

INDOOR AIR QUALITY (IAQ) AS A PARAMETER AFFECTING WORKPLACE PRODUCTIVITY

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Abstract: The aim of this paper is to give a review of the effects of indoor air quality (IAQ) upon the productivity and performance within the workplace. IAQ is known to be a factor causing health issues and has been connected with sick-leave among office workers through many studies in developed countries. This is a problem which persists in developed countries, however it has not been given the attention it deserves in developing countries, considering the fact that there is a lack of information and statistical data on the subject. Throughout this text we point out the main workplace factors which affect productivity of office workers on a daily basis, without taking into consideration additional factors such as the effects of noise and lighting in large urban areas, as well as previous health issues, personality type, socioeconomic status, food habits, etc. Our main focus is put on raising IAQ awareness where it is not considered a threat, through assessing signs as health implication, worker complaints, increased sick-leave, absenteeism and reduced productivity.

Keywords: IAQ, WORK PERFORMANCE, PRODUCTIVITY, OFFICE WORKERS, SICK-LEAVE

1. Introduction

In order to improve their business processes, organizations rapidly implement new solutions and software, resulting with process automation and more than the usual eight hours a day, five days in a week are being spent by employees indoors rather than outdoors. The impetus over recent years to conserve energy has resulted in warmer, tighter buildings with much reduced air exchange and therefore a greater propensity for indoor pollutants to build up; the combination of reduced ventilation rates (especially in winter), warmer and more humid conditions indoors, together with the greater use and diversity of materials, furnishings and consumer products, has resulted in concentrations of a wide range of pollutants occurring indoors at levels exceeding those outdoors.¹ Indoor air pollution in working places is widely recognized as one of the most serious potential environment risks to human health.² Fast urbanization trends are increasing the indoor pollution and causing high rates of sick leave among office workers, while employers are not aware of this problem, especially if we consider the fact that this can cause serious productivity loss if not assessed properly and on time. Assessing IAQ in office buildings of both public and private organizations, should be the main focus of employers and employees in both, developed and developing countries. Industrialized and developed countries have already recognized the health issues that low IAQ could cause. In developing countries, this problem persists and has potential to become a health hazard that may cause a serious money loss problem among the employers.

IAQ is defined by four factors such as temperature, humidity, room air motion and contaminant concentration. Unhealthy indoor air has been estimated to cost the Australian community \$12 billion dollars a year, and is a generally unrecognized significant environmental issue.³ Results of studies conducted in Dutch offices reveal that, on average, approximately 35% of office workers are dissatisfied with the interior climate and approximately 20% suffer from health complaints.⁴ Poor IAQ is costly to U.S. businesses; total costs to the U.S. economy from poor IAQ range as high as \$168 billion per year.⁵ Therefore, this should be a primary concern of developing countries and it is why our main goal is to raise awareness among employers and their employees for the negative effects of poor IAQ upon their performance.

2. IAQ and its effect on performance and health

The complexity of a real environment makes it very difficult to evaluate the impact of a single parameter on human performance, mostly because many of them are present at the same time and as a consequence, act together on each individual.⁶ The results of three

independent experimental studies done by Wargocki et al., have shown that the performance of typical office work (such as typing, arithmetical calculations and proof-reading) can be improved by improving air quality and indicate that this performance may increase by 5% when the air quality is improved from a mediocre level often found in practice to a high level.⁷ Based on existing information and on new research results, five principles are suggested as elements behind a new philosophy of excellence: 1) better indoor air quality increases productivity and decreases Sick Building Syndrome (SBS) symptoms; 2) unnecessary indoor pollution sources should be avoided; 3) the air should be served cool and dry to the occupants; 4) "personalized air", i.e. a small amount of clean air, should be served gently, close to the breathing zone of each individual; and 5) individual control of the thermal environment should be provided.⁸

Extensive scientific research conducted by Roelofsen (2002) has also yielded indications suggesting that improving working environment results in a reduction in a number of complaints and absenteeism and an increase in productivity and the indoor environment has the biggest effect on productivity in relation to job stress and job dissatisfaction.⁹ Figure 1 below shows the performance of office work as a function of % dissatisfied with IAQ from a research study done by Wargocki.

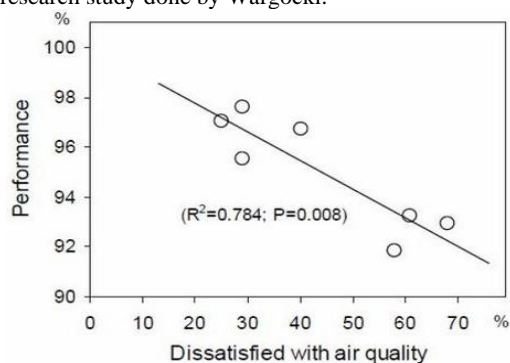


Fig. 1 Performance of office work as a function of % dissatisfied with IAQ¹⁰

In its 1994 rule, OSHA calculated a three percent loss of productivity from IAQ.¹¹ Poor IAQ is associated with many phenomena such as the Sick Building Syndrome (SBS), Building-related Illness (BRI), and Multiple Chemical Sensitivity (MCS), and they all are proven to have major effects on productivity. Since that cost of providing the indoor environment is more than an order of magnitude smaller than the cost of the workers in that place, providing a superior environment may well be the most cost-effective way of increasing worker productivity [Abdou O.A. et al.].

Studies provide us with evidence that indoor environmental quality do influence the prevalence of acute respiratory illnesses, allergies and asthma, and sick building symptoms.¹² Complaints by office workers in the Netherlands have been on the rise since the seventies, which is when new office equipment and arrangements were introduced, such as new spatial concepts (open-plan offices), advanced climate control equipment, new materials, upscaling and computerization [Bergs D. 2002]. Table 1 below shows the three perspectives on acceptable IAQ.

Table 1: Three Perspectives on Acceptable IAQ¹³

Building owners	No complaints, no tenant requirements for ventilation, no tenant polluting activities
US Environmental Protection (EPA) / Public Health Perspective	Minimizes exposure to toxics, irritants; no adverse health effects, no comfort complaints
Building Occupants	Clean, dry, well ventilated; thermally comfortable, no unfamiliar or objectionable odors.

Deteriorated indoor environments cause various symptoms, sicknesses, reduced comfort and loss of concentration which may result in inconsistent work, longer breaks, less care of customers, shorter working hours and sick leaves.¹⁴ Keeping the indoor environment healthy and safe includes listening and assessing employee's complaints on low or high temperature level, air humidity, health symptoms that occurred while working in the office, etc. Uncomfortably high temperatures can cause fatigue, which can then lead to awkward postures such as slouching or slumping in the chair; the cool air blowing directly down can cause cold feet and hands, as well as increased muscle tension and increased risk for tendinitis.¹⁵

According to a studies done by Preller (1990) and Schermer (1992), 27.9% of the complaints and dissatisfaction with office environments (Government Building Agency) in the Netherlands are for the *air quality* which is defined as *stuffy*, *uncomfortable*, and *dry air*. Sick leave reports in Ireland and Great Britain shows that the most cases for sick leave among public administration office workers are because of respiratory problems which may be a product of poor IAQ.¹⁶

4. Discussion

Considering the previously mentioned various health and performance implications, the potential of IAQ for becoming a health hazard for employees in developing countries has risen significantly. Our discussion is based on four main elements: a) performance measurement systems, b) an IAQ survey, c) an IAQ measures and d) an IAQ protocol.

In order to be able to determine IAQ effect on productivity, one organization should be using an adequate performance measurement system. Organizations should be able to determine the significant dimensions of their performance measurement system such as: productivity, effectiveness, efficiency, quality, financial control, equity/fairness etc., as defined by the European Union Ministry of Interior, Public Administration and Decentralization for the purpose of a survey on Public Sector Performance Measurement Systems & Indicators in the EU. Numerous methods and tools are being used by European Union countries. In table 2 are shown methods and tools for performance measurement among EU countries.

Table 2: Methods and tools used for performance measurement¹⁷

Country / Method	CAF	TQM	EFQM	BS	BP/B	Other
Austria	•	•		partly		3-E
Finland				•		I
France						I
Italy						I
Netherlands		•			•	QA, I
Spain	•		•		•	CC, QA

CAF – Common assessment framework

TQM – Total Quality Management

EFQM - The European Foundation for Quality Management Framework

BS - Balanced Scorecard

BP/B – Best Practices/Benchmarking

3-E - Efficiency, Effectiveness, Economy

I - Indicators

QA – Quality Award

CC – Citizens Charters

Therefore, through conducting a survey which can help us determine the health status of the working environment, we can determine if any of the many phenomenons, such as whether the Sick Building Syndrome (SBS), Building-related Illness (BRI), and Multiple Chemical Sensitivity (MCS) are present. The survey should also be based on health implications and the effects occupants have had, or are facing, since they have been working in the present workplace. There are some uncertainties that have to be taken in consideration here, such as the cognitive effect that the whole situation might have on each person, which might mislead employees to answer impulsively on the survey and to give a totally different perception which might not correspond with the real situation. Also, in order to determine if some of the possible health implications are a product of the work environment, or the living habits of the employee, we have to include a part in the survey that will concentrate on defining the employee status outside the workplace, and take in consideration factors such as: socioeconomic statuses, previous health issues, lifestyles, previous working environments, personality types, etc. So far, we have detected two important elements which may help organizations in a way that they could improve their performance: an adequate performance measurement system and employee survey on IAQ status.

The next step would be to do IAQ measuring within a previously determined time period. In Europe, standards and guidelines for common indoor air contaminants from WHO¹⁸, NIOSH¹⁹ and GFEA²⁰ can be used. Measuring the level of IAQ in occupied office buildings will be used in order to conduct an IAQ picture of the working environment. We strongly recommend that the final step which organizations should consider is to implement an IAQ complaint protocol. Complaints have the main objective to resolve issues and problems that are raised by the employees. If something wrong has occurred, an appropriate action should be taken. If we can provide quality statistical data on employees' sick leave for a certain period of time for an organization, a link between IAQ and health implications can be established. One of the main obstacles may be the lack of adequate performance measurement systems in both private and public organizations in developing countries.

5. Conclusion

Research on IAQ show that low IAQ significantly decreases productivity and performance among office workers. In the future it is necessary to raise awareness for the working environment especially in developing countries which may be facing a serious health hazard. Of huge importance is to take in consideration and asses problems connected with poor IAQ and health implications which may occur on the workplace. Signs as health implication,

worker complaints, increased sick-leave, absenteeism and reduced productivity shouldn't be ignored. Defining an adequate performance measurement system for public and private organizations which will provide accurate data as well as an IAQ protocol that will promote fast IAQ problem assessment may be the future of health workplaces. Employers should concentrate on creating healthy workplace and reduce productivity loss from low IAQ.

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