



TECHNICAL UNIVERSITY OF CLUJ-NAPOCA

ACTA TECHNICA NAPOCENSIS

Series: Applied Mathematics, Mechanics, and Engineering
Vol. 64, Issue Special I, January, 2021

INTERPRETIVE STRUCTURAL MODELLING APPLICATION FOR EVALUATING ERGONOMICS FACTORS OF THE PUBLIC SECTOR

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Abstract: Ergonomics is important for both the public and private sectors. Ergonomics contributes to: improving working conditions, improving human characteristics, improving workplaces and designing equipment, designing and organizing work, employee health and safety. Assessing ergonomics factors in public institutions is a challenge for researchers, governments and local and national authorities. This research proposes a hierarchical framework for assessing the importance of ergonomics in these institutions. The proposed framework consists of performance measures for the improvement and evaluation of institutional policies, relationships between people, working conditions of the various factors that contribute to the work performance. The assessment of ergonomic factors captures the entire activity of public institutions. The framework was tested using data from a public institution. At the end of the paper, a model of framework performance elements is proposed which was developed using interpretive structure modeling (ISM).

Key words: Public sector, ergonomics, sustainability, human characteristics, work condition, health and safety, employee.

1. INTRODUCTION

The public sector is that segment of the economy that integrates all of government and government-controlled enterprises. Private companies, voluntary organizations and households are not included in this sector. The subjects that intervene in the public sector are ministries and government bodies, state and private companies, which develop public or private goods [1; 2].

The public sector tries not to generate profit and is made up of organizations that are owned and operated by the government. This sector existed to provide services for its citizens [1].

Ergonomics aims to improve the work systems taking into account the different tendencies of the environment. This concept contributes to improving the characteristics, abilities and limitations of people, or stakeholders, to increase performance efficiently, comfortably and safely [1; 2; 3].

The current conditions of the working environment have changed, based on the implications of digitalization, sustainability and

increasing the level of innovation. In these conditions, both the private and the public sectors make different efforts to get involved in these actions [3]. There is a connection between ergonomics, sustainability and innovation. Thus, the assessment of the work environment considers different directions aimed at sustainable development [3; 5].

When different measures are taken, they must be innovative. If we talk about the private sector, the level of innovation is increased and the steps to get involved in sustainable development are numerous. But in the public sector, the level of innovation is not at the same intensity because there are several barriers [11].

The requests for involvement in sustainable development are more numerous due to the involvement of local administrations in improving the living conditions of the inhabitants [4; 6]. There are certain requirements regarding the quality of the air, of the agglomerations at certain points, of the types of transport used in the cities, the quality of the water and other directions that contribute to

reducing the negative impact on the inhabitants [4].

Improving the conditions of the workspace, improving the human characteristics, improving the jobs and designing the equipment, designing and organizing the work, the health and safety of the employees are the elements concerned with the field of ergonomics [7]. If these elements are evaluated and improved under the conditions of sustainable development and innovation, the results obtained in public administration are valuable [11].

The specialized literature presents some missing elements from the perspective of the ergonomics of the workplace in public institutions. This study aims to identify the main factors of ergonomics that contribute to the good performance of the activity of the public sector. The research was carried out using interpretive structural modelling, taking into account the factors identified by the key individuals.

2. LITERATURE REVIEW AND METHODOLOGY

2.1 Basic concepts of research

Under the current conditions of globalization and global sustainability, every aspect of human life - science and technology, culture, economic, environmental, social and political has undergone an extraordinary transformation [7]. In these circumstances, it is clear that the economic and environmental aspects have undergone a number of changes. In this context, more and more ergonomics are taking place. The aspects of ergonomics are found in all aspects evaluated [11].

Ergonomics is that the science of creating jobs and the work environment in which the worker or their user find their place. Ergonomics aims to minimize the physical efforts on the worker (or users of the environment) by restructuring the physical work environment based on the basic elements of the functioning of the human body.

The results obtained from applying the action of ergonomics refer to: reducing physical fatigue, pain and other health problems. Ergonomics is oriented towards the design of a sustainable working environment to satisfy the comfort and health of the people, of the human

beings directly involved in the activities of the institution [10;8].

The principles of ergonomics concern the stakeholders and the relationships between them [8]. The stakeholders involved in the relationship with the public sector are presented in Figure 1.

As can be seen in the Figure, there is a bidirectional relationship between the public sector and several stakeholders. This category includes: government, employees, and supplier. Between the public sector and clients, other agencies, tax payers are unidirectional. These relationships were established based on the relationships the public sector develops with these stakeholders.

2.2 Research methodology

The review of the specialized literature has led to the identification of frameworks for the evaluation of ergonomics factors in the private sector. Most of these models use qualitative methods or qualitative method of appreciation. By evaluating the existing research, we have been able to identify several categories of factors that appear in the ergonomics of the workspace in this sector [7; 8; 9].

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Following the evaluation of the specialized literature, a framework was developed. This framework consists of performance measures for the improvement and evaluation of institutional policies, relationships between people, working conditions of the various factors that contribute to the work performance.

The next step was an empirical test. There were semi-structured interviews with employees. The suggestions obtained were implemented within the proposed framework. To validate the proposed framework, interpretive structured modeling (ISM) was used.

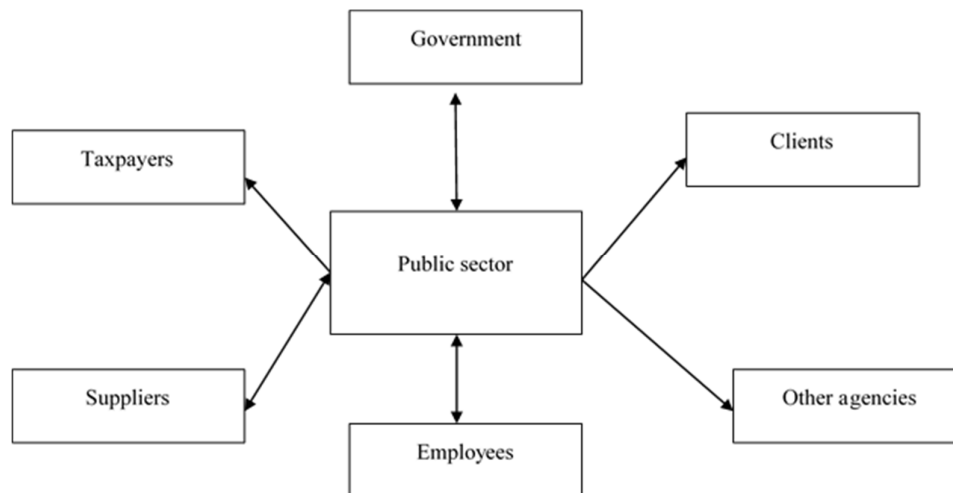


Fig. 1. The stakeholders involved in the relationship with the public sector

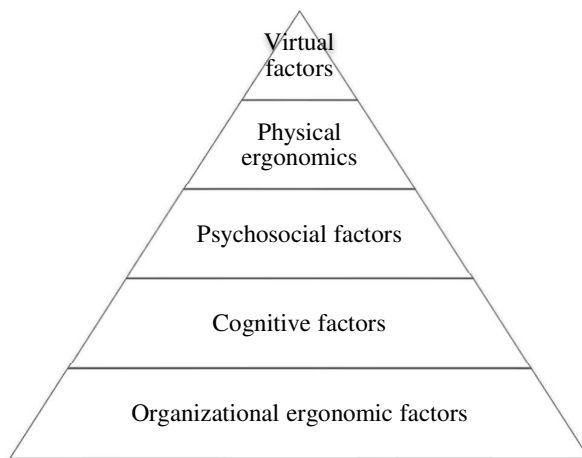


Fig. 2. The 5 levels of the proposed framework

Finally, the following research directions were developed. Following the research of the specialty literature and the interviewing of the public sector employees (between May and December 2019), 5 levels of ergonomic factors were identified that contribute to the good performance of the activity in the public environment [10].

In a semi-structured interview, the interviewer asks the subjects a few predetermined questions, and the rest of the questions are not planned (in advance). This technique combines both structured and unstructured interview styles, which can offer the advantages of both. It offers the opportunity to ask additional questions to clarify some issues [8]. Interpretative structural modeling (ISM) is a

process that transforms certain unclear and poorly identified mental models into visible, systemic, well-defined models that can be used in different fields [7]. The brainstorming management method was used to record the opinions of the experts in the structural self-interaction matrix.

3. THE PROPOSED FRAMEWORK FOR ERGONOMICS FRAMEWORK

The framework proposed after the research is proposed in Figure 2. It can be observed that this framework comprises 5 levels. The basis is organizational ergonomic factors because the interaction and activities of the worker depends on the factors of the institution in which he works.

The next level is occupied by cognitive factors. The third level is occupied by psychosocial factors, and then the fourth level is physical ergonomics. Due to the current conditions, most of the activities are carried out in the online environment. The employees work at home, and the interaction is only in the online environment. The online environment has made its mark on how employees behave and how they work.

These categories for the proposed framework levels are described in Table 1. These factors were established after the specialized literature was studied and a semi-structured interview was applied to 45 public sector employees.

A small description of the factors of the measured categories

| Level | Factors | Description |
|----------------------------------|--|--|
| Organizational ergonomic factors | Adaptive Coordinator (AC) | The typology of the coordinator at the workplace influences the employee. |
| | Hierarchical task analysis (HTA) | The hierarchy of tasks is an important activity for strengthening working relationships. |
| | Risk Perception (RP) | The level of perceived risk contributes to the smooth functioning. |
| | Lighting of the space (LS) | Lighting of the workspace is important for the work of public sector employees. |
| | Delay in Payment (DP) | Payment delays are identified factors that influence employees. |
| | Working Overtime (WO) | Loading of employees with multiple tasks is not accepted by the employees. |
| Cognitive factors | Stress (S) Easy to Use (EU) Task sharing (TS) Mental Workload (MW) | The cognitive factors contribute to the daily activities: stress, ease in performing tasks, possibility of separating activities and mental loading with activities. |
| Psychosocial factors | Personal statement (PS) Gender based Work (GW) Mode of Communication (MC) General health (GH) | The self-image perceived in the employee's mind, the gender, the communication and the general state of health contribute to the good performance of the activities. |
| Physical factors | Sound (S) Working environmental (WE) | The sound from the rooms and the working environment (the environment) were considered important. |
| Virtual factors | The level of interaction (LI) Complexity of the System (CS) Lack of Trust (LT) | The factors of the remote work influence the state of the employees. |

4. EMPIRICAL TESTING OF FRAMEWORK IN ROMANIAN PUBLIC SECTOR

Interpretative structural modeling (ISM) is an interactive learning process. It is an interpretive method because the group's judgment decides whether and how the elements are linked.

Within this method we talk about structural relationships between the elements of a system. These direct and indirect relationships between the factors describe the situation much more accurately than if the evaluation had made it unique. ISM develops a series of information on various established factors.

The application of ISM will be done for the 19 factors structured in Table 2. The method follows the following steps [9; 12]:

- a. The 19 established elements were selected.
- b. A structural self-interaction matrix (SSIM) is made for the elements selected from point a.

- c. Initial reachability matrix is achieved by converting it into a binary matrix (we replaced V, A, O with elements X, 1 and 0).
 - V = parameter i will lead to parameter j. In the binary matrix the (i, j) becomes 1 and the (j, i) entry becomes 0.
 - A = parameter j will lead to parameter I. In the binary matrix the (i, j) becomes 0 and the (j, i) entry becomes 1.
 - X = parameter i and j will lead to each other. In the binary matrix the (i, j) becomes 1 and the (j, i) entry also becomes 1.
 - O = parameters i and j are unrelated. In the binary matrix the (i, j) becomes 0 and the (j, i) entry also becomes 0.
- d. Integration of the reachability matrix transitivity.
- e. The result obtained is shown in Figure 3.

Table 2

Final reachability matrix

| # | Elements | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | Driving power |
|----|----------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|---------------|
| 1 | AC | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 19 |
| 2 | HT A | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 19 |
| 3 | RP | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 19 |
| 4 | LS | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 15 |
| 5 | DP | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 15 |
| 6 | WO | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 15 |
| 7 | S | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 14 |
| 8 | EU | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 13 |
| 9 | TS | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 13 |
| 10 | MW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| 11 | PS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| 12 | GW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| 13 | MC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 7 |
| 14 | GH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 6 |
| 15 | S | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 5 |
| 16 | WE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 5 |
| 17 | LI | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| 18 | CS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| 19 | LT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 |

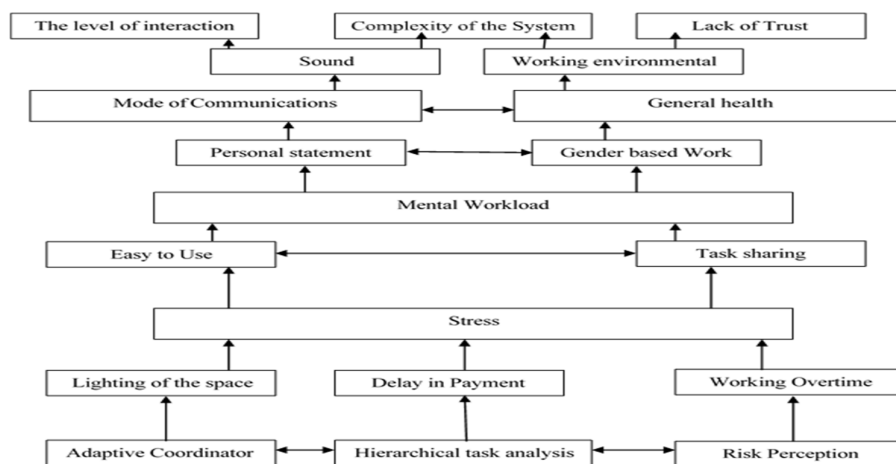


Fig. 3. The ISM model of the proposed framework

5. CONCLUSION

This study highlights the main ergonomic factors identified in the literature for the public sector. A semi-structured interview was applied to select the ergonomic factors that are applied in the public sector in Romania. These factors constitute a hierarchical evaluation framework, depending on the results of the interview.

The framework was tested in public institutions in Romania and the ISM model of the proposed framework was obtained. This is shown in Figure 3. The Romanian public

institutions invest and evaluate ergonomic factors to increase the motivation level of the employees.

No critical factors were identified. Future research will target the public sector.

6. ACKNOWLEDGEMENT

This work was partially supported by research grant GNaC2018-ARUT, no. 1359/01.02.2019, financed by Politehnica University of Timisoara.

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Aplicarea modelării structurală interpretativă pentru evaluarea factorilor ergonomici în sectorul public

Rezumat: Ergonomia este importantă atât pentru sectorul public cât și pentru cel privat. Ergonomia contribuie la îmbunătățirea condițiilor mediului de lucru, minimizarea condițiilor de solicitare a lucrătorilor, îmbunătățirea concepției locurilor de muncă și a echipamentelor, concepția și organizarea proceselor de muncă, a condițiilor de sănătate și securitate a angajaților. Evaluarea factorilor ergonomici în instituțiile publice reprezintă o provocare pentru cercetători, guverne și autoritățile locale și naționale. Această cercetare propune un cadru de ierarhizare pentru evaluarea importanței factorilor ergonomici în aceste instituții. Ca urmare a aplicării cadrul propus se pot elabora măsuri pentru îmbunătățirea și evaluarea politicilor instituționale, a relațiilor dintre oameni, a condițiilor de muncă și a altor factori ce contribuie la derularea productivă a proceselor de muncă. Evaluarea factorilor ergonomici surprinde întreaga activitate a instituțiilor publice. Cadrul de ierarhizare a fost testat folosind date reale de la o instituție publică. În finalul lucrării este prezentat un studiu de caz dezvoltat folosind modelarea interpretativă structurală (MIS).

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