DOI: 10.1590/1413-81232020255.34942019

Work fatalities in a Brazilian oil and gas company: analysis of workers' health and safety policy

Hilka Flavia Saldanha Guida (https://orcid.org/0000-0002-0743-7809) [1]
Marcelo Gonçalves Figueiredo (https://orcid.org/0000-0001-5612-2929) [2]
Élida Azevedo Hennington (https://orcid.org/0000-0001-5280-8827) [1]

Abstract *This paper aims to discuss the changes in the safety and health policy (SHP) of an oil and gas company from the enlarged accident that occurred in 2001, seeking out to understand the consequences of these changes in the daily activity of workers. It is a mixed study employing an epidemiological data triangulation method, documental research, and qualitative approach. The 2001 oil platform accident (RJ) was considered a milestone in the process of changes in the company's SHP. Several actions and programs have been implemented, and investments in health and safety have increased substantially. We identified that such initiatives had limited participation by workers in their planning and elaboration. They did not prioritize the most critical problems, and emphasis was placed on the establishment of standards and audits to assess compliance with the prescription. Finally, it was observed that learning about severe or fatal occupational accidents is incipient and unstructured, and the system of consequences triggers workers' fear and insecurity, blaming, in general, the injured person for the occurrence, without considering the multiple factors that influence and condition the accident.*

Key words *Occupational Accidents, Occupational Mortality, Oil and Gas Industry, Occupational Health, Ergology*

[1] Escola Nacional de Saúde Pública, Fundação Oswaldo Cruz. R. Leopoldo Bulhões 1480, Manguinhos. 21041-210 Rio de Janeiro RJ Brasil. hilka.guida@yahoo.com.br
[2] Engenharia de Produção, Universidade Federal Fluminense. R. Passo de Pátria 156, Campus da Praia Vermelha, São Domingos. 24210-240 Niterói RJ Brasil.

Introduction

According to the Aurélio[1] Dictionary, the word "accident" is a masculine noun that means "casual, unforeseen event", a meaning accepted by common sense. However, the meaning of the term in Portuguese is inappropriate for the nature of the occupational accident (OA)[2] event. Ordinance GM/MS No. 737/2001 mentions that accidents are understood, to a greater or lesser degree, as predictable and preventable events[3].

By pointing out that the accident, to a certain extent, is predictable, Perrow[4] affirms that it is not necessarily possible to avoid it, but rather to mitigate its impacts because the apparent predictability puts in check the whole socio-technical system and the decision-making by the organization. In turn, Lorry[5] points out that "severe accidents and incidents lead to profound revisions of the concept of safety, and numerous technical, ergonomic and organizational changes".

In the area of Occupational Safety and Health (OSH), for many years and, even today, in more conservative views, OAs have been considered to be the work of chance, unintentionality[6], so nothing or hardly anything can be done to avoid or minimize their effects.

Cordeiro et al.[7] argue that OAs are the biggest health problem for workers in our country today. They are a relevant theme for various sectors of our society, especially when it comes to the public health area, because of their high incidence and the social and financial costs for the injured and their families, the health system, employers and the State[6,8,9].

The National Health Policy for Male and Female Workers (PNSTT)[10] mentions that OAs should be the object of priority action by the Unified Health System[3], with inter-sectorial and interdisciplinary action of fundamental importance, aiming at effective ways of coping with this problem that kills and daily injures thousands of Brazilian workers.

The need to face this serious problem gains relevance in the oil and gas industry, in which the company studied is incorporated, insofar as the production processes characteristic of such industry are typical examples of what the scientific literature calls the complex sociotechnical system[4]. Perrow[4] affirms that, given the characteristics of such systems, multiple and unexpected interactions of failures can assume catastrophic proportions, causing more significant or expanded accidents. Such a line of argument converges with the criticism of current OSH approaches that consider the possibility of total and unrestricted elimination of risks in these systems. The danger of working in industries such as oil and gas is reiterated, recognizing, however, that the existence of risks does not imply their unrestricted acceptance, but the indispensability of implementing technologies and incorporating interdisciplinary knowledge to reduce them as much as possible in the production processes[11]. Despite such efforts, a margin of uncertainty and irreducible unpredictability as a structural characteristic[4] would remain in such (sociotechnical complex) systems.

Figueiredo et al.[12], when analyzing (an expanded type of) OAs in this industry, call attention to the existence of a substantial and dangerous gap between the advances obtained in the management of technological innovation and risk management. Authors state that the technological advances identified over time have not been adequately accompanied by the adoption of a set of programs or measures capable of effectively dealing with the dynamics of the risks engendered by the functioning of intricate sociotechnical systems.

Within such a context, this paper presents and discusses changes in the safety and health policy of a Brazilian oil and gas company, from an enlarged accident that occurred in 2001, seeking to understand the repercussions of these changes on the daily routine of the workers.

A watershed: explosion and sinking of an oil rig in 2001

The milestone in the inflection of the SHP of the studied company was the accident of a large oil rig located in Campo de Roncador, in the Campos (RJ) Basin, in March 2001. At the time of the accident, 175 people were on board the vessel, which had state-of-the-art technology, with an estimated cost of US$ 350 million, which was considered the largest offshore oil production platform at the time. Two big explosions affected one of the pillars of this production unit, causing the death of 11 workers of the emergency response team. Five days later, the facility sank on the high seas[13].

Despite the technological attributes, it is necessary to point out, especially when such an accident is under discussion, that oil rigs are industrial installations endowed with processes whose nature is highly intricate and hazardous, with the presence of several risks to health and worker safety, as Figueiredo[13] points out based on Rundmo[14,15].

Ciência & Saúde Coletiva, 25(5):1819-1828, 2020

According to the analysis[13] of the report of the National Petroleum Agency and the Directorate of Ports and Coasts of the Brazilian Navy (2001), it was concluded that the accident occurred due to noncompliance with operational, maintenance and project procedures, where the "operation of emptying the emergency draining tank of the port stern column" was pointed as the critical factor directly related to the explosions on the platform.

Since then, given the economic, social, political impact, and adverse effect on the image of the company in the media, besides pressure from shareholders, workers, regulatory bodies and union entities, several efforts, investments and changes have been undertaken to implement and improve its SHP and Health, Safety and Environment (HSE) management system, as highlighted by Loureiro et al.[16].

Theoretical-methodological procedures

This study used a mixed method with a quantitative and qualitative approach. It is understood that this set of data produced has a complementary nature and enables an integrated and dynamic understanding of the analyzed reality[17].

A descriptive, cross-sectional epidemiological study was carried out using data from the 222 Fatal Occupational Accidents (FOAs) from 2001 to 2016 in the company. The primary sources of information were the Company's Sustainability Reports from 2005 to 2016 and, and other complementary sources were used, such as union and press news, referred to in this study as "other sources". Then, documentary research was carried out, focusing on the analysis of the company's SHP. Furthermore, 24 semi-structured interviews were held with key informants: Safety and Health managers, outsourced workers and employees of operational units where FOAs occurred in the last five years, as well as representatives of union entities linked to the Unified Federation of Oil Workers (FUP) and the National Federation of Oil Workers (FNP).

Thus, a triangulation of the results of the epidemiological study of the FOAs, documentary research, and semi-structured interviews was carried out in order to reconstruct and critically analyze the path of the SHP.

The ergological perspective was decisive for the weaving of our theoretical-methodological framework, especially concerning the understanding of work situations, always marked by an enigmatic and complex component. Ergology understands human activity as a constant debate of norms, which is guided by values, insofar as it cannot be disregarded at all that a level of an evaluative nature is present during the activity, that is, that values traverse the activity. Moreover, in this process, we are driven to address the tension between the requirements of the preceding/prescriptive dimension and the demands of the current situation. However, this work is never entirely anticipated, predictable, assuming, in this sense, an always singular character, and this effort of anticipation will always be redefined and renormatized somehow at some level to make a way of life or work intelligible[18]:

The ergological approach is then anthropology, a conception of the human as an activity being: what does it mean, a being in a permanent debate of norms (renegotiations) with his life environment, to try to update these norms, always edited in a relative timelessness, and personalize them, as they have stabilized outside any consideration of their uniqueness as a living being[19](p.254).

The Three Poles Dynamic Device (DD3P) proved to be a valuable tool to access the work, including what it contains in a complex and enigmatic way, above all, as a way of producing knowledge and approaching reality, seeking to access/enhance the viewpoint of the activity through cooperation between the pole of concepts and the pole of knowledge, and values produced from the experience of workers, invested in the activity, under the mediation of the ethical-epistemic pole, which articulates the other two. Thus, the DD3P is understood as an Ergology tool that helps us in the difficult task of building dialogical spaces, interaction, exchange of knowledge (formal and informal), functioning as "places or devices where we can build knowledge that integrate explicitly the epistemological requirements adjusted to this triangular configuration"[20].

This study followed the recommendations of Resolution CNS/MS 466/2012 and is approved by the Ethics Committee of ENSP/FIOCRUZ.

The safety and health policy

The company's SHP has changed over time, either to adapt to legal requirements or to respond to pressure from its stakeholders, especially after the occurrence of severe events or the deaths of workers. Thus, the main SHP milestones will be presented, seeking to envisage the documentary narrative with the data from the FOAs, also articulating them with the perspec-

tive of the interlocutors directly involved in the implementation of the SHP, in order to summon the viewpoint of the activity from the DD3P.

The first program after the event that was a milestone in the inflection of the SHP was PEGASO, with an initial investment of US$ 4 billion, and which had a dual objective: the development of a risk management program, as well as the transformation and recovery of the company's reputation[21]. PEGASO's actions focused on pipeline network integrity and automation projects, waste reduction, and sought proactive action in the management of safety and the environment:

According to the Company, PEGASO has already achieved its goals: automation of 70% of priority pipelines, installation of nine Environmental Defense Centers, reduction of 90% of existing residues, certification of all units by ISO 14.001, and BS 8.800 or OSHA standards 18,001[22](p.15).

In 2001, the Corporate Health, Safety, and Environment Policy (PCSMS) was also approved by the Executive Board of the company studied, explained in its 2015 Strategic Plan, which was to achieve what the company called "HSE excellence" at the time, and be an international benchmark in the oil and gas sector[23]. During this period, as determined by senior management, all Business Units also obtained certifications related to the environment, safety, and occupational health: ISO 14001, BS 8800, OSHA 18001[24].

Beltran et al.[25] reiterate this tendency to implement certifications of the OSHA system and the ISO management system, leading to a substantial increase in bureaucracy, with the completion of self-verification forms, checklists, among other documents. According to these authors, from the study carried out in an oil refinery, the implementation of these management systems favored the unrestricted compliance with institutional bureaucracy, and the focus was no longer the work performed by people.

The external scenario strongly influenced the movement adopted by the company. Since the last decade of the last century, international oil companies have been seeking to implement management systems and enhance international certification processes, in order to attest and give visibility to their commitment to risk management in their activities:

The company started a daring project to implement a Corporate SMS Management System. A corporate HSE manual was prepared with a strong focus on the behavioral factor to assist in the implementation of this Corporate System. This work primarily aimed to disseminate a culture of risk perception and protection of life at all levels of the System[24].

However, the implementation of HSE management systems and certifications do not guarantee the safety of the units. They only attest to the compliance or not of the requirements established by such regulations[25]. The full compliance of such requirements do not warrant the non-occurrence of OAs, especially severe and complex ones, nor are the low OA statistics predictive of total control of risks in the workplace, although they may provide a false sense of security for the organization of work, which is confronted with the reality experienced by workers in their daily activities at operational units.

During this period, the HSE Management Assessment Process (PAG-SMS) was established as a tool to assess the level of adherence of its units to the HSE Guidelines and the Process Security Program (PSP). Since 2002, through the PSP, the guidelines have been implemented with support from external consultants. It should be noted that the system for verifying adherence to corporate HSE guidelines is unique, regardless of the specificities of each context, such as the size of the unit, operational conditions, types of process, and the level of maturity of the unit's OSH management system. Furthermore, it does not take into account ethnic, cultural, regional differences, among others, thus seeking to standardize practices without considering the multiple situational distinctions.

It appears that the company goes to the market seeking solutions and proposals for its SHP but does not carry out a critical and participatory reflection of its main issues – at least not with the necessary depth – in order to create their coping strategies from them.

The workers identify that there has been a change in the company's posture since the platform accident, landmark of this study, and perceive a more significant investment in HSE in their daily lives. However, they also highlight negative aspects such as the attempt to operate all work activity in an overly prescriptive manner, and the increased institutional bureaucracy due to the implementation of the OSH Management System:

Today it seems that each oil worker formally or informally supervises some third party, some process, but the expertise is lost to bureaucracy and the excesses instituted. (Employee D).

The company did not involve all the workers in the design of its SHP to carry out such changes, and there was not even a call for a better un-

derstanding of their problems in their daily work. However, given the degraded situations of the facilities and the frequent OAs, the implementation of the SHP was seen as a hope of changing their working conditions. Workers tended, at first, to adhere to and support the adoption of such measures, as they envisioned that they could reduce the OAs and the risks to which they were submitted, referring to what Schwartz[26] discusses about their dramatic needs to enable work in the context of change:

The issue of fatality, the loss of millions there with the P-36 too, the way fellow workers died, you know, that affected the workforce a lot, and... Mainly, whoever was at the front bought the idea. "Even if it is coming through corporate means, this will be good for us. It will reduce accidents". In that saying that goes like this: "Now, whatever comes is good. Whatever comes to avoid accidents..."– (...) *Consciously or unconsciously, those who were up at the front, right,* (...)*, as a rule, bought the idea.* (Manager A).

Workers resist and act to make work a viable medium, through the dramatic use of oneself by oneself, and the entire mobilization of the subject in a space where they confront and stress norms and values. Besides the use of oneself by oneself, the work involves the use of oneself by others – in this case, what is put in the work environment, from submissions to the set of new norms and standards, such as the implementation of the OSH system – where the arena of activity is a constant debate. Since work is not mere implementation, but a place for debate where the worker is always summoned integrally in the activity, there is "always a space of possibilities to be negotiated"[19]:

A dramatique is, thus, the place of a true micro-history, essentially unapparent, in which each one is under the obligation to choose or choose to guide his/her activity in this or that way. Affirming that the work activity is nothing but a dramatique of the use of oneself means to go against the idea that work is, for most workers, a simple "implementing" activity, which does not involve their person[27].

From 2002 to 2006, the guidelines were implemented through the SHP. This implementation aimed to ensure efficient management of HSE, control or minimize personal, environmental, and material risks, achieve international HSE standards and contribute to education and awareness of the workforce concerning risk perception[28]:

The company evolved a lot after the accident, mainly concerning the level of resources that – language is unique – the capacity for achievement was the most limiting factor; money was not lacking. (...) *So, resources were available, everything that was needed was not modernized because it did not have the capacity for realization, so the company has this divider* (...) *The great evil is because all abundance also brings waste, and it does not necessarily focus on what is necessary, because the most difficult was left aside and priorities were given to what the ability to achieve was easier*. (Manager B).

Workers, union leaders, and OSH managers identify a mismatch between the discourse adopted and the practices implemented, insofar as the preponderant production constraints remain at the expense of safety requirements. Production is always prioritized and at any cost:

As a value, not really. You even have campaigns. For example, "When in doubt, stop", it's... "Life first", "Life, first of all", right? They even put these catchphrases, but in the daily routine, depending on the situation, you are asked why you are giving your opinion to stop production, to stop the equipment (...). (Employee C).

It can be seen here, as underlined by Figueiredo and Alvarez[29], based on Schwartz[30], how the heterodeterminations of the uses of oneself by others can sometimes significantly overcome the self-determinations of the uses of oneself by oneself.

In 2006, the company entered the Dow Jones Sustainability Index and was ranked as a "Top 5" company by Goldman Sachs. It became the first Latin American company to join the United Nations Global Compact Board and received recognition as the second most sustainable company in the energy market by Management & Excellence[28]. During this period, new guidelines for contracting goods and services were also developed and introduced, and, as of 2007, the HSE Annexes became mandatory for all service providers. These documents assessed the company's level of risk and established HSE requirements that should be adopted, and failure to comply could result in fines or non-payment for the provision of services. The intention was to encourage good OSH practices in the oil and gas production chain and to evaluate the quality and degree of implementation of the PCSMS in service providers. However, prioritizing financial sanctions opened up a flank for underreporting occurrences with contractors.

In 2007, the company approved the program called Project Excellence in HSE, prioritizing the focus on workers' health, preventing accidents, incidents and deviations, and preparedness to respond to contingency situations, from the

following initiatives: "Integrated HSE management"; "Eco-efficiency of operations and products"; "Prevention of accidents, incidents, and deviations"; "Workers' health"; "Emergency preparedness-contingency"; and "Minimization of persisting risks and liabilities".

As of 2009, priority is given to actions related to Process Security (PS), aiming to meet the requirements of regulatory bodies and choosing the identification of risks in the process and the prevention of severe operational occurrences as the focus of action.

In 2014, the actions were aligned with the Continuous Improvement Program (PMC) and the structuring of the "ten golden rules". The golden rules established included the following themes: Work Permit; Energy Isolation; Work at height; Confined space; Explosive atmosphere; Safe Positioning; Personal Protective Equipment; Attention to Changes; Traffic Safety and Alcohol and Other Drugs.

Note that there was a great deal of work to disseminate these rules to workers, establishing a mandatory training, subject to the application of sanctions if it were not performed. However, a manager's analysis questions this type of approach, stressing that it is contradictory to what the company intends to spread since the implementation of its SHP remains centralized, top-bottom, and without the active participation of workers in its construction, seeking to impose their adherence:

While technically not deployed with appropriate tools, with its guidance, it manages to discipline our contractors and our workforce. (...) *And then we try, somehow, to measure this adherence and make some mistakes, let's say, technical errors, which are very gross. For example, the security perception assessment survey was a way for us to try to see ourselves within this policy adherence. How am I going to get that answer when I force these people to answer?* (Manager B).

It is essential to highlight the normative and prescriptive view of the rules with a focus on the individual and not on the work process, imputing the failures to the worker and thereby hindering the perception of systemic, organizational or process failures. The relentless search to eliminate the risk of human activity imposes the failure of OSH policies, and it is necessary to break with this conservative view, understanding that if workers are fallible, liable to make mistakes and failures, the detection rates of anomalies that they can perform are incredibly high. It is crucial to think about how prevention can incorporate and act on the consequences of human error[31]:

If errors are inevitable, the most effective prevention must act on its consequences and not only eliminate errors (...)*, requiring the active contribution of workers* (...)*, whose conditions are clarified by concepts of situated action* (...)[32](p.569).

It is necessary to recognize that only procedures, standards, prescriptions, and scientific knowledge, which is called "standardized safety"[33], while important, due to their crucial role, are insufficient to eliminate or minimize OAs. It is also necessary to incorporate "security in action", related to the real-time response of agents to events by adapting procedures to the situational and contextual specificities, resulting in "adapted security"[34]:

The daily work is a confrontation between what is anticipated by the work organization (...)*, and the activity, which addresses situations and events that were not foreseen in their singularities* (...)*. In companies, the attempt to anticipate situations occurs, in most cases, through norms, rules, and procedures developed by experts and members of the board. This accumulation of rules, however, does not warrant that they will be respected by workers and does not prevent incidents* (...)*. Overprocedurialization* (...) *can even be counterproductive: the excess of safety rules can generate insecurity, preventing workers from establishing new rules appropriate to each situation*[32](p.570).

In 2016, the PGSMS was revised again, and the "Commitment to Life" Program is launched, which provides for the 2017-2021 period a 36% reduction in the rate of recordable accidents[35], and is conceived, according to the company, from the analysis of results and assessments of the primary causes of OAs in previous years[36]. Its pillars are the Obligation to Do, Consequence System, Reinforcement of Process Security, and Integrated Actions, and one of the priority actions is the implementation of the golden rules.

Among these pillars, the Consequence System stands out and aims to hold the culprits responsible for OAs. However, the union believes this liability would fall exclusively on workers:

The company's managers made it clear that the Consequence System aims to penalize the worker. (...) *The company is inefficient in educating, training, and qualifying workers to prevent accidents, but not to punish*[37].

At that point, the SHP principles are geared to the company's workforce and focus what they call Human Factors, imputing to them the responsibility for caring for life and promoting ethical and safe behavior[33]. Based on this direc-

Ciência & Saúde Coletiva, 25(5):1819-1828, 2020

tion, it is essential to underline that emphasizing the prevention of severe accidents in actions that prioritize individual behavior, to the detriment of the so-called organizational factors, sounds quite contradictory with the proposals of researchers who have been dialoguing in the field health and safety[32,38] for years.

The focus on individual factors is not sufficient to address the elements found in the genesis of situations that can trigger the severe process accidents associated with the operation of intricate systems. We understand that for the development of a safety culture it is necessary not only to invest in the knowledge and mapping of the organization's most significant risks but also carry out approaches in an integrated and systemic manner, with actions geared to the technical dimension, management systems, and human and organizational factors[34]. Such procedure would be one of the essential requirements to achieve the status of an effective safety management system, that is, one that articulates past experiences, current debates, and likely future situations to engender the ability to anticipate and prevent risk situations[39].

Figure 1 shows a summary of the HSEP's path in the company from 2001 to 2017.

According to FUP data[40], despite intensified investments in OSH areas, 365 OA-related deaths were recorded from 1995 to 2015, 297 of which were of outsourced workers, and 68 were of employees. There is a particular paradox there, because if on the one hand, investments in OSH increased, countless situations of danger and deaths of workers are still observed in the daily work routine. The data analyzed in this study corroborate this analysis. The occurrence of 222 FOAs was identified (Figure 2), with a predominance of OAs with outsourced workers, totaling 83.8% (186), whereas 16.2% were of employees.

When calculating the OA-related mortality rate (number of deaths due to occupational accidents/mean annual number of workers x 100,000 workers) by work and year of occurrence, we identified higher rates in outsourced workers in the analyzed series, with a peak in 2004, 2005, 2007 and 2015 (Figure 3). On average, an OA-related mortality rate five times higher among outsourced workers when compared to employees is identified.

Final considerations

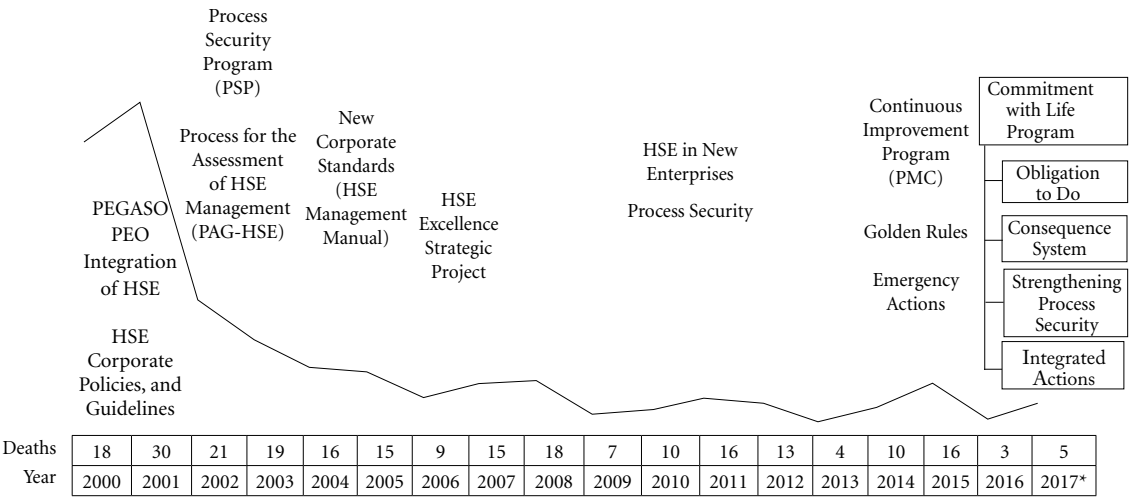
This paper aimed to analyze the changes in the HSEP of a Brazilian oil and gas company based on a severe occurrence of an expanded accident in 2001, articulating qualitative and quantitative information from documentary analysis, a descriptive epidemiological study on FOAs, and semi-structured interviews.

The option for an ergological view allows us to understand the situation in focus more broadly, allowing us to apprehend, in part, the tensions between the macro and micro dimensions of work in their vast intricacy, richness and multiple facets, as well as highlighting the different viewpoints that influence and determine the activity. To this end, the use of the DD3P as an analysis tool was providential to access the activity, know the tensions and debates around norms and values present there, as well as the dramatic uses of oneself raised in the course of work situations.

We identified that changes in the SHP, in general, have a sensitive, reactive bias and, more often than not, are driven by a substantial impact on the company's image after the occurrence of severe accidents. As such events bring numerous financial losses, and sanctions from supervisory bodies, the company is compelled to give forceful and immediate responses.

However, in this movement of response, concerning the implementation of the OSH policy and practices, the lack of participation by the leading figures of the activity, namely, workers, predominated. Moreover, this gap, which occurs in the process of elaborating the rules and procedures (of the norms), and of the principles and practices in general, enhances the mismatch between the prescriptive dimension and that of the effectively performed, hindering compliance with the rules, as these would reverberate such a mismatch in the course of the activity.

In short, the participation of workers in the decision-making processes is of great importance, considering statements, knowledge, built and accumulated heritage, aiming at the horizontalization of more participatory and collaborative actions and practices, to allow the contribution of the leading figures of work in the construction of industrial security and health protection.



Deaths	18	30	21	19	16	15	9	15	18	7	10	16	13	4	10	16	3	5
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017*

Figure 1. Trend of Health, Safety, and Environment (HSE) Management.

Notes: NAF, TAF-Fatal Accident Rate, up to Oct/2017.
Source: Own elaboration based on Sanches[35].

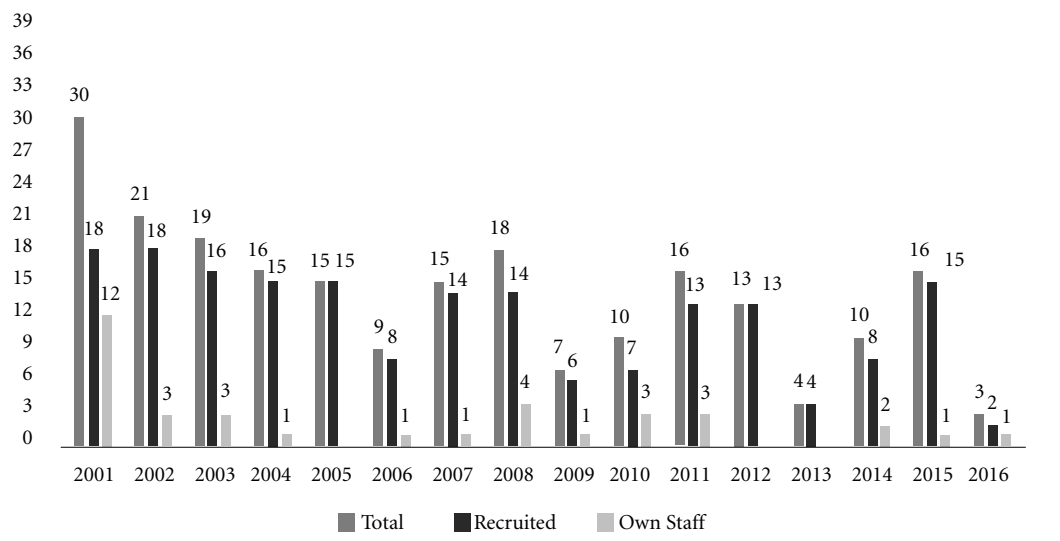


Figure 2. Number of Fatalities per Year and Employment Relationship, 2001-2016.

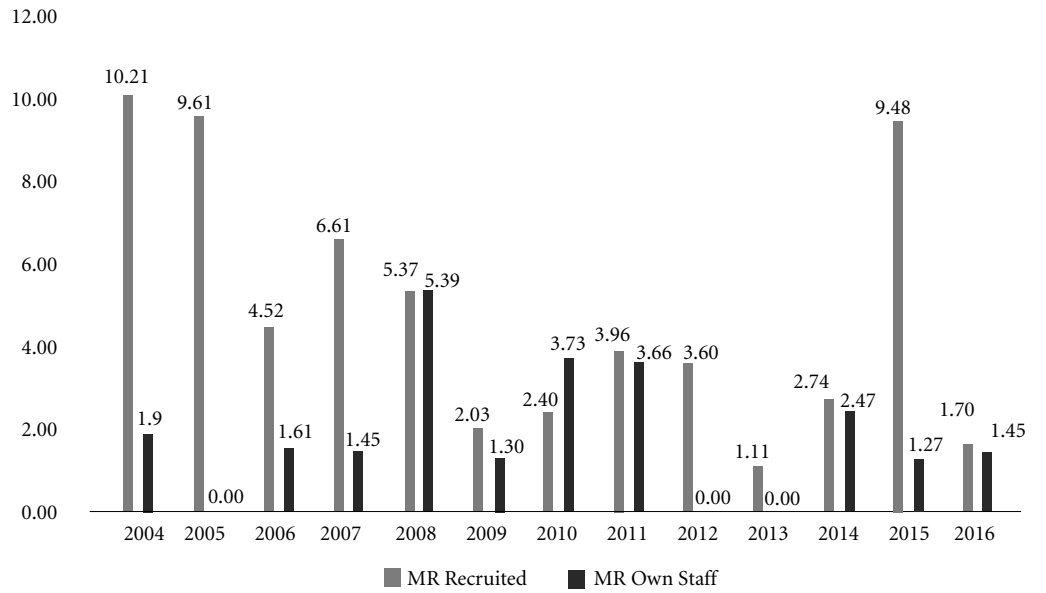


Figure 3. Mortality rate due to fatal occupational accidents per year and employment relationship, 2004-2016.

Collaborations

The three authors were responsible for the elaboration and design of the study, performed the analysis and interpretation of the data, as well as drafted, revised, and approved the final version of the manuscript.

References

1. Ferreira ABH. *Miniaurélio: o dicionário da língua portuguesa*. 8ª ed. Curitiba: Positivo; 2010.
2. Vilela RAG. Acidente do trabalho. In: Mendes R, organizador. *Dicionário de saúde e segurança do trabalhador: conceitos, definições, história, cultura*. Novo Hamburgo: Proteção Publicações; 2018.
3. Brasil. Ministério da Saúde (MS). Secretaria de Políticas de Saúde. Departamento de Atenção Básica. *Área Técnica de Saúde do Trabalhador Saúde do trabalhador*. Brasília: MS; 2001.
4. Perrow C. *Normal Accidents: Living with high-risk technologies*. New Jersey: Princeton University Press; 1999.
5. Llory M. *Acidentes industriais: o custo do silêncio*. Rio de Janeiro: Multiação Editorial; 2001.
6. Santana VS, Araújo Filho JB, Albuquerque-Oliveira PR, Barbosa-Branco A. Acidentes de trabalho: custos previdenciários e dias de trabalho perdidos. *Rev Saude Publica* 2006; 40(6):1004-1012.
7. Cordeiro R, Luz VG, Hennington ÉA, Martins ACA, Tófoli LF. A violência urbana é a maior causa de acidente de trabalho fatal no Brasil. *Rev Saude Publica* 2017; 51:123.
8. Brasil. Ministério da Saúde (MS). *Notificação de acidentes do trabalho fatais graves, com crianças e adolescentes*. Brasília: MS; 2006.
9. Scussiato LA, Sarquis LMM, Kirchhof ALC, Kalinke LP. Perfil epidemiológico dos acidentes de trabalho graves no Estado do Paraná, Brasil, 2007 a 2010. *Epidemiol Serv Saude* 2013; 22(4):621-630.

10. Brasil. Ministério da Saúde (MS). Portaria nº 1.823, de 23 de agosto de 2012. Institui a política nacional de saúde do trabalhador e da trabalhadora. *Diário Oficial da União*; 2012.
11. Adams RN. *Saúde e segurança do trabalho em plataformas off-shore*: *revisitando o acidente no FPSO cidade de São Mateus três anos depois* [dissertação]. Niterói: Universidade Federal Fluminense; 2018.
12. Figueiredo MG, Alvarez D, Adams RN. O acidente da plataforma de petróleo P-36 revisitado 15 anos depois: da gestão de situações incidentais e acidentais aos fatores organizacionais. *Cad Saude Publica* 2018;34(4):e00034617.
13. Figueiredo MG. *A face oculta do ouro negro: trabalho, saúde e segurança na indústria petrolífera offshore da Bacia de Campos*. 2ª ed. Niterói: Editora UFF; 2016.
14. Rudmo T. Risk Perception and Safety on Offshore Petroleum Platforms Part I: Perception of risk. *Safety Sci* 1992; 15(1):39-52.
15. Rundmo T. Associations between risk perception and safety. *Safety Sci 1996; 24*(3):197-209.
16. Loureiro AC, Lima GBA, Barros SRS. Gestão de qualidade, segurança, meio ambiente e saúde: estudo de um modelo integrado para a engenharia da Petrobras. In: *IV congresso nacional de excelência em gestão Responsabilidade Socioambiental das Organizações Brasileiras.* Niterói; 2008.
17. Minayo MCS. *O desafio do conhecimento: pesquisa qualitativa em saúde*. 2ª ed. São Paulo: Hucitec/Abrasco; 1993.
18. Schwartz Y. O trabalho se modifica. In: Schwartz Y, Durrive L, organizadores. *Trabalho & ergologia: conversas sobre a atividade humana*. Rio de Janeiro: EDUFF; 2010.
19. Schwartz Y. Abordagem ergológica e necessidade de interfaces pluridisciplinares. *ReVEL* 2016; 11(ed. esp.):253-264.
20. Schwartz Y. Ergonomie, philosophie et exterritorialité. In: Daniellou F, organizador. *L'Ergonomie en quête de ses principes: débats épistémologiques*. Toulouse: Octares; 1996. p. 141-182.
21. Azevedo JSG. *Uma Petrobras mais verde* [página na Internet]. Harvard Business Review Brasil; 2011. Disponível em: https://hbrbr.uol.com.br/uma-petrobras-mais-verde/
22. Instituto Observatório Social. *Perfil de empresa Petrobras*. Florianópolis: Instituto Observatório Social; 2004.
23. Amaral SP. *Estabelecimento de Indicadores e Modelo de Relatório Sustentabilidade Ambiental, Social e Econômica: Uma Proposta para a Indústria de Petróleo Brasileira* [tese]. Rio de Janeiro: Universidade Federal do Rio de Janeiro; 2003.
24. Duque RHM. *Estudo de caso em obra de construção e montagem em uma refinaria de petróleo* [dissertação]. Niterói: Universidade Federal Fluminense; 2004.
25. Beltran SL, Vilela RAG, Almeida IM. Challenging the immediate causes: A work accident investigation in an oil refinery using organizational analysis. *Work* 2018; 59(4):617-636.
26. Schwartz Y. Circulações, dramáticas, eficácias da atividade industriosa. *Trab Educ Saude* 2004; 2(1):33-35.
27. Schwartz Y. Os ingredientes da competência: um exercício necessário para uma questão insolúvel. *Educ Soc* 1998; 19(65):101-140.
28. Espinosa B, Azevedo R, Glitz A. *Petrobras HSE Management System*. Madrid: World Petroleum Congress; 2008.
29. Figueiredo M, Alvarez D. Gestão do trabalho na perfuração de poços de petróleo: usos de si e "a vida por toda a vida". *Trab Educ Saude* 2011; 9(Supl. 1):299-326.
30. Schwartz Y. Trabalho e uso de si. In: Schwartz Y, Durrive L, organizadores. *Trabalho & ergologia: conversas sobre a atividade humana*. Rio de Janeiro: EDUFF; 2010. p. 189-204.
31. Amalberti R. *La conduite de systèmes à risques*. Paris: Press Universitaires de France; 1996.
32. Rocha R, Lima F. Erros humanos em situações de urgência: análise cognitiva do comportamento dos pilotos na catástrofe do voo Air France 447. *Gest Prod* 2018; 25(3):568-582.
33. Morel G, Amalberti R, Chauvin C. Articulating the differences between safety and resilience: the decision-making process of professional sea-fishing skippers. *Hum Factors* 2008; 50(1):1-16.
34. Daniellou F, Simard M. Boissières I. *Fatores Humanos e Organizacionais da Segurança Industrial: um estado da arte*. Toulouse: FONCSI; 2013.
35. Sanches AR. Programa compromisso com a vida. In: *XVI Seminário Nacional de Telecomunicações*. Rio de Janeiro; 2017.
36. Petrobras. *Segurança operacional* [página na Internet]. 2019. Disponível em: http://www.petrobras.com.br/pt/sociedade-e-meio-ambiente/meio-ambiente/seguranca-operacional/
37. Sindicato dos Petroleiros (Sindipetro). *A política de SMS da Petrobrás mata e não previne* [página na Internet]. 2017. Disponível em: http://sindipetrocaxias.org.br/entertainment/item/359-a-politica-de-sms-da-petrobras-mata-e-nao-previne
38. Amalberti R. *Piloter la sécurité*. Paris: Springer-Verlag France; 2013.
39. Rocha R, Mollo V. Daniellou F. Work debate spaces: a tool for developing a participatory safety management. *Applied Ergonomics* 2015; 46(Pt A):107-114.
40. Federação Única dos Petroleiros (FUP). *Balanço da Petrobrás reflete crise do setor. É preciso fortalecer a empresa* [página na Internet]. Informe FUP; 2016. Disponível em: https://www.fup.org.br/publicacoes/informativo/item/19075-balanco-da-petrobras-reflete-crise-do-setor-e-preciso-fortalecer-a-empresa

Article submitted 30/05/2019
Approved 07/08/2019
Final version submitted 02/12/2019