Revista Tecnologia e Sociedade
ISSN: 1984-3526

https://periodicos.utfpr.edu.br/rts

Ergonomics and sustainability in business

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ABSTRACT

Ergonomic management with the generation of social, environmental, and economic value should encompass all operational and administrative activities from conception to product delivery. In this context, this research aims to analyze ergonomic management for business sustainability through the promotion of a safe working environment that complies with labor rights, considering Sustainable Development Goal number 8. The research is exploratory in nature, with a qualitative approach and case studies. Among the results, it is observed, from the analysis of the categories of Business Sustainability, Ergonomics Program, Ergonomic Performance, and Ergonomic Risks, that the challenges of maturity can be manageable in an ergonomic program established in a company that values health and safety in the workplace.

PALAVRAS-CHAVE: Ergonomics. Ergonomic maturity. Ergonomic risks. Sustainability.

INTRODUCTION

Ergonomics in the business context has been discussed to ensure a safe working environment and conditions. However, the challenge is to align ergonomics with business strategies. In the study by Dul and Neumann (2009) and Gonçalves (2014), it was observed that ergonomics included in business strategies allows for better achievement of organizational objectives. In this sense, ergonomics, when not aligned with the company's strategies, ends up being associated exclusively with compliance with health and safety legislation at work.

Silva and Trkman (2013, p. 4) state that "strategy shapes the development of capabilities that can alter current business models in the future." Sustainability plays a significant role in changing business strategies, prompting a reevaluation of products, technologies, processes, and even the business model itself (NIDUMOLU et al., 2009). The sustainable business model allows for the creation of a competitive advantage by generating value for both the customer and society (LUDEKE-FREUND, 2010).

Ergonomics and sustainability share the purpose of adapting human activities with a systematic vision, by encompassing the relationships and interdependencies of surrounding systems. The integration of ergonomics management and business sustainability with environmental and quality policies strengthens the culture of continuous improvement, as costs and resource consumption are reduced by eliminating waste (ZINK, 2014).

Ergonomic management with the generation of social, environmental and economic value must cover all operational and administrative work activities from conception to product shipping. Zink (2014) reports that this does not always occur, mainly due to the existence of professionals who do not have a vision of ergonomics based on or associated with the social, environmental and economic dimensions of sustainability. The training of ergonomics specialists should not only be oriented towards the social dimension, requiring a more comprehensive understanding related to the performance of organizations, considering a systematic approach that includes the three dimensions of sustainability (ZINK, 2014).

Ergonomics aligned with sustainability can provide safer and more efficient companies, by having well-being at work as one of its goals (MANUABA, 2007). Another aspect of ensuring well-being in the workplace refers to the reduction of ergonomic risks that impact the quality of products or services (TRINDADE, 2017).

According to Bolis (2015), products and services are developed by people and health-related working conditions impact workers and company performance. Therefore, ergonomics and sustainability "can benefit from a reciprocal partnership" (BOLIS, 2015, p. 161).

Silva and Moreira (2021) identify a dependency between corporate factors (such as leadership involvement) and behavioral factors (like adherence to health and safety regulations) within corporate cultures aiming to mitigate workplace accidents.

However, significant costs in addition to fines are avoided when compliance with Regulatory Standard 17 (NR-17) of the Ministry of Labor and Employment (MTE), designed exclusively to address issues related to ergonomics (BRASIL,

2002). Guaranteeing labor rights and providing safe environments is a duty of companies and is present on international agendas, such as the United Nations 2030 Agenda (UN, 2016).

Given this context, this research presents the following problem question: How does ergonomic management impact business sustainability? The objective of the research is to analyze ergonomic management for business sustainability, through the promotion of a safe work environment in compliance with labor rights, considering Sustainable Development Goal nº 8.

ERGONOMICS AND SUSTAINABILITY

Sustainability is a concept under construction that requires an interdisciplinary approach to promote environmentally sound and socially just growth (VEIGA, 2008; FABER et al., 2005).

Zink (2014) highlights that although sustainability applied to ergonomics in organizations is generally associated with human and social aspects, the three pillars of sustainability are found in traditional approaches when it comes to ergonomic management at work. In this sense, examples for ergonomics are presented: economic - in the design or redesign of work processes considering productivity gains, cost reductions in improving working conditions and consequently less exposure to possible labor processes; social - worker satisfaction, appreciation and recognition; environmental – considering issues related to noise or pollution adjustments, which are important for the design of work systems.

Companies play an important role in sustainable development, as they “add value to the community in which they operate, improving the human capital of their members, as well as promoting the social capital of these communities”, which contributes to business sustainability (DYLLICKS; HOCKERTS, 2002, p. 134).

Vieira (2020, p. 31) states that the discussion around the topic of ergonomics in companies has evolved and that “the current concept and principles unify and add together the various contributions, around common objectives: quality of life and user satisfaction, in addition to providing optimizations to system performance”.

Brunoro (2013) emphasizes that collaborations in the ergonomics of the activity from the perspective of sustainability, considering implemented improvements and adjustments that will be adapted throughout the worker's life, will require continuous changes over the years.

According to Iida and Buarque (2016, p. 2), the activities of business ergonomics involve: "a) planning and design, which take place before the work is carried out; b) monitoring, evaluation, and correction, which occur during the execution of this work; c) subsequent analysis of the consequences of the work”.

Another relevant aspect for structuring work are the goals related to working conditions in companies' planning and monitoring cycles (DUL; NEUMANN, 2009). Therefore, for business sustainability, ergonomic management can reduce costs and value the production process, in addition to counting on the support of management information systems to provide real-time data for decision-making that reduces existing ergonomic risks in production processes.

The contribution of ergonomics to improved industrial performance includes "enhancement of the human-machine-environment system, improvement of working conditions, and organization of work" (IIDA; BUARQUE, 2016, p. 20). However, it should be noted that ergonomics will only be part of a company's activities if it is economically viable (IIDA; BUARQUE, 2016).

Sustainable Development Goal (SDG) nº 8 aims to promote growth and decent work conditions. Ergonomic management directly and indirectly impacts the specific goals of SDG 8, as shown in Table 1.

Table 1. Relationship of ergonomic management with goals present in SDG 8.

Targer	United Nations
8.2	Achieve higher levels of productivity in economies through diversification, technological modernization and innovation, including through a focus on high-value-added and labor-intensive sectors.
8.4	Progressively improve, by 2030, the efficiency of global resources in consumption and production, and strive to decouple economic growth from environmental degradation, in accordance with the Ten-Year Plan of Programs on Sustainable Production and Consumption, with developed countries assuming the leadership.
8.8	Protect labor rights and promote safe and secure working environments for all workers, including migrant workers, in particular migrant women, and people in precarious employment.

Source: Adapted from UN (2016).

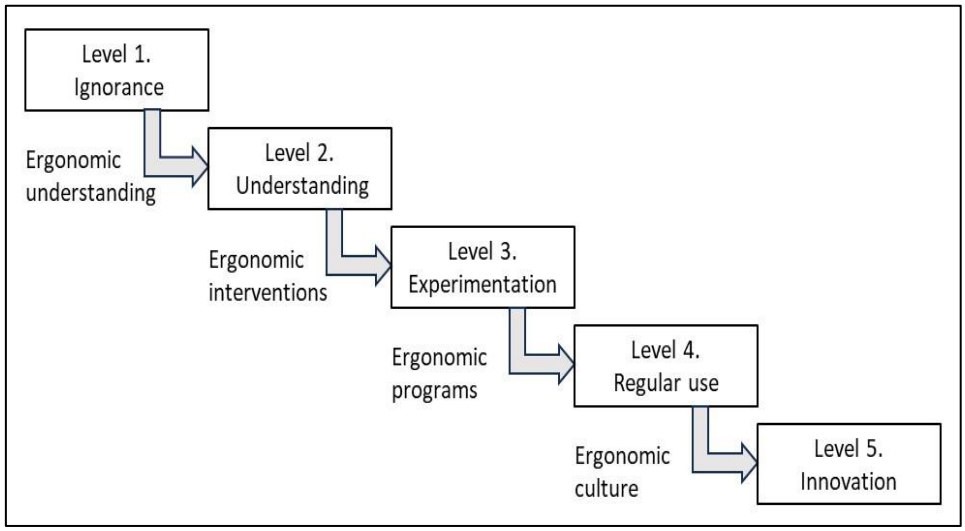
The term maturity is defined within the scope of Project Management as the ability of people to make changes in an organization (VIDAL *et al*., 2012).

Among the existing ergonomic maturity models, we can mention those proposed by Vidal *et al.* (2012) and Rodríguez *et al.* (2022), among others.

The ergonomic maturity model proposed by Vidal *et al.* (2012) was organized into the following steps: (a) definition of case studies; (b) pre-assessment of the maturity level; (c) construction of a scale (based on organizational problems); (d) validation of the new scale by experts; (e) application of the model. The study revealed that people's role and behavior is crucial to the success of ergonomics programs.

Another study that presents an ergonomic maturity model is that by Rodríguez *et al*. (2022). The authors propose a model organized into three stages: planning, design and execution. The model proposes five maturity scales, being: (1) ignorance; (2) knowledge; (3) experimentation; (4) regular action; (5) innovation. It is worth mentioning that in the last scale, people are involved in organizational learning and engaged in the search for sustainable ergonomic solutions, as can be seen in Figure 1.

Figura 1. Example of ergonomics maturity scale.



Source: Rodríguez *et al.* (2022).

According to Vieira (2020), the four main challenges in maintaining ergonomics programs, identified in the literature, are related to:

- Rotation of those involved in ergonomic management;
- Low prioritization in meeting planned actions to reduce/eliminate existing risks;
- Existence of budget for ergonomic solutions;
- Cultural issues that do not consider health as a priority, but production goals.

Andrade (2011, p.20) reinforces "the importance of giving a voice to workers, understanding that the accounts of their experiences in real activity are rich and bring the researcher closer to the reality of the work context," also ensuring a commitment to participatory management. Furthermore, it emphasizes the importance of establishing ergonomics committees, valuing interdisciplinary collaboration and cooperation from those involved in the development of proposals to mitigate risks until the confirmation of desired results.

The work of Moraes and Mallin (2018) analyzed ergonomic risks related to health and safety in the use of an outdoor rowing simulator in a gym in Curitiba, considering the ergonomic issues of both the object and the studied environment. The mapping conducted contributes to proposing solutions to ergonomic challenges found in outdoor gym environments, prioritizing the quality of life and user satisfaction.

METHODOLOGY

To assess the relationship between ergonomic management and business sustainability as proposed, strategies were defined, resulting in the classification of the research method based on its nature, objectives, approach, and procedures.

The nature of this research is applied, as according to Gil (2017) and Prodanov (2013), this type of research aims to produce knowledge to solve specific problems.

Regarding its objectives, the present research is classified as exploratory. Severino (2017) explains that this type of research is designed to survey and identify specific information within a well-defined field of study.

In the qualitative approach, "the natural environment is the direct source for data collection, and the researcher is the key instrument," as detailed by Prodanov (2013, p. 71), interpreting phenomena and assigning meanings to relationships impossible to measure in numbers.

To achieve the objectives outlined in the research, a multiple case study approach was employed, as it allows for describing the actions undertaken in the selected companies.

Case studies

The case studies two multinational companies were selected, leaders in their segments that implemented ergonomic management more than five years ago. Both are recognized as a reference for their respective sectors and globally for their own plants in other countries, including Europe. Recently, the ergonomics management of both companies was audited and awarded.

One difference between companies is related to the hiring model for ergonomics specialists. This model can consist of specialists hired as direct employees (company A), or external consultancy companies or even a model with both possibilities (company B).

The leading company in the production of durable goods, identified as Company A, has almost 5,000 employees in the unit that participated in this research and stands out for its production processes with short cycle times and light inputs. It is one of the companies certified by the Brazilian Association of Technical Standards (ABNT) for its Ergonomics Management System. Through the professional rehabilitation and absenteeism management program, it won a relevant award. In company A, the entire ergonomics technical team has a direct employment relationship with just one third party focused on the rehabilitation program and dealing with People with Disabilities (PwD). The technical program of Company A is well-developed, encompassing job evaluations, improvements, control dynamics, a defined schedule, and investments. This program has been in place for over 12 years, demonstrating its enduring nature.

Company B is a large-scale metallurgical company that holds a leading position in its industry, employing approximately 1,000 direct workers. The production process involves long cycle times, and the majority of the components are heavyweight. Notably, its ergonomics program secured victory in a state-level management innovation competition, competing against other corporate management programs. The company concurrently develops physiotherapy processes for its employees, underscoring its commitment to injury prevention and the treatment of work-related issues.

The research participants were divided into two groups:

Group X: managers responsible for industrial strategic management, occupational health and safety, or sustainability;

Group Y: employees under the direct or indirect responsibility of managers, but who do not hold a management position.

Data collection and analysis

Data collection was carried out in March and April 2022 using the following methods:

1- Semi-structured Interviews: The interview structure and script were developed based on other case studies found in the literature review;

2- Questionnaire: Developed and validated by Vidal *et al*. (2011), it consists of 50 questions aimed at analyzing the level of ergonomics maturity within the company.

The research was approved by the Human Research Ethics Committee (CEP), Certificate of Presentation of Ethical Appreciation (CAAE) no. 55611722.8.0000.5481, opinion nº 5.265.416.

Data collection occurred in two stages, with the first involving the administration of semi-structured interviews to 15 participants, including:
Company A: 4 managers and 1 non-managerial staff;
Company B: 4 managers and 6 non-managerial staff.

The interviews with Company A took place remotely, while those with Company B were conducted in person. The group of managers answered eight exclusive questions, in addition to the seven questions posed to the non-managerial group. In the second stage of data collection, a questionnaire was administered to the managers. From the results, scores were calculated to identify the level of ergonomic maturity in the organizations (Table 2).

In the second stage, the questionnaire assessing ergonomic maturity was applied to managers, utilizing a five-level Likert Scale. The questionnaire results were used to calculate the score, allowing for the identification of the organization's level of ergonomic maturity (Table 2).

Table 2. Ergonomic maturity rating.

Score	Level of ergonomic maturity	Caracteristics
0 – 1	Informal	Conduct awareness training Take emblematic actions Conduct awareness training Map the company
1 – 2	Organized	Form committees Train facilitators Create action plan
2 – 3	Structured	Create indicators Evaluate indicators and histories Establish standards
3 – 4	Managed	Repertoire of good practices Bank of lessons learned Set up a permanent management system
4 – 5	Escellence	Train suppliers Continuously improve

Source: Adapted from Vidal *et al.* (2011).

Unlike Vidal *et al.* (2011), in this research, it was decided to disregard the "undecided" response; in other words, the scoring was defined according to the following rule :

(SA) Strongly Agree = 10 points;

(A) Agree = 6 points;
(D) Disagree = 2 points;
(SD) Strongly Disagree = 0 points.

To calculate the ergonomic maturity score for each company, the average scores of the managers were considered.

The instruments applied to both groups made it possible to verify the relationship between ergonomics management and business sustainability to promote safe working environments. Furthermore, the research made it possible to compare employees' perception of ergonomic maturity with existing classifications in the literature, validating the score obtained.

To analyze the data, the content analysis technique was used to assimilate the information generated, directly or not, after the interview transcriptions (SOUZA JÚNIOR, 2010).

Firstly, the initial categories were developed by grouping terms captured during the data collection through repetitions (Table 3).

Table 3. Initial research category.

Initial categories	
1. Corporate Sustainability	3. Ergonomic performance
2. Ergonomic program	4. Ergonomic Risks

Source: Elaborated by the authors.

Then, for each category, the most frequently mentioned terms during the interviews were grouped. These terms were sorted so that the transcribed statements could be organized and related to the initially defined categories (Table 4).

Table 4. Research categories and subcategories.

Categories	**Subcategories**
1. Corporate Sustainability	a. Social responsibility – Ethical conduct, generating a positive impact on society, welcoming (return to work), integration of people
	b. Governance – Participatory ergonomics, facilitation structures, leadership involvement, prioritization of demands, ergonomic culture, awareness
	c. Information technology – Storage and dissemination of data, use of software.
2. Ergonomic program	a. Interdisciplinarity – Capillarity, participation and responsibilities (individual and collective)
	b. Strategic planning – Ergonomics planning in business processes, indicators and business results
	c. Ergonomic maturity – Levels, evolution and consolidation
3. Ergonomic performance	a. Investment – Regulatory updates, cost reduction projects, development of new products/processes, new technologies, scope and correlation of improvements
	b. Human factor – Turnover, appreciation, engagement, knowledge management

4. Ergonomic Risks	a. Correction ergonomics – Complaint, sick leave, evaluation and adaptation (after incidents)
	b. Continuous mitigation – Monitoring, validating solutions and managing risks (during work)
	c. Design ergonomics – Prevention of occurrences when designing processes/products (before the work is carried out)

Source: Elaborated by the authors.

RESULTS AND DISCUSSIONS

The assessment of the companies' ergonomic maturity as assessed considering organizational aspects classified as: (1) acceptance of the subject, (2) ergonomics team training, (3) management training, (4) certification, (5) process mapping and standardization, (6) continuous improvement, (7) organizational climate, (8) governance, (9) social responsibility, (10) strategic planning, (11) information technology, (12) leadership, and (13) relationship.

Each aspect was evaluated by four managers from the selected companies, who answered between two and seven questions for each aspect. With their answers, summary tables were prepared for each company, informing the total responses from the managers of Company A (Table 5) and Company B (Table 6). The columns called “evaluation” show the number of managers who chose each criterion.

Table 5. Summary of the ergonomic maturity assessment – Company A.

Organizational aspects	**Items for assessment**	Evaluation				
		SA	A	I	D	SD
1. Acceptance of the subject	1.1 - Knowledge of company employee ergonomics	2	2			
	1.2 - Formal presentation of the team and work to interested parties	3	1			
	1.3 - Initial awareness meeting	3	1			
	1.4 - Awareness meeting program	4				
	1.5 - Presentation of ergonomics results to senior management	4				
2. Ergonomics team training	2.1 - Ergonomics training for the team	3	1			
	2.2 - Differentiated skills among team members	2	2			
	2.3 - Knowledge to evaluate jobs - quantitative	3	1			
	2.3 - Knowledge to evaluate jobs - qualitative	1	3			
3. Management training	3.1 - Clarity in processes and contracts (external consultancy)	1	2	1		
	3.2 - Choice of ergonomists regarding technical qualifications	3	1			
	3.3 - Speed in resolving problems	1	3			
	3.4 - Knowledge about Ergonomics and Ergonomic Management	2	2			
4. Certification	4.1 - Technical debates on Certification and Ergonomics	4				
	4.2 - Understanding the potential of ergonomics results	3	1			
	4.3 - Hiring certified professionals in Ergonomics	3	1			
5. Process mapping and standardization	5.1 - Standardization in ergonomic requests (method and text)	3	1			
	5.2 - Level of organization at all stages of work	1	3			
	5.3 - Report standards avoiding rework	2	2			
6. Continuous improvement	6.1 - Involvement between sectors	2	2			
	6.2 - Meetings for debates and problem solving	3	1			
7. Organizational climatel	7.1 - Leadership commitment to ergonomics work	3	1			
	7.2 - Alignment between teams and the health and safety team	4				
	7.3 - Commitment of the team responsible for the area analyzed	3	1			

8. Governance	8.1 - Employees can stop work and provide information	4				
	8.2 - Adequacy of instruments and tools in the company	3	1			
	8.3 - Existence of a committee. Frequency of meetings	3	1			
	8.4 - Existence of facilitation structure	4				
9. Social Responsibility	9.1 - Coordination of the technical team	4				
	9.2 - Existence of technical support from the company	4				
	9.3 - Integration of the responsible team with other sectors	4				
10. Strategic Planningo	10.1 - Ergonomics pre-project planning	4				
	10.2 - Structuring the team according to demand	3	1			
	10.3 - Cost planning	2	1	1		
	10.4 - Flexibility of goals to meet demands	3	1			
11. Information Technology	11.1 - Database with lessons learned	1	2	1		
	11.2 - Use of ergonomics software		3	1		
	11.3 - Electronic dissemination of information	1	2	1		
12. Leadership	12.1 - Clear and unified work procedures	1	3			
	12.2 - Participation of senior management with the responsible team	4				
	12.3 - Need for coordination, providing technical and social support	4				
	12.4 - Centralization of work by the leader	2	1	1		
	12.5 - Communication between the leader and the team	2	2			
	12.6 - Ability to negotiate fair prices and deadlines	3		1		
	12.7 - Recognize each person's skills by the leader	4				
13. Relationship	13.1 - Team integration	3	1			
	13.2 - Dialogue between the team to prepare reports	3	1			
	13.3 - Leader's relationship skills with people	3	1			
	13.4 - People management by leadership	3	1			

Source: Adapted from Vidal *et al.* (2011).

Table 6. Summary of the ergonomic maturity assessment – Company B.

Organizational aspects	**Items for assessment**	Evaluation				
		SA	A	I	D	SD
1. Acceptance of the subject	1.1 - Knowledge of company employee ergonomics	1	3			
	1.2 - Formal presentation of the team and work to interested parties	1	3			
	1.3 - Initial awareness meeting	2	1		1	
	1.4 - Awareness meeting program	1	1	1	1	
	1.5 - Presentation of ergonomics results to senior management	2	2			
2. Ergonomics team training	2.1 - Ergonomics training for the team	2	2			
	2.2 - Differentiated skills among team members	2	2			
	2.3 - Knowledge to evaluate jobs - quantitative	2	2			
	2.3 - Knowledge to evaluate jobs - qualitative	2	2			
3. Management training	3.1 - Clarity in processes and contracts (external consultancy)	1	2	1		
	3.2 - Choice of ergonomists regarding technical qualifications	2	2			
	3.3 - Speed in resolving problems	1	3			
	3.4 - Knowledge about Ergonomics and Ergonomic Management	2	1	1		
4. Certification	4.1 - Technical debates on Certification and Ergonomics		2	1	1	
	4.2 - Understanding the potential of ergonomics results	1	2		1	
	4.3 - Hiring certified professionals in Ergonomics	2	1	1		
5. Process mapping and standardization	5.1 - Standardization in ergonomic requests (method and text)	1	3			
	5.2 - Level of organization at all stages of work	1	3			
	5.3 - Report standards avoiding rework	1	3			
6. Continuous improvement	6.1 - Involvement between sectors	2	2			
	6.2 - Meetings for debates and problem solving	2	2			
	7.1 - Leadership commitment to ergonomics work	2	2			

7. Organizational climatel	7.2 - Alignment between teams and the health and safety team	2	2			
	7.3 - Commitment of the team responsible for the area analyzed	2	2			
8. Governance	8.1 - Employees can stop work and provide information	2	1	1		
	8.2 - Adequacy of instruments and tools in the company	3	1			
	8.3 - Existence of a committee. Frequency of meetings	2	2			
	8.4 - Existence of facilitation structure	2	1	1		
9. Social Responsibility	9.1 - Coordination of the technical team	2	2			
	9.2 - Existence of technical support from the company	3	1			
	9.3 - Integration of the responsible team with other sectors	4				
10. Strategic Planningo	10.1 - Ergonomics pre-project planning	1	2	1		
	10.2 - Structuring the team according to demand	1	3			
	10.3 - Cost planning	1	2	1		
	10.4 - Flexibility of goals to meet demands	1	3			
11. Information Technology	11.1 - Database with lessons learned	1	2		1	
	11.2 - Use of ergonomics software	1	1		2	
	11.3 - Electronic dissemination of information	1	1		2	
12. Leadership	12.1 - Clear and unified work procedures	1	3			
	12.2 - Participation of senior management with the responsible team	3	1			
	12.3 - Need for coordination, providing technical and social support	1	3			
	12.4 - Centralization of work by the leader	1	1	2		
	12.5 - Communication between the leader and the team	1	3			
	12.6 - Ability to negotiate fair prices and deadlines	1	2	1		
	12.7 - Recognize each person's skills by the leader	1	2	1		
13. Relationship	13.1 - Team integration	2	2			
	13.2 - Dialogue between the team to prepare reports	2	2			
	13.3 - Leader's relationship skills with people	1	2	1		
	13.4 - People management by leadership	1	3			

Source: Adapted from Vidal *et al.* (2011).

The calculation of ergonomic maturity was done based on the average of the scores assigned by the four managers. The fields with evaluation criteria were highlighted in color in Tables 5 and 6, indicating the quantity of responses.

To differentiate the survey responses when all managers selected the same criterion, a dark green color was used. In situations where three managers chose the same response option, a light green color was used. When all managers chose different response options, yellow color was used.

Tables 7 to 10 below provide a summary of the analysis of the categories: Corporate Sustainability, Ergonomics Program, Ergonomics Performance, and Ergonomic Risks.

Table 7. Summary of the Corporate Sustainability category .

Subcategories	Company A	Company B	Comparative
a. Social Responsibility	Individualized reception process to integrate workers who return from leave. Ergonomics is relevant for business sustainability, worker	Employees highlight that beyond the company, their own health is valued as a resource, so they	The management team acts in a participatory manner and care for employee health exceeds

	and company health and for complying with Laws.	can retire working.	physical limits in company A. In company B, concern with the sustainability of products was highlighted.
b. Governance	Ergonomics is a priority on the leadership agenda. Linking productivity results with interventions allowed the ergonomics team to take a greater role.	Ergonomics and sustainability committees are strategic so that the topics are part of the culture and processes. Awards for results, encouraging employees to pay attention to existing risks.	In both companies, health and safety were presented as a priority by managers. In company A, the topic of governance is addressed in all forums, from the conception of processes to products.
c. Information Technology	Fundamental in organizing procedures and sharing data, especially for job rotation and employee unavailability. There is a record of best practices.	There are opportunities to integrate information into decision making. Use of simulation software to validate working conditions in the development of production processes, aiming to avoid risks.	To respect the confidentiality of personal information, information technology is used that allows integrated management in company A.

Source: Elaborated by the authors.

From the results regarding Corporate Sustainability (Tables 7 and 8), the importance of discussing ergonomic management for business sustainability in the company's strategic planning is observed. This involves establishing goals, considering costs related to workers' health and safety, and planning investments to prioritize actions necessary for an ergonomics program that mitigates risks and contributes to ergonomic maturity.

Table 8. Summary of the Ergonomics Program category.

Subcategories	Company A	Company B	Comparative
a. **Interdisciplinarity**	Ergonomics is connected to all areas, focusing on	The employee is made aware of health and safety	Company A values the "voice of the employee", so that

	rehabilitating people and improving processes. The ergonomics team is responsible for the project approval process.	issues and is aware of solutions to actively participate in minimizing risks.	they can find solutions related to health. Changing the mindset from punitive to collaborative ergonomics. Communication and active listening are highlights at Company B.
b. Strategic Planning	The ergonomics program is part of strategic planning, and there are global goals that are broken down by region.	Intensification of technical hours for the ergonomics team to map the activities of the production and administrative sector with a focus on innovation in the production chain. Ergonomics and sustainability programs are under the responsibility of the Environment, Health and Safety area.	At Company A, ergonomics positively impacts the sustainability of the business and is related to process efficiency. Company B checks the health insurance accidents rate.
c. Ergonomic Maturity	Work is driven by demand rather than priority. Ergonomics is addressed in various forums and processes.	The ergonomics committee brought actions closer to needs, so projects are developed in compliance with standards before being implemented.	Company A aims to take the ergonomics developed in Brazil to other company units outside the country. In company B there is greater productivity and motivation with the evolution of ergonomic maturity.

Source: Elaborated by the authors.

The interdisciplinary character of ergonomics was highlighted in the research by Gonçalves (2014) and Faber et al. (2015). Analysis of participants' statements reveals that within the surveyed companies, ergonomic considerations extend across all organizational domains, with a primary emphasis on the rehabilitation of individuals and the optimization of organizational processes to align with established standards.

Regarding the role of ergonomics in corporate strategic planning, the findings indicate active engagement from various departments in formulating annual strategic plans, including the allocation of investments and the definition of goals, both of which prioritize ergonomic principles.

When discussing the evolution of ergonomic maturity, company managers noted advancements in ergonomic programs. However, they emphasized the importance of establishing ergonomic committees or involving the ergonomics team in meetings to discuss risk assessments.

Table 9. Summary of the Ergonomic Performance category.

Subcategories	Company A	Company B	Comparative
a. Investiment	Direct correlation in investments for workers' health with productivity and quality results.	The program is characterized as an investment; adjustments that generate greater productivity are related to financial gains. There is an impact on the company culture.	In company A, cost reduction projects that bring improvements in safety or ergonomics are recognized. There is an exclusive budget for ergonomics.
b. Human Factor	Difficulty finding qualified people. Employee turnover is driven by team development.	The outsourced company maps production and administrative processes and facilitates benchmarking with other companies.	For the managers of company A, the focus is on ergonomics of excellence, as health cannot be reworked. In company B there are common and distinct sources for exchanging experiences, it has external experts who work in other companies.

Source: Elaborated by the authors.

Regarding Ergonomics Performance, it is important to highlight that achieving ergonomic maturity and producing results relevant to business sustainability is not an abrupt process but rather requires the systematic management of ergonomics The initial stage in this process involves mapping critical aspects and is carried out through ergonomic work analyses (Table 9).

It is interesting to note, based on the research findings, how investments concerning employee health are managed. According to one manager, ergonomic safety projects may not necessarily need to generate financial returns, while the company prioritizes cost-reduction initiatives that enhance safety and adhere to ergonomic principles. Another noteworthy aspect mentioned involves the pursuit of straightforward, low-cost solutions that can swiftly address ergonomic-related demands.

The research findings show the significance of the human factor in shaping the performance of ergonomics within companies. As explained by Bolis (2015), products and services are developed by people, and the working conditions affecting health play a crucial role in their performance within the organizational context. Consequently, ergonomics and sustainability, in this context, "can mutually benefit from a reciprocal partnership" (BOLIS, 2015, p. 161).

Ergonomics and sustainability both aim to align elements of human activities within a systematic framework. The integration of ergonomic management and business sustainability with environmental and quality policies is believed to enhance the culture of continuous improvement. This integration facilitates waste elimination and reduces costs and resource consumption (such as raw materials, processing time, and energy consumption) (ZINK, 2014).

Barreto Netto, Santos e Rezende (2023) endorse the need for technological investment in developing applications as an efficient means for employee rehabilitation.

Table 10. Summary of the Ergonomic Risks category.

Subcategories	Company A	Company B	Comparative
a. Ergonomics correction	In the event of complaints, the internal ergonomist team analyzes the cause. Ergonomists attend project meetings and proactively scan ergonomic assessment.	Ergonomic management helps to ensure adequate workplaces and minimize risks.	In company A, complaints were grouped, prioritizing the most frequent complaints. Both companies highlight the minimization of complaints and accidents.
b. Continuous mitigation	There are risks that are difficult to resolve. 100% of jobs are evaluated.	Improve the selection and maintenance of people with a more proactive and less reactive profile. Highlight the importance of risk perception.	Ergonomic complaints are identified in the ambulatory clinic and during periodic examinations.
c. Ergonomics design	Managers highlight the importance of investing in design ergonomics. To prevent risks, campaigns and awareness are carried out.	Engineering sees ergonomics as a requirement for designing processes and products. There is the possibility of validating activities with operation in project design with workers and customers in the product design review process.	Design ergonomics were identified as challenging by company A. In company B there are actions to include people who will work in the ergonomics design processes.

Source: Elaborated by the authors.

In relation to Ergonomic Risks in the companies studied, ergonomic assessments allow us to analyze activities, classify criticalities, prepare diagnoses and provide recommendations for approval and action by the interdisciplinary team responsible for reducing and eliminating existing risks, ensuring safe work environments (Table 10).

The research results show that both surveyed companies allocate investments to ergonomic design, enabling proactive risk management before project implementation and potential incidents involving workers. Technology serves as an ally in ergonomic management, enabling the monitoring and anticipation of potential ergonomic risks.

The reduction or elimination of ergonomic risks in the workplace brings well-being to the workers and has positive impacts on the quality of products and/or services offered by the organization (TRINDADE, 2017).

Kleine and Hauff (2009) acknowledge the significance of ergonomic management in meeting business strategies. They assert that investments and the allocation of resources to manage ergonomic risks for workers' health should not be perceived solely as costly obligations for legal compliance. Instead, these efforts should be regarded as a strategic approach to ensuring the longevity and sustainability of the business.

FINAL CONSIDERATIONS

The research carried out met the objective of analyzing the contribution of ergonomic management to business sustainability, based on literature and company case studies.

Ergonomic management for business sustainability depends on several factors, such as the organizational structure, from a physical point of view, but mainly on the conception of working relationships between employees and managers.

From this perspective, the contribution of ergonomics to business sustainability requires a systemic construction for the design and planning of ergonomics in the company's activities. To ensure the effectiveness of this purpose, organizations aligned with business sustainability must guide the ergonomics presented in the research in strategic planning as a means of guaranteeing adequate working conditions for all employees, including those who work in administrative areas and who can sometimes not be prioritized in ergonomics programs.

The research results confirmed the possibility of replicating the ergonomic maturity assessment model by Vidal *et al.* (2011), according to adjustments to the model to meet the objective of this research. It is suggested that other research focusing on ergonomic management for sustainability consider cultural, political and organizational aspects to adapt data collection instruments with a view to successfully applying the maturity assessment model.

A contribution of this research is to bring to light the challenges in the evolution of maturity levels and consolidation of ergonomics programs that can be managed and instituted in companies or based on an organizational culture that values ergonomics as a preponderant factor for health and safety in work environments.

It can be concluded that the research participants understand that the ergonomic maturity achieved in the ergonomics program brought important results to the performance of the company's activities. Even so, attention should be paid to the occurrence of practices that seek only to comply with inspections in

accordance with regulatory standards, not taking advantage of all the benefits that make ergonomics programs a competitive differentiator and a decisive factor in workers choosing to join and remain in companies. It is believed that this is still a gap to be overcome in future research.

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Recebido: 21/03/2023
Aprovado: 04/03/2024
DOI: 10.3895/rts.v20n60.16564
Como citar:

GARCIA FILHO, João Francisco Alfonso; SUGAHARA, Cibele Roberta;BRANCHI, Bruna Angela. Ergonomia e Sustentabilidade nos Negócios. Tecnol. Soc., Curitiba, v. 20, n. 60, p.308-327, abr./jun., 2024. Disponível em:

https://periodicos.utfpr.edu.br/rts/article/view/16564

Acesso em: XXX.

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