



## STUDIES ON THE NEED TO MONITOR IAQ INDICATORS IN THE PRODUCTION HALL WITH MICROCLIMATE WITH HEAT RELEASE - STUDY ON COMPANIES FROM MURES COUNTY

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### Abstract

*Hundreds of millions of people around the world spend almost a third of their day at work. Many of them are dissatisfied with the climatic conditions in which they work, being exposed to various risks of heat or cold. The most common reasons for dissatisfaction are elements related to IAQ (Indoor Air Quality), in other words, thermal comfort and air quality inside the buildings. Thus, the assessment of the microclimate in the workplace is very important, and the IAQ indicators play a decisive role in the mental and physical capabilities. This writing wants to identify for the area of Mures county how many of the managers of the production halls with microclimate with heat release, where the workers are exposed to stress because of the heat, are aware of these elements and give them the proper importance.*

**Key words:** Indoor air quality (IAQ), comfort level, Corporate Social Responsibility, employee health

### 1. Introduction

Indoor air quality plays a major role in terms of employee health, an element emphasized by many researchers. [2], [7]. The interdisciplinarity of this subject also emerges from the studies of civil engineers [1], [8], who have established with certainty, the causal link between the low indoor air quality in the student classes and the poor school performance and even the increased incidence of respiratory diseases at children, a fact even pointed out by Romanian researchers. [3] The study of the air quality in the office spaces was one of the topics of interest also for the Romanian researchers, [4] who demonstrated that the thermal discomfort affects the work capacity proportional to its

severity. They concluded the need to ensure a proper microclimate at the workplace, an important factor for solving tasks by requesting concentrated attention. The closest researches [9] in the field of the proposed project are carried out by researchers in Denmark, who concluded that poor indoor air quality can reduce office work performance by 6-9%. They also performed some simulations in their research laboratories and demonstrated that there is an approximate linear relationship between performance decline and indoor air quality. However, laboratory experiments and field intervention experiments demonstrate that performance decline may be greater in practice than in laboratory simulations. Other

researches in the field [5] also report the impact of the perceived quality of the indoor air, in order to decrease the productivity in the air-conditioned office buildings. Indoor air quality (IAQ) can be predicted using classical mechanical models, or it can use statistical models, which are demonstrated by measured data. Statistical models have great potential to explore captured IAQ in large measurement campaigns or in real busy environments. A recent study [6] identified thirty-seven publications in which statistical models were applied to predict IAQ. These studies have been published in the last decade, indicating the emergence of awareness and application of statistical modeling in the field of IAQ. From a business perspective, employee performance is directly related to the environmental conditions at the workplace, so the project will identify to what extent these IAQ parameters are known by the managers who calculate the labor productivity in the production halls.

## 2. Purpose and Methodology

The results obtained through the present research are important as they can help to increase the CSR activities of the companies through awareness but also by identifying environmental problems in the production halls. The research was carried out through the events organized in the project "IAQ study according to EN ISO 7730[10] and ASHRAE 55 [11] and its influence on the KPI calculation."

This writing aims to evaluate how an important element of ergonomics in the workplace, namely IAQ (Indoor Air Quality), is known by the production managers as an important element that can influence the activity of the workers in a hall of production. Thus, this work is an important one within the concept of CSR (Corporate Social Responsibility) and the way in which it is viewed by the productive companies. It is known that working standards are always increasing and optimization is an important element in any mass or series production activity, but the results depend on the way employees are treated. They may or may not add value.

At the level of the institutions in the area, there it is not implemented a program for monitoring the stress factors in the respective microclimate, but in the institutions are interested for the application of some statistical methods for the identification of IAQ.

There were 20 questionnaires distributed by e-mail to the companies in Mures county that have production halls with microclimate with heat release. The distribution of the types of production halls can be found in Figure 1 below.

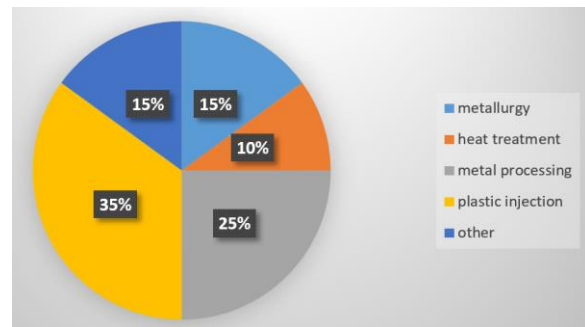


Fig. 1: The distribution of the types of production halls

Thus, we identified several hypotheses that we tried to analyze through the questionnaire.

H1 - At least half of the production companies know the specifications of SR ISO 7730: 1997 - Moderate thermal environments [10].

H2 - It is considered that in the halls, the ambient temperature influences the most the conditions of thermal comfort

H3 - Production managers are aware that the CO2 content of carbon dioxide can influence the inefficiency of the activities.

H4 - The quality of the ambient air and the level of comfort at the workplace is a basic condition for performance and productivity.

## 3. Results of the research

Due to the fact that the technology and equipment used, creates a significant thermo-hygienic microclimate in the production halls, IAQ assessment at the work places is very important. This study dealt with companies where workers are exposed to heat stress, measuring and processing results in accordance with SR ISO 7730: 1997 - Moderate thermal environments. Determination of PMV (Predicted Mean Vote) and PPD (Predicted Percentage Dissatisfied) indices and specification of thermal comfort conditions, SR EN 27243: 1996 - Warm environments are important starting elements in any assessment.

Thus, in the questionnaire I asked about knowing the specifications SR ISO 7730: 1997 - Moderate thermal environments. Unfortunately, as Figure 2 shows, our hypothesis H1 - At least half of the production companies know the specifications of SR ISO 7730: 1997 - Moderate thermal environments are denied, as only 25% of the respondents said they give importance to this standard and they know it.

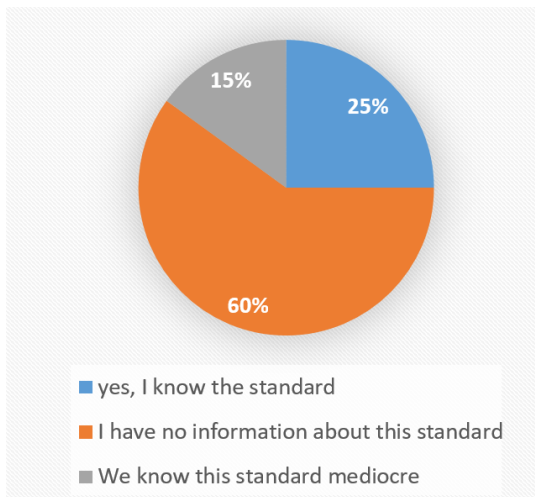


Fig. 2: Do you know the standard SR ISO 7730: 1997- Moderate thermal environments ?

Predicted Mean Vote (PMV) is the average thermal sensation of a large group of people. The PMV value is calculated based on the ambient temperature, the radiated temperature, the air flow, the relative humidity and values such as the clothing index and the activity level, which represents a measure of the energy produced by a person. A person in complete rest has a basic metabolic rate of  $M = 0.8$  met (met = metabolic rate = metabolic unit, 1 met =  $58 \text{ W / m}^2$  of

body surface).

PPD (Predicted Percentage Dissatisfied) is an indicator that shows the proportion of people dissatisfied with the indoor climate, and the value is indicated as a percentage. PPD cannot be registered below the 5%, because thermal comfort will not be perceived by everyone in the same way.

The PMV / PPD ratio is one of the basic indicators of the IAQ, representing an objective perspective of the thermal comfort level. This report can be measured using an IAQ measuring set, which contains a collection of probes. Together, they are mounted in the respective workplace at the employee's working height. The measurement program of the PMV / PPD must be performed after step by step measurements, indicating the specific clothing and activity index.

Thus, the results of our questionnaire showed that employers consider that the PMV / PPD ratio can be regulated by controllable elements, such as: influential ambient temperature (24.5%), radiated temperature (19.4%), air flow (6.3%), relative humidity (31.7%) and values such as clothing index (12.9) and activity level (5.2%). Thus, according to these data and as shown in Figure 3, Hypothesis H2 - It is considered that in the halls, the ambient temperature influence influences the thermal comfort conditions the most.

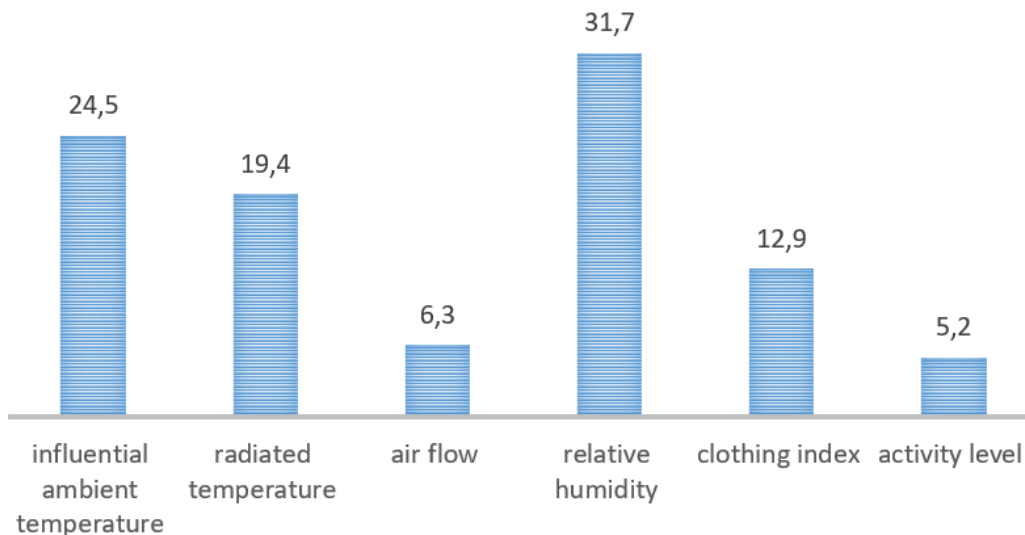


Fig. 3: What do you think can affect the thermal comfort conditions ?

In assessing the comfort level, maintaining air quality in indoor spaces is an important factor, and the carbon dioxide (CO<sub>2</sub>) content may be the cause of inefficiency problems due to fatigue or lack of concentration.

The results of our questionnaire (Figure 4) show, however, that the managers consider that others are in fact the important reasons for the inefficiency of the activities, and the lack of concentration or fatigue is mainly due to other reasons, and only 12% is attributed to the CO<sub>2</sub> content from the breathed air.

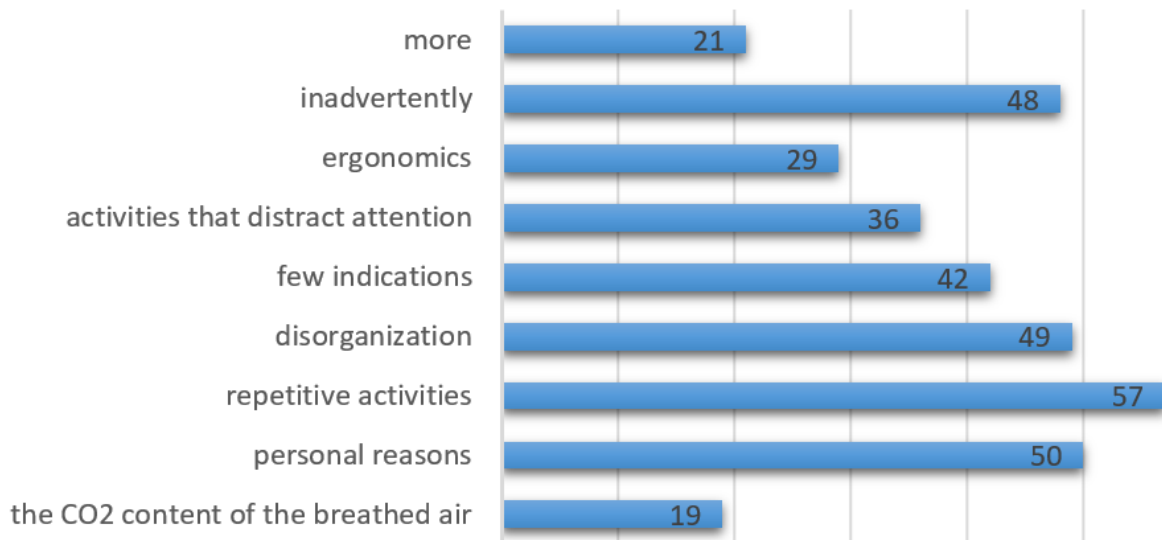


Fig. 4: What do you consider to be the reasons for the inefficiency of the employees' activities?

For measuring CO2 level, long-term measurements can be made during the working day. The software contained by the new measuring devices can identify the moment when the CO2 concentration is maximum and thus take some corrective measures.

In some cases, by overlapping diagrams of the

process steps based on the production data, lead time (LT) and the Flow Factor (FF) with thermal comfort indicators, we can obtain identical curves. These assumptions may be related to an addiction to these elements, and once identified, measures to improve the working climate can be taken for optimal results.

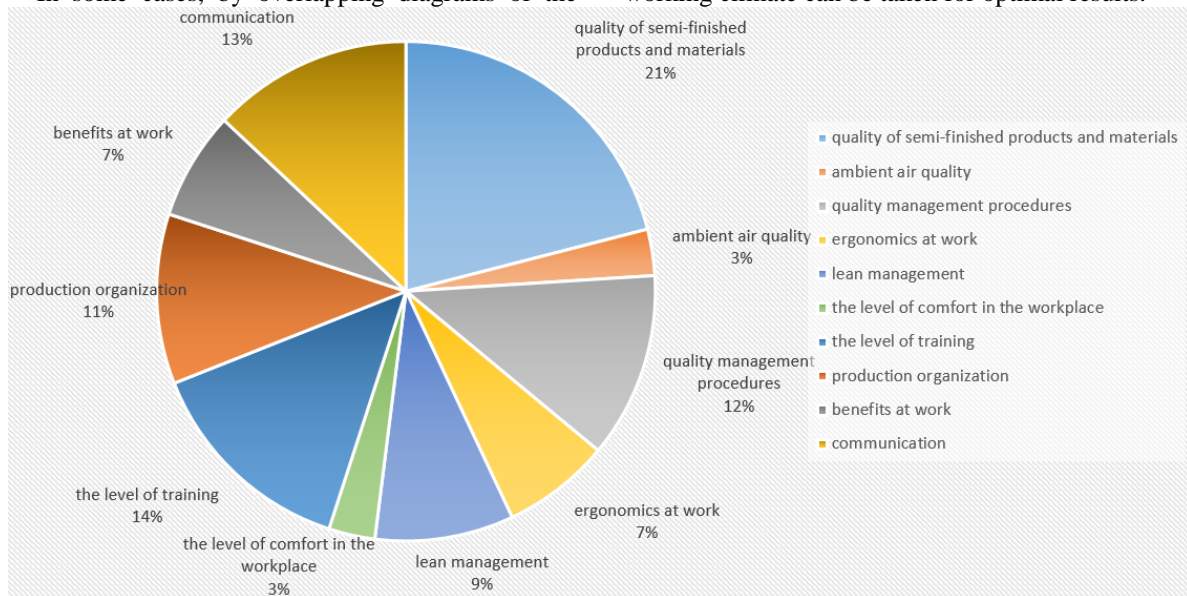


Fig. 5: Which you think are important prerequisites for performance and productivity

Hypothesis H4 - The quality of the ambient air and the comfort level at the workplace is a basic condition for performance and productivity, but it was rejected, as shown in Figure 5, because from the analysis of the results of the questionnaire, the quality of the ambient air and the comfort level at the workplace seems to be an unnecessary luxury for the employees and less a basic condition for performance and productivity.

#### 4. Proposals and conclusions:

From this study it is clear that IAQ (Indoor Air

Quality) is an element of ergonomics in the workplace, known by the production managers, but little evaluated and monitored, given that its importance is clearly diminished, there are no studies on to the way in which the IAQ can influence the activity of the operators in a production hall.

The fact that only Hypothesis H2 - It is considered that in the halls, the ambient temperature influence most influences the thermal comfort conditions is confirmed, we are ambitious to demonstrate that the perception on the hypothesis H3 - Production managers are aware that the carbon dioxide content

CO2 can influence the inefficiency of activities as well as H4 - The quality of the ambient air and the level of comfort at the workplace is a basic condition for performance and productivity can be changed after we can factually prove how the conditions of the environment influence the production data, both lead time (LT) and the Flow Factor (FF).

The following research, based on the results of this study, will thus try to concretely monitor a series of IAQ indicators in production rooms with microclimate with heat release, where workers are exposed to stress due to heat. Specific parameters will be monitored, such as comfort level PMV (Predicted Mean Vote) / PPD (Predicted Percentage

Dissatisfied), WBGT (Wet-Bulb Globe Temperature) thermal stress indicator. All measurements as well as processing of the results will be carried out in accordance with SR ISO 7730: 1997 - Moderate thermal environments. Determination of PMV and PPD indices and specification of thermal comfort conditions, SR EN 27243: 1996 - Warm environments. Estimation of the human thermal stress at work based on the WBGT index (humid temperature and globometer), as well as with the American standard ASHRAE 55 - Thermal comfort conditions for the occupants of the buildings.

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