Analysis of Worker Perceptions of Risk in The Workplace: Case Study in Unit Operation of a Brazilian Energy Company

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Abstract

To ascertain if the worker perceives the risks in the workplace he or she operates in, which is increasingly relevant for companies looking to improve their Health and Safety Management and to strengthen their public image in the competitive modern marketplace. To investigate and analyse worker Perceptions of Risk as a factor behind causing accidents in the workplace, make it possible to adopt specific administrative measures in the area, consequently reducing the number of accidents. This research, therefore, has the general aim of analysing worker perceptions of risk in the workplace. To carry out this research, one of the Operation Units of the Storage and Transport of Petroleum and By-products belonging to the Brazilian Energy Company was chosen, after being identified as the Unit with the largest number of accidents between 2008 and 2010. A structured Questionnaire was used as the main tool for field research. It was divided into two parts: Part I – Information about the collaborator and Part II – Perception of Risk. Part II of the Questionnaire was based on data, Information about Features, Impacts, Dangers and Consequences in the Operation Unit being researched, related to the Industrial Paint Service. The results of the research revealed that only a minority of workers perceive all the risks in their working environment and that the Risk Communication Programs implemented in the unit are not sufficient to prepare the worker so that he perceives these risks and develops safe attitudes in the workplace.

Keywords: Work Accident. Safety Management. Perception of Risk.

1 Introduction

Concern with the number of accidents and problems related to health in the workplace, and the search for mechanisms capable of preventing them, is a global issue. An accident in the workplace has a negative impact on the life of the worker and the costs involved have considerable economic consequences.

Estimates provided by the International Labour Organization (ILO) reveal that nearly 6,000 workers die on a daily basis worldwide due to accidents in the workplace or occupational illnesses. Furthermore, it is estimated that 270 million non-fatal accidents occur every year and lead to at least a three day absence from work, and there are 160 million new cases of work related illnesses. The total estimated cost of these accidents and illnesses according to the ILO is the equivalent of 4% of the global GDP, or more than 20 times the global amount for public help for development (ILO, 2008).

In Brazil, data from the 2009 Annual Statistics of Accidents in the Workplace, from the Ministry of Labour and Employment (MTE) and the Ministry of Social Welfare, record a total number of 723.452 accidents of which 528.279 contacted the Labour Accident Communication (CAT). Of the total number of accidents with CAT, 79,7% were typical accidents (421.141). The Ministry of Social Welfare, through the National Health and Safety Institute (INSS), is responsible for the majority of accident-related benefits. In 2009, Social Welfare awarded 4,5 million in benefits, of which 83,9% were social security and pension benefits, 7,9% for victims of accidents and 8,1% went towards health care, totalling R$ 3,18 billion. This represents growth of 8,3% on the previous year, and urban benefits also grew 7,0% and rural benefits 15,8%.

In light of this alarming data, it is important to take action aimed at preventing accidents in the workplace to ensure the economic wellbeing of companies. Additionally, companies must honour the Brazilian Federal Constitution (1988), which in Chapter II, Article 7, section XXII confirms the right of all urban and rural workers to the reduction of inherent labour risks, through the application of health, hygiene and safety standards. Furthermore, in the competitive modern marketplace, companies that are visibly committed towards social and environmental responsibility generally obtain a greater competitive advantage in the eyes of wider society and investors. The health and safety performance of a company is included within this context of social and environmental responsibility.

The search for excellent in Health, Safety and Environmental Management (SMS), has become a strategic goal for companies that aim to guarantee participation in an increasingly competitive market that is dictated by an increasingly demanding society (THEOBALD 2007, p. 50).

In accordance with the ILO (2011) the implementation of Health and Safety Management Systems in companies over the last decade has been fundamental in terms of improving labour standards and conditions in the workplace. In this sense, companies are increasingly seeking Certification for their Health and Safety Management by applying the BS OHSAS 18001 standard. Therefore preventing accidents in the workplace is key to the performance of a company. To improve results in health and safety, it is becoming increasingly important to carry out more extensive research and analysis of accidents in the workplace with the aim of identifying the cause(s) and of proposing measures capable of preventing these accidents from reoccurring and minimizing their impact and damage.

According to Hollnagel (1998), between 80-85% of accidents that occurred in nuclear power plants in the 1980s and in the National Aeronautics and Space Administration (NASA) between 1990 and 1993 were due to human error or erroneous human actions. Extending this analysis, one of the variables related to human error or fault identified in literary sources as a factor that contributes towards accidents in the workplace is the perception of risk by the worker. Oliveira (2007) states that the relationship between accidents in the workplace, a climate of safety, and safe behaviour, is influenced by variables such as the perception the worker has of a determined risk he or she identifies in the workplace, or by his or her knowledge of safety issues in this same context.

In this sense, the problem identified for the purpose of this research is: How is the perception of risk by the worker a contributing factor in improving the SST Management System?

The main objective of the article is to analyse the perception of the worker of the risks he or she is exposed to in the workplace. To achieve this, the aim is to study the perception of workers operating in Industrial Painting Services from an Operation Unit of a Business Area of a Brazilian Energy Company, which was identified as the Unit with the largest number of accidents in the workplace between 2008-2010, given that several of their Accident Investigation Reports stated that one of the causes of these accidents was the lack or failure of the Perception of Risk in the worker. Using the information compiled, the objective is to identify the contribution of perception of risk for the SST Management System.

One of the reasons for choosing an Operation Unit of a Business Area of a Brazilian Energy Company for research purposes is that, in Brazil, this sector is an area of activity that is considered essential for the supply of Petroleum by-products in the internal market. Add to this fact the following reasons: the record of accidents in the workplace between 2008 and 2010, meaning the Unit had the largest number of accidents of any Operation Unit in the aforementioned Business Area; the number of employees that make up the workforce; the size of the Unit in relation to the express quantity of products turned over; the accessibility of information from the Unit. Extending the analysis of accidents in the workplace that occurred in the Unit, the Industrial Painting Service, coordinated by Maintenance Activity, was identified as the Service that suffered the largest number of accidents between 2008 and 2010 and that, in the majority of cases, the respective Accident Investigation Reports stated that one of the causes of these accidents was the lack or failure of the Perception of Risk in the worker.

Therefore the public aim of this research is to study the workers operating in the Industrial Painting Service, including one of our own employees, an employee loaned from another Operation Unit of the Brazilian Energy Company and the contracted employees of the company.

The issue of Perception of Risks was defined after observing the express frequency with which the lack or failure of Perception of Risks in workers was stated as a cause of accidents in the workplace in Accident Investigation Reports from the Storage and Transport of Petroleum and By-products Unit being researched. This research does not aim to identify and study the factors that may influence the perception of workers regarding risks in the workplace.

According to Mullen (2004, p.276), "few researchers have studied if the individuals are aware of the risks involved in their activities" [...]. Therefore this research aims to contribute and expand knowledge in the academic field about the issue of Perception of Risks by workers, considering the lack of studies previously undertaken in Brazil. Furthermore, this research will help companies operating in the competitive modern marketplace to take a greater interest in understanding the perception of workers of risks in the workplace, and has the aim of applying effective measures to prepare the worker for perceiving risks, consequently improving SMS performance.

2 Literary Review

In the literature dealing with the analysis and research of accidents, human error appears as a key factor in the cause of accidents, ahead of the possible conditions that may lead to the accident happening.

2.1 Human Error/Human Fault

Human error has been diagnosed since the beginning of the industrialisation that originated with the Industrial Revolution, due to the migration of workers from agricultural activities to working in factories without the necessary training.

According to Trepess (2003), research about human error has been carried out across several different fields, such as psychology, sociology, medicine, ergonomics, computing and anthropology, with each one adopting a slightly different focus in their analysis of human error. Going back to the oldest literature, probably the first record that recognised the importance of human error in the analysis of industrial accidents was made by Heinrich (1931) through the Domino Theory that included terms such as unsafe acts coming from human actions and unsafe conditions. The concept of human error has suffered changes as a consequence of technological advances and the growing interaction between man and machine, yet there is still no universally accepted definition (SALMON, et al 2010).

According to Dekker (2002), there are two different visions of human error and human contribution to accidents. In the "old vision", human error was considered to be the result of a fault and in the "new vision", human error was considered to be a symptom of fault. Researchers involved in the study and analysis of accidents support the new vision (REASON, 1997; SHAPELL and WIEGMANN, 2000).

Despite this trend, it appears the idea of erroneous human actions recorded by Heinrich still survives in the research of accidents associated with unsafe acts. REASON, 2000; ALMEIDA, 2006; KOROLIJA AND LUNDBERG, 2010).

2.2 Theories, Cause Models and Accident Research Methods

Theories and accident cause models provide a base for the process of accident research and analysis, because they allow the amelioration of the conclusions drawn from these accidents and, therefore, the improvement of safety systems in companies. (BALLARDIN, et al, 2008).

Among the literary sources, one of the most accepted and widely used models of Human Error is that put forward by Rasmussen (1987). The most recent models of analysis and classification of human errors

include the model developed by Shappell and Wiegmann (2000). This model is based on the Swiss Cheese Model by Reason (1990) that expands the categorisation of errors into errors of decision, errors in ability and errors of perception in virtue of defining the error and failure proposed by Reason (1990), which has been inadequate for the research and study of aviation accidents. Errors of decision refer to intentional behaviour that proceeds as planned, but in reality the method is inadequate or inappropriate for the situation. Errors of ability are those that occur inconsistently, and are related to a lack of attention, memory or technical skill.

Already we can see that errors of perception occur when that which is perceived by a person differs to a real situation. These errors take place when sensory entry is damaged or unusual, as in the case of visual illusion, spatial disorientation or error in judging distance, height and speed in the case of aviation accidents. Visual illusions occur when the brain tries to fill in the "holes" or "faults" which may seem normal in an environment of reduced visibility.

According to Correa and Junior (2007), the model of analysis and classification of human errors proposed by Shappell and Wiegmann (2000) can be applied to the analysis of industrial accidents, and can contribute significantly towards effectively eliminating the view that accidents happen due to chance, and promote the view that only proactive management focused on "labour safety" is capable of reducing the economic and social costs of industrial accidents.

2.3 Health and Safety Management Standards

Systems of Health and Safety Management in the workplace are managerial tools that contribute towards improving performance in companies regarding issues of Health and Safety in the workplace. In the modern world, it is extremely important for companies, workers and societies at large to all work together towards achieving the goals mentioned above. In the literary sources, it is clear that few organisations aim to develop standards for management systems of health and safety. Among the most commonly applied standards we can mention: standards BS 8800, ILO-OHS 2001, BS OHSAS 18001.

2.4 Perception of Risk

The issue of the Perception of Risk emerged in the 1960s when it became the object of popular public opinion against the implantation of nuclear technology that scientists considered clean energy. The scientific and governmental communities did not understand why the public perception went against the use of nuclear energy, when scientists were declaring how safe the new technology was. The first study of the Perception of Risk was carried out in 1969 by Chauncey Starr titled "Social benefit versus technological risk" that examined in great detail the risks and identified what were socially acceptable risks by the extent to which they were associated with benefits.

Slovic (1987) in Perception of risk, one of the most quoted articles in this field of literature, declared that while analysts employ sophisticated techniques to assess risk, the majority of citizens have an intuitive judgement of risk commonly called "Perception of Risks". According to Bley (2007, p.113) "the Perception of Risks speaks of the ability of the person to identify danger and recognise risks, attaching significance to them, in the workplace, or in traffic, or in the air" [...]. The ability of people to perceive risks is influenced by their state of health, their attention, and their emotional state. The mapping of worker Perceptions of Risks allows us to assess, to a certain extent, the importance these factors have in SST management processes within a company. On many occasions, the worker performs unsafe actions because he or she is unaware of the risks these actions may entail in the workplace. According to ABNT/ISO/IEC Guide 73 (2005, p.3) Perception of Risks is defined as "the way in which the party involved perceives a risk based on a collection of values or interests."

For Masini (2009, p.16) "the psychometric paradigm represents an approach in which risk is specifically defined and perceived by individuals who are influenced by several psychological, social, institutional and cultural factors". Slovic (2000) states that these questionnaires systematise and predict the Perception of

Risks, identifying similarities and differences among groups, demonstrating that different people conceive and perceive risks in different ways.

According to Oliveira, the Perception of Risks is related to how a worker interprets a determining factor that he or she considers to be a risk. While this factor may genuinely be a risk or, conversely, may not represent an actual threat, it is still seen by the worker as something that places him or her at risk. (OLIVEIRA, 2007, p.16)

For Gordon (2006), the literary sources do not provide a great amount of information about how risk is perceived by the individual, and instead focus more on how these perceptions are influenced. Despite a risk being considered a combination of probability multiplied by severity, as is generally accepted, it is impossible to measure this physically. Since risk does not have a unit, any attempts to label it with a clearly worded definition quickly demonstrate how intangible an idea risk is. Given they cannot be measured, feelings, experiences, social and cultural factors, individual past experiences such as social background, lifestyle and culture can all inevitably influence the process of evaluating risk (as is the case with insurance specialists) and the way in which risk is perceived. According to the aforementioned author, this study shows that permanent safety measures implemented by health and safety managers in the sector under analysis (for example, the use of seatbelts and helmets) were not taken into consideration as agents of risk perceived.

2.5 Risk communication

One of the most important mechanisms for developing worker perceptions of risk is the communication of risk – a stage in the process of risk management that contributes towards the creation and reception of the necessary information so the interested parties not only understand the initiatives, the processes of decision making by organisations to manage their risks, either occupational or environmental, but also in order to promote and develop the perception these parties have regarding the existing dangers and risks as a consequence of the activity being carried out. (RINALDI, 2007, p.15. Emphasis made by the author). According to Meneguetti (2010), as part of the risk communication program titled Behavioural Audit that aims to raise awareness and educate the worker, there is a trend towards changing cultures of worker safety, due to improving Perception of Risks, which encourages the exchange of experiences between the auditor and the worker being audited.

3 Case Study

In Brazil, the Brazilian Energy Company which owns the Operation Unit of the Storage and Transport of Petroleum and By-products being researched is increasingly installing more adequate managerial tools for risk in all its Operation Units by adopting several mechanisms, such as using advanced technology in their processes, the certification of their Management System for Safety, Environment and Health, the implementation of specific guidelines for Safety, Environment and Health (SMS) with the aim of achieving excellent in SMS. With this, as evidenced over several years, we have seen a considerable improvement in SMS performance, but accidents in the workplace still happen.

One of the instruments employed in companies that support the prevention of accidents is the process of studying accident Investigation and Analysis. As evidenced in recent years, Accident Investigation Reports have shown a significant frequency in attributing the lack or failure of worker Perceptions of Risks as the cause of accidents in the workplace. The Operation Unit of the Storage and Transport of Petroleum and By-products of the Brazilian Energy Company being researched is made up of four areas: Operation, Maintenance, SMS Operational and Conformity and standards certification ISO 14001:2004, ISO 9.001:2008 and BS OHSAS: 18001:2007.

To analyse if the workers perceive the risks they are exposed to in the workplace, field research was carried out with workers directly operating with the Industrial Painting Services that had the largest

number of accidents in the workplace between 2008 and 2010, as revealed by the results of the Annual Statistics of Accidents in the Workplace for the aforementioned period, and also taking into consideration the fact that, in the majority of cases, the Accident Investigation Reports indicated that the lack/failure of perception of risks was one of the causes of these accidents.

As a research instrument, a Questionnaire divided into four sections was used. Part I was titled Collaborator information, aimed at identifying the worker characteristics necessary for research, such as sex, age, working experience, employment relationship with the Operation Unit under research, educational background, role inside the company, position held and history of accidents in the Unit. The questions are multiple-choice, except one of a dichotomous nature.

Part I of the Questionnaire includes instructions explaining how to fill it out. The information provided must correlate with the information obtained in the Questionnaire Part II – Perception of Risks, consisting of questions that aim to identify, at the time of the research being carried out, the Perception of Risks workers have of dangers existing in the workplace and if the programs of risk communication (Daily Safety, Environmental and Health Dialogue – DDSMS, Behavioural Audit, Preliminary Risk Analysis, Integration Lecture, Painting Services Procedure and/or Working Permit) used in the Operation Unit being researched, help to perceive the risks (identify the dangers and recognise the risks) in their workplace. Twenty-four (24) workers operating in the Industrial Painting Service took part in the research, of which 23 were outsourced. They were asked to fill out Part I (Collaborator Information), and Part II (Perception of Risks) of the Questionnaire.

4 Results Analysis

4.1 Questionnaire Part I – Collaborator Information

The information of the collaborators obtained through the questionnaire is presented as follows.

Sex: The male sex is dominant in the Industrial Painting Service. Only one woman was identified as working in the position of safety technician, aged between 22 and 32. Due to the low number of women, it was not possible to provide a comparison between Perception of Risks in Men and Women.

Age range: Graph 1 reveals balance (29%) between the age ranges of 22 to 32 years old and 44 to 54 years old, representing an adult team with an average age of 38 years old. It must be remembered the average itself is not enough to characterise the maturity of the team. There are other factors that need to be taken into consideration.

Length of time working in the Operation Unit being researched – A minor predominance of workers who have been employed between 11 and 15 years by the Operation Unit being researched was recorded. Despite the predominance of workers who have been with the company for between 11 and 15 years, according to the statistical data for accidents that occurred in the Operation Unit being researched between 2008 and 2010, 62.3% of the accidents involved workers who had been with the company for up to 6 years. This information leads us towards the creation and implementation of measures aimed at worker education with the objective of improving the Perception of Risks and developing safe attitudes.

Employment relationship with the Operation Unit being researched – Of the twenty-four (24) workers operating in the Industrial Painting Service that took part in the research, twenty-three (23) were contracted by the company (95,8%) and one (1) employee had been loaned by another unit of the Brazilian Energy Company. This information is worrying considering the high level of rotation of outsourced employees and means the business must increase investment in training with the aim of ensuring workers are able to identify and recognise the risks in their workplace.

Level of educational background: Fifty-nine (59) % of the workers in the Industrial Painting Service who took part in the research had completed up to the 1st grade. Not one worker who participated in the research had higher-level studies. This is another worrying piece of information that emphasises the

urgent need to train workers and may influence the perception of risks and the understanding of the importance of risk communication programs.

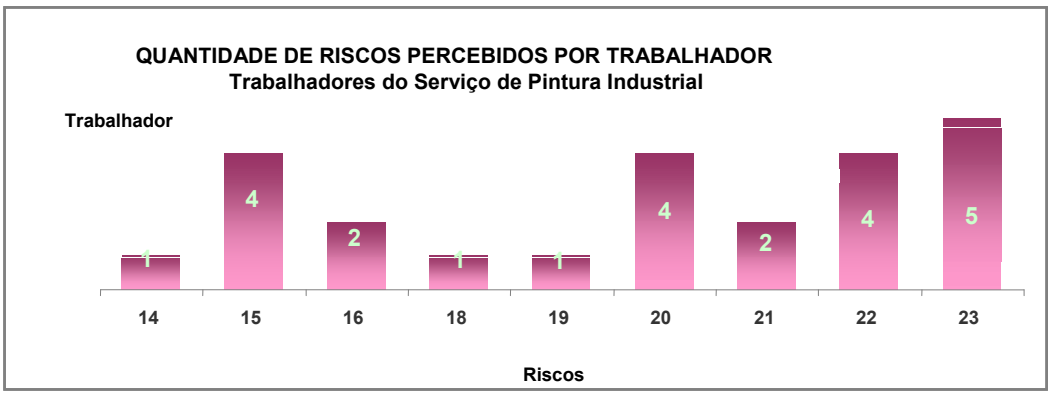
Action Areas – Of the workers operating in the Industrial Painting Service, the painters (58%) were those who suffered the most accidents between 2008 and 2010.

Level of accidents – Of the twenty-four (24) workers who took part in the research, nineteen (19) said they had never suffered an accident, whereas four (4) answered that they had suffered an accident, and one did not reply. The accidents recorded happened in 1980, 2008 and 2010, and one of the workers did not specify the year of the accident. It must be recorded that only 2 of those who suffered accidents included in these statistics currently continue to work in the company contracted by the Industrial Painting Service. The analysis of the information provided by each worker in the Questionnaire Part II – Risk Perception is detailed below.

4.2 Questionnaire Part II – Risk Perception

For the analysis of Risk Perception, the information obtained in Part II of the Questionnaire is used to verify if the workers manage to identify the dangers associated with the working environment in the Industrial Painting Service, and is compared to the "Level of Risks defined for each danger identified for the Operation Unit being researched" as the "Risk perceived" by workers. Questionnaire Part II – Perception of Risks revealed a total of 29 risks and only 23 are related to the Industrial Painting Service.

Quantity of dangers perceived by the worker - Graph 1 shows that of the 24 workers who took part in the research, only 5 or 21% identified all 23 dangers in the Industrial Painting Service workplace, as referred to in the AIPC Database of the Operation Unit being researched. The others identified less than 23 dangers, and 9 or 38% identified less than 20 dangers. This result reveals that 79% of the workers did not identify all the dangers in the Industrial Painting Service workplace.



Source: Questionnaire Part II – Perception of Risks compiled by the author - 2011. (BOTTOM = Risks, LEFT = Worker)

Figure 1: Quantity of dangers identified by the worker in the Industrial Painting Industry of the Operation Unit being researched.

Dangers identified but unrelated to the Industrial Painting Service – Chart 01 describes the 6 dangers from other tasks that were recorded in the Questionnaire – Part II, but that are unrelated to the Industrial Painting Service as defined in the AIPC Database. Therefore, the workers were not expected to identify these dangers.

Table 1: Risks unrelated to the Industrial Painting Service.

Code	Danger	Task
PR 3	Being exposed to contact with sharp/piercing materials	Administrative Service

PR 9	Being exposed to visual discomfort	Inspections for Safety, Environment and Health
PR 11	Being exposed to inadequate/insufficient lighting	Inspections for Safety, Environment and Health
PR 16	Being exposed to infection by microorganisms, bacteria, viruses and fungus	Inspection and maintenance for network of sanitary and water drains
PR 19	Being exposed to adverse climate conditions (e.g. strong winds, rains, gales, floods, etc.)	Maintenance of electrical industrial equipment
PR 25	Being exposed to risk of contact with rotary parts of machines	Maintenance of loading machines

Source: AIPC Database of the Operation Unit being researched (2009)

The information obtained shows that on average, 77% of workers perceive the risks detailed in Chart 01 as being related to the Industrial Painting Service. In this sense, the information highlights the need for Maintenance Activities in the Operation Unit being researched to reassess the information entered in the AIPC Database related to the Industrial Painting Service alongside with the workers and to encourage a revision of the aforementioned Database and the retraining of workers, if this is deemed necessary.

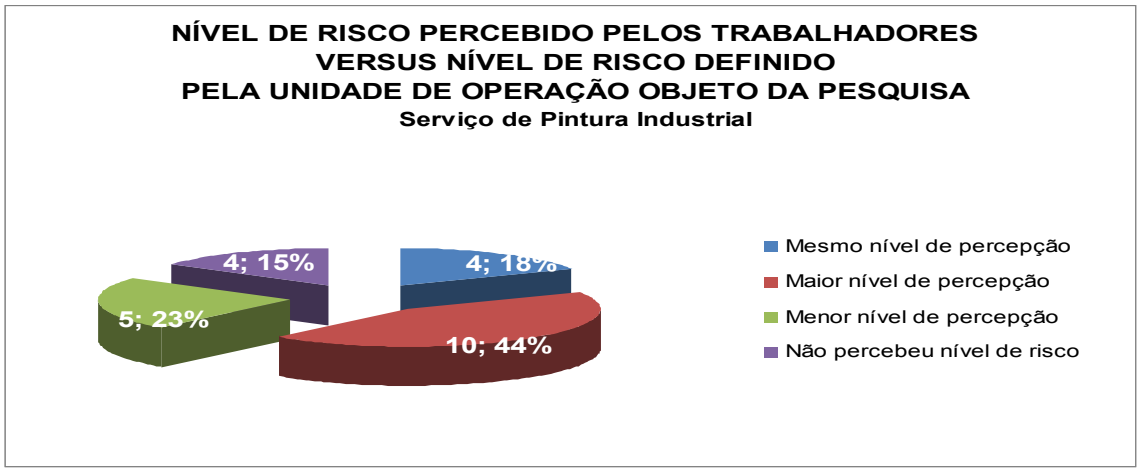
Levels of Risks perceived by workers in the Industrial Painting Service -. Based on the answers from the Questionnaire referring to (Severity + Probability) each dangerous event, the level of risk perceived by workers was identified, as was the percentage of answers in which the level of risk was considered by the workers to be high.

According to the information, 48% of the workers perceive on average a Low level of risk for the issues contained in the questionnaire, whereas 52% perceive on average a Moderate level of risk. It is important that, on average, none of the levels of risk were considered to be High by the workers, however, it is worth emphasising that some of the questions, twenty-eight (28%) dealing with Perception of Risks, were considered to be of a "High" level of risk by (20% or more) or the workers, these being: exposure to the risk of contact with moving hoses / depressurised jet equipment; being exposed to risk resulting from inadequate posture; being exposed to risk of explosions; being exposed to risk of contact with and/or inhaling gasses and fumes; being exposed to risk of inhaling aerodispersoids (dust); being exposed to risk of contact with chemical products; being exposed to contact with high levels of noise (above 85 decibels) and being exposed to risks resulting from fires.

Another point to be highlighted is that none of the questions about Perception of Risk not included in the AIPC Database, despite the high incidence of such answers (on average 77%), revealed a notable frequency of answers of "High" risk level. Furthermore, only one of them (being exposed to the risk of infection by microorganisms, bacteria, viruses and fungus) revealed on average a "Medium" level of risk, whereas for the others the level of risk was "Low" We can therefore infer, without drawing conclusions, that these 6 issues are not really needed in the questionnaire. In other words, the workers themselves, despite having responded that they perceive these risks, consider them to represent, on average, a "Low" level of risk.

Worker versus Operation Unit being researched – levels of risks perceived The result of the level of risk perceived by the workers for each danger recorded in the Questionnaire Part II – Perception of Risks was compared to the level of risk defined for each danger in the AIPC Database of the Operation Unit being researched for the Industrial Painting Service. Graph 16 reveals that only 4 levels of risks from the 23 stated in the AIPC Database for the Industrial Painting Service were perceived by the workers as having the same level of risk as defined in the AIPC Database. Furthermore, 4 levels of risks were not perceived.

What is most noteworthy is the fact that 10 levels of risk were perceived by the workers as having a higher level than that defined by the Operation Unit being researched. Furthermore, 5 of them have a rating that was below the levels of risk defined by the unit, which is very worrying, because it means that some workers are not fully aware of the real consequences of the dangers they are exposed to.



Source: Questionnaire Part II – Perception of Risks compiled by the author – (2011) (Blue = Same level of perception/Red = Higher level of perception/Green = Lower level of perception/Purple = Did not perceive level of risk)

Figure 2: Level of risk perceived by workers versus Level of risk defined by the Operation Unit being researched – Industrial Painting Service.

With the aim of extending the analysis of the risks perceived versus the risks defined by the Unit being researched, the information obtained and detailed below shows the distribution of answers relating to the same level of risk, higher or lower level of risk and when the worker who took part in the research did not perceive the risk.

Total number of workers versus the same level of risk defined by the Operation Unit for the Industrial Painting Service: Analysing the information obtained we can see that the worker who has the closest level of perception to that considered adequate by the Operation Unit, has 11 identical levels of perception of risks. After this worker, two more had 9 identical answers.

Total number of workers versus the higher level of risk defined by the Operation Unit being researched for the Industrial Painting Service: from the information gathered, it is clear that the workers generally had levels of perception of risks that were higher than those considered real by the Operation Unit being researched. One worker stated in the questionnaire that he had 19 levels of perception of risks higher than those considered adequate by the Unit and another responded with 17.

Total number of workers versus the lower level of risk defined by the Operation Unit being researched for the Industrial Painting Service: the information gathered reveals that for the levels of risk that were lower than those defined by the Operation Unit being researched, there was a worker that classified 12 levels of risk below those defined as real by the unit. 4 workers responded with 10 levels of risk lower than those defined by the unit as being real.

This information is extremely worrying, as it demonstrates that some workers are perceiving risks below what is considered real by the unit, and this could lead to greater exposure to risk due to the lack of worker awareness of the real consequences of these risks.

Total number of workers versus the level of risk not perceived – Industrial Painting Service: Finally we can observe, as mentioned above, that some levels of risk that should be perceived by workers are not being perceived. One worker did not perceive 9 levels of risk and another 4 did not perceive 8 levels of risk that ought to have been perceived. This is of great significance, because not perceiving some levels of risk can lead to the worker being exposed to a greater risk of suffering accidents. We cannot draw conclusions from this information if the level of educational background can influence the perception of risk.

Regarding the risk communication Programs, the Operation Unit being researched has several mechanisms for communicating risks to the work force and the interested parties that are included in

their Health and Safety Management System. Within these mechanisms, the most recognised and employed in the Operation Unit being researched, with the aim of developing worker perceptions of risk, are the Daily SMS Dialogue, Behavioural Audit, Preliminary Risk Analysis, Integration Lecture, Working Permit and standards for performing tasks. The questionnaire Part II contained a multiple-choice question in which the workers answered which program(s) helped them to perceive risks in the Industrial Painting Service workplace.

Table 2 shows that 21 of the workers (88%) perceive the DDSMS as the program that provides the most help for workers in terms of perceiving risks in the workplace.

Table 2: Risk Communication Program applied in the Operation Unit being researched.

Risk Communication Program	Number of references	Percentage of references
DDSMS	21	88%
Behavioural Audit	8	33%
Integration Lecture	11	46%
Working Permit	19	79%
Preliminary Risk Analysis (APR)	16	67%
Procedure of Painting Service	6	25%

Source: Questionnaire Part II – Risk Perception compiled by the author (2011)

5 Conclusions

The analysis of the results of the study demonstrates that the majority of workers in the pilot-sample managed to identify all the dangers they were exposed to in the workplace. Other information obtained and considered of relevance includes the discovery that for some dangers the levels of risk perceived by workers are less than those defined by the unit or, what is even more serious, are not perceived at all by the workers. Based on this information, we can see that the Risk Communication Programs implemented by the Operation Unit being researched are not capable of preparing the worker to perceive the risks he or she faces in the workplace and of developing safe attitudes. Furthermore, not all the programs are recognised by the workers as being important in terms of improving the perception of risks. This information means that these programs currently incorporated in the SST Management System of the unit need to be improved. Additionally, the mechanisms of risk communication must be reconsidered so that the messages reach the workers and the population in a reliable and adequate manner. It is therefore necessary, in the first instance, to find ways of identifying the differences and the individual needs of the workers and include information about the worries felt by the internal and external public. It is important that the worker understands the message communicated.

Regarding the level of educational background, the data shows that the workers with lower levels of education tend to suffer more accidents. This information, along with additional information gathered in Parts I and II of the Questionnaire, confirm the continuing need on behalf of the unit leadership to invest in training for the workforce, but also to make decisions alongside the companies contracted in order to improve the training given to their employees, mainly in relation to working standards when performing tasks.

It is important to include within these task standards the dangers, and the consequences related to these dangers, and to train workers in these standards using the correct training material together with patterns, figures for improving worker understanding of the task to be carried out, and the risks entailed in performing the task.

The proposals for improvements in the risk communication programs adopted in the unit can contribute towards improving worker understanding of risks in the workplace, and this can support the continual improvement process in the SST Management of the unit. The analysis of the perception of risks by the worker includes as a component the causes of accidents in the workplace, allowing specific administrative measures to be adopted in this area, with the consequence of reducing the occurrence of accidents, and leading to the amelioration of SST Management inside the company. Therefore the suggestion of including a Questionnaire of Perception of Risks in the analysis and investigation of accidents affords the researcher more reliable information to determine if perception of risk is the real cause of an accident.

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