REVISTA Ação Ergonômica

R. Ação Ergon., 16(2), 2022.
ISSN 2965-7318. doi: 10.4322/rae.v16n2.e202218.en

COGNITIVE ASSESSMENT OF WORK: APPLYING THE TECHNIQUE OF COGNITIVE ANALYSIS OF WORK

Carmen Elena Martínez Riascos[1]*

Nathalia Lamari[2]

Jéssica Mayumi Takeshita[3]

Carlos Sobrinho[4]

Ana Paula Perfetto-Demarchi[5]

Abstract

Ergonomic Work Analysis (EWA) is a methodology that aims to assess workplaces to identify risks and propose improvements. It covers physical, cognitive and organizational aspects, and is regulated by NR-17 in Brazil. EWA comprises structured analyses, including analysis of demand, task, activity, diagnosis and ergonomic recommendations.

Cognitive work analysis, part of EWA, was defined with several methods by Carvalho and Vidal (2008), aiming to understand and transform work activity to promote worker well-being and improvements in the company. The Cognitive Work Analysis Technique (TACT) is applied in nine stages, including collecting spontaneous reports, observing activities, preparing knowledge process maps, guided interviews and final diagnosis.

A case study applied TACT in an insurance brokerage, evidencing differences in cognitive load among employees. The results highlighted issues such as handling digital platforms, the need for multiple information devices and overload of online services. Based on this, interventions were proposed to improve working conditions and reduce cognitive risks.

It is concluded that ergonomic assessment should encompass physical, cognitive and organizational analyses, and the application of TACT can contribute to a complete AET, enabling the identification and control of risks in different work domains.

Keywords: Cognitive ergonomics; Ergonomic Work Assessment; Occupational risks; Cognitive load at work; Cognitive Work Analysis Technique.

1. INTRODUCTION

The Ergonomic Analysis of Work (AET) defined by Santos and Fialho (1997) is a methodology used to evaluate the workplace and its surroundings, to identify risks, observe work situations, propose changes for improvements, etc. This analysis must be carried out

[1]UEL. *carmen.elena.mr@uel.br.
[2]UEL.
[3]UEL.
[4]UEL.
[5]UEL.

holistically, including both the physical aspects of the activity and the cognitive and organizational aspects. all of which generate occupational risks. The AET is divided into analysis of demand, task, activity, diagnosis, and ergonomic recommendations (BRAATZ et al., 2021), corresponding to a set of structured analyses, applied according to the risks and type of occupational activity. It is used to understand and transform the activity of individuals in an organization, generating well-being for the worker and improvement for the company (GUÉRIN *et al.*, 2001). ELA can often lead to transformations of technical systems, in the organization of work, as well as in the organization and management of the company (WISNER, 2004). This method is regulated by NR-17, a standard that aims at the employer's compliance with the practices and rules that adapt the work, making it safe for the worker's mind and body, covering the entire workspace and all activities developed by employees (BRASIL, 2021).

A part of the ELA corresponds to the cognitive analysis of the work. This cognitive analysis was defined by Carvalho and Vidal (2008) with several methods, techniques and instruments that aim to elucidate the way specialists, experts and other professionals perform it, based on the generic ergonomic analysis model of Marmaras and Pavard (1999). According to Carvalho and Vidal (2008), there was a change of paradigms and was concurrently appropriated by several disciplines, such as computer science, psychology, anthropology, ergonomics and engineering, and led to the introduction of new methodologies, concepts, models and terminologies. Based on this, the authors state that there is no exact and correct rule for the analysis of complex skills or cognitive capacities, which sounds coherent, as changes in work environments have been increasingly rapid, as well as the development of new methodologies from the most diverse fields of knowledge and studies.

The present research aimed to evaluate the cognitive load of the workplace using the Cognitive Work Analysis Technique.

2. METHOD

The present study has an applied nature, as it provides information that can help in the optimization of the work environment analyzed. Regarding its objective, it is an exploratory-descriptive study, as it aims to explain and describe the cognitive assessment of the workload. Finally, in terms of technical procedures, it was framed as a case study carried out in a company that sells insurance by applying the Cognitive Work Analysis Technique in two office assistants. The case study was based on a bibliographic research (GIL, 2008).

The Cognitive Work Analysis Technique (TACT), applied in this research, consists of 9 steps: Collect spontaneous reports; Systematically observe individuals at work; Prepare the map of the knowledge process (inputs, cognitive process, results); Perform the preliminary diagnosis; Structure the directed interview (mental load, decision-making, cooperation and communication); Apply the directed interview; Tabulate the directed interview; Perform the final diagnosis; Define the intervention proposal (PERFETTO- DEMARCHI, 2021).

In the collection of spontaneous reports, the workers explain how they understand the work they do. Systematic observation allows them to identify how they perform their activities, the risks to which they are exposed, which work tools they use, as well as the time dedicated to each part of the activity. With this information collected, the visual representation of the activities is carried out with the Knowledge Process Map. On the map, it is possible to record the order in which each worker performs the activities, the inputs used, the interaction with the work environment, as well as the worker's resources (characteristics of the person) and external resources (characteristics of the system's design) that may be influencing the process to obtain the results of the activity. Which allows the preliminary diagnosis to be made.

Then, it is possible to structure the directed interview. TACT has a Guide for the Directed Interview of Cognitive Factors at Work. It is composed of questions that will allow the identification of mental load factors, decision-making factors and those of communication and cooperation. The questions are adjusted according to the workstation to be analyzed. Once the interview is done, the answers are tabulated. Soon to make the final diagnosis. Finally, define the intervention proposal.

3. DEVELOPMENT

Cognitive Ergonomics focuses on individuals' ability to memorize, attention, perception and other cognitive processes. It refers to mental processes such as perception, memory, reasoning, and motor response as they affect interactions between humans and other elements of a system. Relevant topics include the study of mental workload, decision-making, specialized performance, human-computer interaction, stress, and training as they relate to projects involving humans and systems (IEA, 2019).

According to Richard (1990), mental activities can be inferred from behaviors and verbalizations, and can be simulated by information treatment models. Mental activities can be defined by the nature of the information from which they work and the decisions they produce. The information from which they come is the result of sensory treatments, the identification of

objects and their position, movements, changes and their succession, which are the basis for the perception of events, identification of lexical elements and syntactic marks and, one can also add, the identification of propositional meanings.

In order to assess the cognitive risk present in occupational activities, the Cognitive Work Analysis Technique was used. TACT is structured in 9 steps, described in the method section, of which we present the highlights below. Those that contribute to the differential in the cognitive assessment process.

First, the collection of spontaneous reports, in which the worker makes a verbal explanation of the work he performs, what inputs and resources he uses, how to perform the activities, and how he perceives the work he performs with the objective of making an initial identification of the worker's perception of the activities of his work. The worker presents the activities with a particular chronology, emphasizing the degree of importance of the stages of his work, according to his perception, emphasizing what he considers most relevant and the most exhausting for him.

Secondly, the creation of the map of the knowledge process, which graphically represents how the worker performs the activities, the order in which they are carried out, at what time he uses the resources and inputs and how he obtained the results of the work performed.

And in the third place, the questionnaire to assess the characteristics of Mental Load: refer to intra-individual management - level of knowledge. From Decision Making: the interest is knowledge management in the relationship of the individual with labor elements. And finally, Cooperation and Communication: if the objective is schematized, how various people share and communicate their knowledge.

The other stages are similar to the other processes of the AET: the observation of the activities carried out, the diagnosis and identification of risks and the definition of improvement proposals.

4. Results and Discussions

The company in the case study is an insurance broker that provides insurance intermediation services for damage and theft of vehicles, life, business, residential, cell phone-notebook, travel and civil liability. It sells insurance from 15 insurance companies and has 6 employees.

In the initial part of data collection, each employee was asked to make a spontaneous report, explaining what the activity they perform consists of. Each employee explained their functions and activities, starting with those they consider most important, those that generate some type of discomfort, to the least important. Among the reports, we highlight:

Collaborator 1: "My routine consists of telephone calls, WhatsApp messages with customers, control of customer payments, emails, and closing insurance contracts on the computer. And in addition, help to collaborator 2." Conclusion: it is noted that employee 1 presents discomfort for helping employee 2, in addition to having her daily functions.

Employee 2: "In my day-to-day I provide customer service, closed insurance protocols, follow up on claims by phone and emails." Conclusion: it is noted that collaborator 2 has a restrictive view of her role, so she does not broadly address what she really has to perform.

Then, the employees' routine was observed and the knowledge process maps were elaborated, presented in Fig. 1 for collaborator 1 and in Fig. 2 for collaborator 2. The Map is a visual tool that presents the sequence of activities carried out by each employee, the interaction with materials and resources to obtain the results.

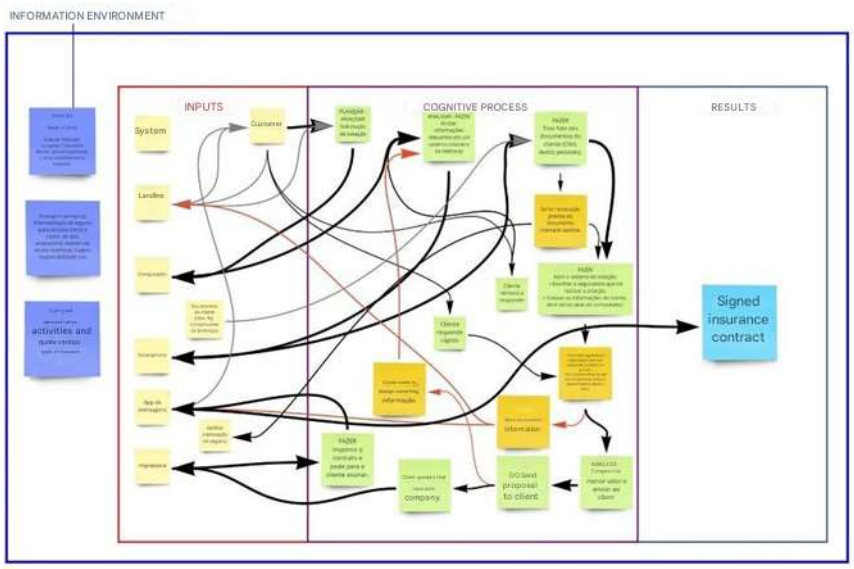


Figure 1. Map of the knowledge process of Collaborator 1 (Authors)

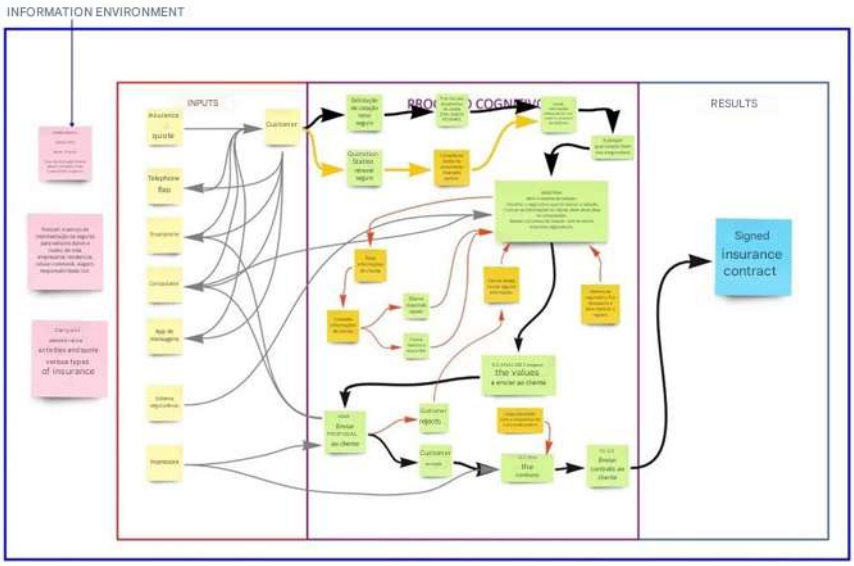


Figure 2. Map of the knowledge process of Collaborator 2 (Authors)

It was possible to see differences in the process carried out by each employee to perform the same activity. The inputs were used at different times, as well as the sequence to carry out the process.

Analyzing the spontaneous reports, the observations of the activities and the elaboration of the knowledge maps, the preliminary diagnosis was carried out, identifying: The activity demands a lot of attention, since the result is a contract proposal for the client; Manipulation of the platform during the entire working period; Need to handle more than one Information Device at the same time; Discomfort of employee 1 for helping employee 2; Printing system only for one computer, interrupting the concentration and performance of the employee 1. Collaborator 2 has a restrictive view of her function, so she does not broadly address the various activities she performs; The system expires and the employee starts the whole process again; Increased mental load due to the number of online calls (Responds to an average of 30 different customers at the same time on WhatsApp); It takes time to make the quotation in all insurance companies.

Then, the occupational risks were identified, namely: Employee 1 - Discomfort for performing support activities for the other employee, Mental processes, Mental workload, Decision making, Human-computer interaction, Stress, Reasoning and motor response and Monotony; Collaborator 2 - Mental processes, Mental workload, Decision making, Human-computer interaction, Stress, Reasoning and motor response and Monotony.

Next, the directed interview was organized with 8 questions related to mental load factors, 7 to decision-making and 4 to communication and cooperation. For each question, the

employee had to select between the levels: total, high, medium, low or not applicable. Each employee has a different perception of the work performed, generating a different cognitive risk. Figure 3 shows that Collaborator 1 has a higher mental load than Collaborator 2, confirming what was manifested in the spontaneous report of Collaborator 1.

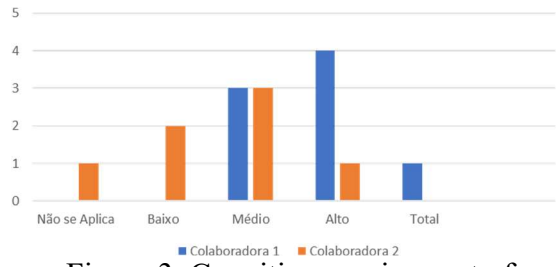
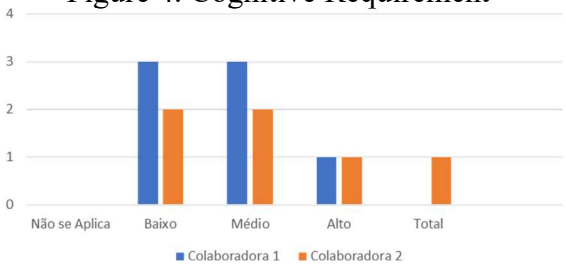


Figure 3. Cognitive requirement of mental load (Authors)

Figure 4. Cognitive Requirement for Decision Making (Authors)



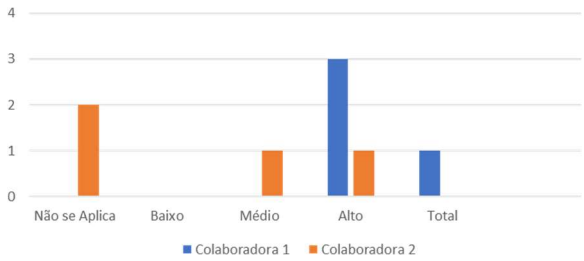


Figure 5. Cognitive requirement for Communication and cooperation (Authors)

Figure 4 shows that employee 1 has decision-making at all levels. And finally, Figure 5 presents the cognitive requirement of communication and cooperation, where Collaborator 1 presents the load at the high and total levels. While Collaborator 2 qualified that some cognitive requirements of this section do not apply to her.

In the penultimate stage, the Final Diagnosis of the mental load of the workstation was carried out: Activity demands a lot of attention, since the result is a contract proposal for the client; Manipulation of the digital platform throughout the work period; Need to handle more than one Information Device at the same time; Discomfort for helping the collaborator 2; Printing system for one computer only, interrupting the employee's concentration and performance 1. Collaborator 2 has a restrictive view of her role, so she does not broadly address what she really has to perform; Registration of the same customer data information on each insurance company website; Reprocess of customer information in the system, when the time of use expires, the employee must start the whole process again; Increased mental load due to the number of online consultations; (Responds to an average of 30 different customers at the same time on WhatsApp); It takes time to make the quotation in all insurance companies.

As an intervention proposal, 6 activities were defined to be carried out to improve the conditions of the workplace in an attempt to reduce the cognitive risk of the evaluated employees. Figure 6 presents the proposed schedule for the company.

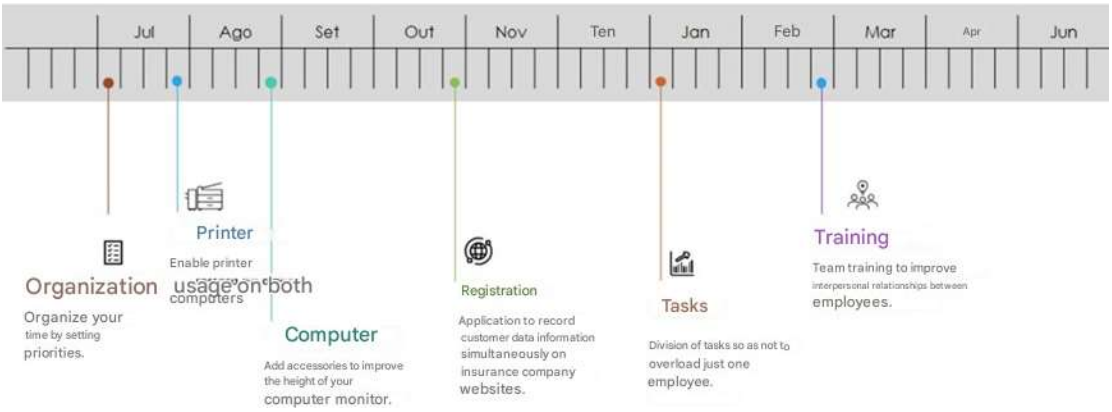


Figure 6. Proposed schedule of activities (Authors)

5. CONCLUSIONS

Analyzing the cognitive risks of the workplace allows us to have a global view of the occupational risks to which employees are exposed during the performance of the activities performed. The Cognitive Analysis of Work Technique applied allowed the generation of the

Map of each employee's knowledge process graphically presenting which inputs are involved and the sequence of the cognitive process to obtain the result of the analyzed activity. Likewise, the directed interview has an important and fundamental contribution to identify the components of the factors of mental load, decision-making, and cooperation and communication of each employee, making it possible to make a proposal for a specific intervention to reduce the cognitive risk of employees during the execution of activities.

The Ergonomic Evaluation of Work must include analyses of the physical, cognitive and organizational ergonomics of all activities performed by workers. The application of TACT allowed to carry out the Cognitive Assessment of Work and define risk control activities in this domain of ergonomics specialization, which is a tool for carrying out the EWS. Other tools should be applied to assess the risks of the physical and organisational domains of the workplace for the purpose of designing a complete ELA.

REFERENCES

BRASIL Ministério do Trabalho e Previdência. Norma Regulamentadora no 17 -Ergonomia. Portaria/MTP No 423, de 7 de outobro de 2021. Brasil, 2021.

BRATZ D, ROCHA R, GEMMA S. *Engenharia do trabalho, saúde, segurança, ergonomia e projeto*. Santana de Parnaíba: Ex Libris Comunicação; 2021.

CARVALHO, P. V. R.; VIDAL, M. C. *Ergonomia Cognitiva, raciocínio e decisão no trabalho*. Rio de Janeiro: FAPERJ, 2008.

FIALHO, F.; SANTOS, N. *Manual de Análise Ergonômica no Trabalho*. 2. ed. Curitiba, 1997.
GIL, A. C. *Métodos e Técnicas de Pesquisa Social*. 6. ed. São Paulo–SP: Atlas S.A., 2008.

GUÉRIN, F. *et al. Compreender o trabalho para transformá-lo: a prática da ergonomia*. São Paulo: Blucher, 2001.

IEA. *International Ergonomics Association*. Disponível em: http://www.iea.cc. Acesso em: 12 mar. 2019.

MARMARAS, N.; PAVARD, B. Problem-Driven Approach to the Design of Information Technology Systems Supporting Complex Cognitive Tasks. *Cognition, Technology & Work*, v. 1, n. 4, p. 222–236, 1999.

PERFETTO-DEMARCHI, A. P. *Ergonimia Cognitiva: formulários da Técnica Análise Cognitiva de Trabalho*. Londrina, 2021.

RICHARD. J. F. *As atividades mentais: compreender, raciocinar, encontrar soluções.* Tradução mimo, 1990.

WISNER, A. Questões epistemológicas em ergonomia e em análise do trabalho. *Ergonomia em busca de seus princípios: debates epistemológicos. Tradução de Maria Irene Stocco Betiol*. São Paulo–SP: Blucher, 2004.