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THE POSITIVE ROLE OF WORKERS IN THE SAFETY OF OIL PLATFORMS

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Abstract: The industrial accidents that have occurred in recent years in Brazil and in the world bring to the fore the debate about their prevention. Evidence of a certain causal and temporal relationship between the decisions preceding major catastrophes is almost inevitable after the event is declared. But how to act in the present, to prevent misfortune from recurring? A perennial solution can not neglect the role of work in industrial safety. Therefore, this article intends to contribute to the discussion about the relationship between the production of offshore oil and the safety in this industry. The privileged point of view is the work on production platforms located on the Brazilian coast, which have been operating for more than 20 years. Based on the Ergonomic Analysis of Work, a methodology was developed for rapid diagnosis of working conditions, applied in 20 different platforms between the years 2011 and 2015. Repertorying these cases allowed to know the work of the main teams on board and the origins of the mode current operation of the units. The analyzes pointed to positive contributions from workers to compensate for the technical problems of installations, devices and systems, and the degradation of platforms. The performance of the embedded teams was essential to maintain the safety, reliability and resilience of these units. The risk of offshore oil production is closely related to the possibilities of process accident prevention. The analysis of the "here and now" of the work of the operational teams, together with a diachronic evaluation of the facilities, allows to understand the current functioning of the platforms and to construct preventive measures.

Keywords: job; safety; industrial accident; oil platforms.

1. INTRODUCTION

1.1 WORK AND INDUSTRIAL SAFETY

In Brazil and around the world, the number of offshore accidents increased from the 1980s onwards (FIGUEIREDO, 2012). The most dramatic was the fire on the Piper Alpha platform in the North Sea in 1988, when there was

167 deaths. In Brazil, the most critical accidents occurred in 1984, on the Enchova platform, with the death of 37 workers and, in 2011, on the P-36 platform, when an explosion occurred that led to the death of 11 people and the sinking of the unit. Recently, in February 2015, an explosion on the Cidade de São Mateus platform, owned by the company BW Offshore, caused the death of nine workers, reigniting the debate about safety conditions on platforms operating off the Brazilian coast.

In offshore oil activities, industrial risk and environmental consequences inevitably come together. The explosion of the Deepwater Horizon platform in 2010, due to its magnitude and severity, caused a shock that highlighted the relationship between risks to the safety of workers, facilities and the environment. In addition to the deaths of 11 people, there was severe damage to the ecosystem off the coast of Macondo, in the Gulf of Mexico, generating devastation in the food chain and interfering with the fishing, seafood collection and deep sea life industries. It is estimated that it will take years or decades for the ecosystem to recover (HOPKINS, 2012).

Major accidents, however, are not specific to the oil industry. More recently, in Mariana, Minas Gerais, an accident of major human and environmental proportions reinforced the debate in Brazil on safety and security issues.

accident prevention in industries. How can we anticipate and prevent catastrophes of these proportions from recurring? How to act in these cases? How and what should we learn from previous experiences?

The experiences of Macondo and Mariana show us that to account for the breadth of the problems, it is necessary to adopt an expanded, multi-level assessment, combining, in particular, ethnographic and historical analyses, as proposed by Vaughan (2004), in the study of the Challenger case. On the platforms, the trajectory from conceptual design to current operation gave each unit a unique configuration, the result of a series of notable events in its ongoing operational life cycle. Looking back and investigating their stories makes it possible to understand how priorities were defined and why there are pending issues that have not yet been resolved (COSTA, 2014). It is important to know the genesis of the problems and identify the logical-temporal chain of their appearance and progression to the present day. This way, we can have clues on how to transform working conditions on board.

However, these retrospective analyses, which show the present in light of the past, can also bring the illusion of immediate causal sequence, by simplifying the contexts of previous decisions, limiting a more global understanding of the complexity of events and action towards prevention. (LIMA; et al., 2015). The situated analysis of the past represents an opportunity to learn from previous experiences, aiming to prevent failures from recurring and triggering the same disaster, but they cannot be the only bias. It is not possible to wait for accidents to happen, and then retrace their origins and relate the causes to the obvious consequences. It is necessary to act to prevent them in the "here and now" time.

Prevention involves reconsidering the place of workers and their work in industrial safety

(DANIELLOU; SIMARD; BOISSIÈRES, 2013). If the

dimension of work is sometimes forgotten, in this article this is the point of view adopted. After all, to avoid the repetition of disasters similar to those that have occurred in recent times, "safety management in complex technological or production systems cannot disregard the everyday experience, whether of lay users or workers" (LIMA; et al., 2015 , pp. 118).

2. METHODOLOGY

2.1 - THE ACCIDENTOGENIC CHARACTER FROM THE POINT OF VIEW OF THE ACTIVITY

Maintaining operational safety and reliability in continuous process industries requires constantly anticipating possible malfunctions of technical devices and systems. This need places workers as agents of systems stability, who develop new operating methods to absorb unforeseen events and uncertainties in work situations. But it was not always so. The first studies on industrial accidents took into account protection rather than prevention and did not look at the circumstances and determinants of activities. Accidents were seen as the result of workers' failures: human error (DUARTE, 1994).

Based on studies that analyzed technical systems and considered that people failed and errors occurred, security measures began to be directed to the conditions under which activities are carried out. Thus, defense systems were created: intermediate barriers, which isolated the worker. However, there was still no direct action on the mechanism that caused the accident. There was protection and not prevention. To prevent this, it would be necessary to investigate active failures and latent conditions, aiming to understand how the barriers failed and were overcome and, consequently, caused accidents, which is one of the possible results of work activities (LEPLAT; TERSSAC, 1990; REASON, 1998;

DUARTE; VIDAL, 2000).

The participation and culpability of workers in the occurrence of accidents began to be relativized. A hierarchy of responsibilities was recognized as the cause, which ruled out the predominance of human error as the origin of accidents. In this way, the worker, who is at the forefront of the process, cannot be the only one responsible for the event, as there is an entire decision-making chain that precedes it. Furthermore, men fail, but so do technical devices and systems (WYNNE, 1987; WISNER, 1991;

1994).

To prevent accidents, it is necessary to understand their production mechanisms, anticipate what is predictable and face unforeseen events. This action will depend on the local team and management resources available in real time. It is important, therefore, to enable workers to adapt during the execution of their activities, based on their experiences. Only in this way will it be viable to integrate standardized security, from formalisms and technical regulations, to security in action, making industrial systems resilient (HOLLNAGEL; WOODS, 2006; DANIELLOU; SIMARD; BOISSIÈRES, 2013).

However, companies tend to direct their efforts towards easily identifiable and high-frequency events, such as workplace accidents, which do not always have fatal potential. Meanwhile, unpredictable fortuitous events, such as process accidents and a set of inadequacies, which may be harbingers of more serious risks, are seen as “minor” and, sometimes, their importance is neglected and they end up being considered normal (ASSUMPTION ; LIMA, 2003; VAUGHAN, 2004; ANDERSON; SCHLUMBERGER, 2010).

In order for there to be security, it must be considered and monitored from the beginning to the end of the installations’ life.

Its management goes beyond resolving technical problems and applying regulations. The costs that accidents impose on organizations are high. Prevention is one of them. However, the risk of death is unacceptable. Companies in the oil sector have increasingly become concerned with environmental and safety issues. But how to solve latent problems, which can lead to major accidents?

Intense daily action and a safety culture put into practice by all individuals in the company are necessary in complex social processes that require: (i) the commitment of leadership;

(ii) clear communication at different levels of the organization; (iii) an information system that collects, analyzes and disseminates data on incidents, near-accidents and individuals' perceptions of safety; and (iv) the involvement, engagement and participation of workers to improve safety systems and processes (FANG; WU, 2013; FRUHEN; et al., 2013).

Actions need to be undertaken gradually and over the long term. It is also important to know that culture and power are inexorably linked and that conflicts are inherent to the process.

As culture is not neutral, static and stable, to be put into practice, it needs certain conditions for sharing between individuals, with spaces for constructive conflicts. Formal and informal power structures influence this exchange. Power by position in the formal hierarchy cannot exceed legitimate issues raised by the lower levels of the chain (ANTONSEN, 2009).

2.2 RAPID DIAGNOSIS FOR LARGE-SCALE ERGONOMIC ASSESSMENT ON OIL PLATFORMS

Ergonomic analyzes adapt to the time and place of the activity, being subject to the uncontrolled conditions of work situations. Therefore, the analyzes developed may require a variable amount of time depending on the diversity of activities and work situations. Therefore, the analysis methodology must adjust to the space and time of real situations.

In the study in question, the demand for ergonomic diagnosis originated in the company's Safety, Environment and Health area, whose objective was to meet the requirements of Brazilian legislation, in particular Regulatory Standard 17. The rapid diagnosis methodological approach was developed with based on Ergonomic Work Analysis and applied from November 2011 to May 2015 on 20 platforms. For each unit, its application was carried out in three distinct stages (COSTA, 2014; COSTA; et al., 2015).

In the first stage, technical information about the platform, accidents that occurred in the last three years and the personnel on board were analyzed. Based on this assessment, a meeting was held on land with the unit manager. This preparation for boarding allowed understanding some diachronic specificities and getting to know the main work fronts on board during the researchers' boarding period.

The second stage consisted of boarding itself, which began with a presentation to the leaders (coordinators and/or supervisors) and security technicians. Guided tours were then carried out and the work activities of the different teams on board were monitored. During observations of real situations, positive and negative aspects of working conditions were characterized. Aspects such as the general conditions of habitability and conservation of the houses, access and integrity of valves and other equipment in the production process, cargo handling devices, support rooms for field operators, the emission process and release of work permits, among others.

In addition to the problems encountered, we also sought to identify the solutions put into practice by workers to ensure the safe and efficient operation of the platform. The objective was to share these practices between the different units, in subsequent meetings with their managers. After validation with the operators, the last activity on board was the presentation of the information obtained to the leaders.

The third and final stage was writing the ergonomic report, with proposals for improving working conditions. This report was presented to the platform manager with the aim of developing action plans that could be incorporated into the maintenance plans of each unit. The boardings on the different platforms, although short (between three and five days in length), made it possible to understand broader processes that led to the accumulation of pending issues and inadequate working conditions. This global vision, which goes beyond the identification of specific critical situations, allows us to understand how and why these conditions were generated and, consequently, reflect on which strategies to adopt to more definitively solve the problems encountered.

The process of accumulating ergonomic issues configures a certain degree of degradation of the system, which ranges from changes that are not very relevant to deteriorations that can compromise the reliability of the system. This broad palette, perceptible only when the analysis goes beyond the immediate appearance of the condition of the facilities, led us to re-interrogate the concept of “degraded mode of operation”, in order to consider the gradations of deterioration in terms of risk potential and the role of regulation of the work activity of operators and technicians in these units (COSTA, 2014; COSTA; et al., 2015).

2.3 A THE ADAPTABILITY OF THE TECHNICAL SYSTEM AND THE COMPENSATORY ACTIVITIES OF WORKERS

The platforms' current operating mode presents continuous wear and tear on facilities and increasing maintenance demands with human resources limited by the accommodation capacity on board. Frequent disruptions in technical devices and systems require compensation from workers to absorb production abnormalities. The maneuvers designed aim to mitigate risks, reliability and operational safety, and involve workers' knowledge and skills in action (SAGAR, 1989; WISNER, 1989; KERBAL, 1990).

After accidents, when their causes are investigated, it is discovered that system safety rules and routines do not always work as recommended. To some extent, this fact is positive. There is a balance and adaptability that the system as a whole goes through to achieve ideal (idealized) functioning that has an intrinsic relationship with work. In the real mode of operation, some degradation of the facilities is normal and workers learn to deal with it. They are the ones who assess the extent of the transformation, at the moment they feel or perceive the limitation and/or inability to carry out the tasks.

The important thing, then, is not to constantly seek to extinguish the new normal operating situation, but to establish the limits between normal obsolescence and unacceptable degradation, which puts the safety of facilities and people at risk (WEICK; SUTCLIFFE, 2007). Analyzing work activities can be one of the ways.

In the study in question, the analysis of work on board pointed to positive contributions from workers to compensate for technical problems and degradation. In several units visited, there were: (i) accelerated corrosive processes in floors and guardrails, which were reconstituted by the workers themselves, while they were not definitively replaced; (ii) pipeline leaks were contained with temporary repairs; (iii) valves that had constant automatism malfunctions were manually actuated, several times a day; and (iv) closed and open drainage systems were obstructed and workers used drums, placed in appropriate locations, to receive oil disposal during daily sample collections.

The movement of drums by production operators and the load handling team and other examples illustrate how the work activity counteracts the degradation of the technical system and, in these examples, including the negative effects on the environment, which could be generated in due to leaks in pipes and the drainage system.

3. CONCLUSION

The risk of offshore oil production is intrinsically related to the possibilities of preventing process accidents. Analyzes carried out on these platforms may lead readers to believe that they are operating under risky conditions. However, observing a certain degradation of the system is inevitable, since the current functioning will always be different from the nominal, especially in a dynamic scenario, which can degrade or even improve.

The central issue in terms of security is whether the system can recover from the problems experienced and operate safely. In part, this resilience depends on the teams' ability to compensate for facility deficiencies without significant losses in production performance or safety. It is easy to recognize the current operating conditions, some of which are easily observable, such as corrosion of floors and guardrails, and leak seals in pipes. It is difficult to evaluate the “here and now” moment without the bias and ease of retrospective analyses, when ambiguities are clearly defined.

The work of operators, in addition to compensating for degradation of technical systems, is a source of precious information to identify problems and restore the integrity of installations and equipment. Associating current analyzes with a diachronic, or even historical, assessment of the platforms allows us to understand the current functioning of these units and to construct preventive measures.

For Hopkins (2012), much of what was written in the media about the tragedy with the Deepwater Horizon platform in the Gulf of Mexico does not hold up after analyzing this accident. Neither is the company completely reckless, nor was this accident an inevitable consequence of operating at the limit of technology. The causes were more mundane and involved a series of human and organizational factors similar to those identified in other serious industrial accidents. What several studies revealed and what made the accident important, from a prevention point of view, was its relationship with the decision-making process outside the platform, at higher hierarchical levels, before it happened.

Therefore, process accidents increasingly need to be discussed in industries. The view that everything is under control, managed and monitored generates an atmosphere of trust that is illusory. It is necessary to be afraid and pay attention to the signals given by people and machines. Workers' perspective on their working conditions and their daily reality is an important pillar in building a safety culture.

4. BIBLIOGRAPHICAL REFERENCES

ANDERSON, M.; SCHLUMBERGER, M.D. The Heinrich Accident Triangle - Too Simplistic A Model For HSE Management in The 21st Century?. *SPE International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production*. Rio de Janeiro, Brasil, 2010.

ANTONSEN, S. Safety culture and the issue of power. *Safety Science*, n. 47, p. 183-191, 2009.

ASSUNÇÃO, A.A.; LIMA, F.P.A. A contribuição da ergonomia para a identificação, redução e eliminação da nocividade do trabalho. In: MENDES, R. *Patologia do Trabalho.* 2.ed. atualizada e ampliada. São Paulo: Atheneu, v. 2, parte III, cap. 45, p. 1767-1789, 2003.

COSTA, P.G.F. *Diagnóstico rápido em ergonomia:* aplicação em plataformas *offshore* na Bacia de Campos. 2014. 221 p. Dissertação (Mestrado em Engenharia de Produção) - COPPE; Universidade Federal do Rio de Janeiro, Rio de Janeiro, 2014. Disponível em: <http://objdig.ufrj.br/60/teses/coppe_m/PatriciaGomesFerreiraDaCosta.pdf>. Acesso em: 12 jun. 2014.

COSTA, P.G.F. *et al.* A efetividade de metodologias de diagnóstico rápido em ergonomia em plataformas offshore: revisitando o conceito de modo degradado de funcionamento. *Rev. bras. saúde ocup.* [*online*], v. 40, n. 132, p. 121-136, 2015.

DANIELLOU, F.; SIMARD, M.; BOISSIÈRES, I. *Fatores humanos e organizacionais da segurança industrial:* um estado da arte. Tradução Marlene Machado Zica Vianna; revisão técnica Raoni Rocha,Francisco de Paula Antunes Lima e Francisco José de Castro Moura Duarte. Toulousse: FonCSI, 2013.

DUARTE, F.J.C.M. *A análise ergonômica do trabalho e a determinação de efetivos:* estudo da modernização tecnológica de uma refinaria de petróleo no Brasil. 2014. 134 p. Tese (Doutorado em Engenharia de Produção) - COPPE; Universidade Federal do Rio de Janeiro, Rio de Janeiro, 1994.

DUARTE, F.J.C.M.; VIDAL, M.C. Uma abordagem ergonômica da confiabilidade e a noção de modo degradado de funcionamento. In: FREITAS, C.M.; PORTO, M.F.S.; MACHADO, J.M.H. (org.). *Acidentes industriais ampliados:* desafios e perspectivas para ocontrole e a prevenção. Rio de Janeiro: Fiocruz, 2000. cap. 2, p. 83-105.

FANG, D; WU, H. Development of a Safety Culture Interaction (SCI) model for construction projects. *Safety Science*, n. 57, p. 138-149, 2013.

FIGUEIREDO, M. *A face oculta do ouro negro:* trabalho, saúde e segurança na indústria petrolífera *offshore* da Bacia de Campos. Rio de Janeiro: UFF/Fac. Educação, 2012.

FRUHEN, L.S.; *et al.* From the surface to the underlying meaning-an analysis of senior managers' safety culture perceptions. *Safety Science*, n. 57, p. 326-334, 2013.

HOLLNAGEL, E.; WOODS, D. D. Prologue: resilience engineering concepts. In:_________. *Resilience engineering:* concepts and precepts. Hampshire: Ashgate Publishing Limited, p. 01-06, 2006.

HOPKINS, A. *Disastrous decision:* the human and the organizational causes of the Gulf of Mexico blowout. Australia: CCH Australia, 2012. 210 p.

KERBAL, A. La genèse du mode dégradé en milieu industriel. *Le Travail Humain*, Paris, v. 53, n. 4, p. 369-372, 1990.

LEPLAT, J.; TERSSAC, G. *Les facteurs humains de la fiabilité dans les systèmes complexes*. Marseille: Editions Octares, 1990.

LIMA, F.P.A. *et al.* Barragens, barreiras de prevenção e limites da segurança: para aprender com a catástrofe de Mariana. *Rev. bras. saúde ocup.* [*online*], v. 40, n. 132,

p. 118-120, 2015.

REASON, J. Achieving a safe culture: theory and practice. *Work & Stress*, v. 12, n. 3, p. 293-306, 1998.

SAGAR, M. *La conduite des dispositifs automatisés fonctionnant en mode dégradé:* modele théorique et methodologique d'analyse. 1989. 277 p. Tese de (Doutorado em Ergonomia) - Conservatoire National des Arts et Métiers, França, 1989.

VAUGHAN, D. Theorizing disaster. Analogy, historical ethnography, and the Challenger accident. *Ethnography*, London, v. 5, n. 3, p. 315-347, 2004.

WEICK, K.E.; SUTCLIFFE, K.M. *Managing the unexpected:* resilient performance in an age of uncertainty. 2. ed. Hobokey: John Wiley & Sons, 2007.

WISNER, A. La nouvelle usine en pays en développement industriel: transfert ou nouvelle conception. *Le Travail Humain*, Paris, v. 52, n. 3, p. 232-246, 1989.

______. Arretons d'opposer cause technique et cause humaine. *Santé et Travail*, n. 2, p. 29-37, 1991.

______. O trabalhador diante dos sistemas complexos e perigosos. In:________. *A inteligência no trabalho:* textos selecionados de ergonomia. São Paulo: Fundacentro, p. 53-70, 1994.

WYNNE, B. Risk assessment of technological system: dimensions of uncertainty. In:________(org.). *Risk management and hazardous waste:* implementation and dialectics of credibility. Berlin: Springer-Verlag, p. 356-398, 1987.