings reduces the risk of influenza virus transmission significantly which is a major productivity and comfort gain. In emerging markets but also metropolitan areas in the west like Paris or Milan fine dust concentrations are dangerously high. Companies like Siemens Building Technology provide products and expertise to create perfect places for your health and productivity.

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