

# Safety Culture Maturity and Risk Management Maturity in Industrial Organizations

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## Abstract

This article presents research about safety culture maturity and safety management maturity in three different types of organizations in Bahia, Brazil. The model and the questionnaire developed by Gonçalves Filho et al (2010) were used to identify both the maturity of safety culture and safety management maturity. The questionnaire was answered by 346 workers of 28 companies : 17 petrochemical, 5 footwear and 6 cable TV. The study also identified the safety management maturity, which revealed that higher levels of safety management maturity tended to display the features associated with higher levels of safety culture maturity. The results demonstrated that petrochemical companies are in a more advanced safety culture maturity stage than footwear industries as well as cable TV companies; the petrochemical ones are also more advanced relating risk management maturity than footwear and cable TV companies. These results indicate that safety culture can contribute for risk management to prosper.

**Keywords:** safety culture; risk management; maturity.

## 1 Introduction

Existing cultural issues in organizations can cause significant impediment or obstacles to the changes required for the implementation of a Risk management System (SMS). Therefore, it is essential to understand the maturity of the existing safety culture in a company in order to prepare the planning of changes, when necessary.

An established safety culture is crucial for the development, success and good performance of the SMS (Choudhry et al., 2007; Ek et al., 2007; Hudson, 2003), because it is in a context where safety culture exists that attitudes and behavior of individuals in relation to safety are developed and persist (Mearns et al., 2003). It is for this reason that the safety culture concept has received such attention, because the management systems will function better in organizations which have developed a safety culture maturity (Hopkins, 2005). According to Ek et al. (2007), the success of the labor risk management system depends on the existence of a safety culture in the organization. The risk management system, on the other hand, causes an impact on the safety of operations.

Despite efforts having been made to improve the risk management systems, failures presented by these systems, such as, poor procedures and communication, are frequently pointed out as being the cause of large accidents. It is due to this reaction that the safety culture concept has been receiving such attention, because management systems will function best in organizations which have developed safety culture maturity (Hopkins, 2005).

The integrated approach of relations between safety, health, environment and culture issues of the worker represent a great challenge in present days, because the traditional approach mentioned previously is still a paradigm in organizations (Almeida, 2006).

A production system, whichever it may be, is not sustainable in social, economic and environmental dimensions when the environment in which the workers exercise their activities is not safe and healthy, causes death, mutilations and diseases of the workforce. It is not socially sustainable, because it affects the lives of workers victimized by death or mutilation. It is not economically sustainable because its main

impact is on Social Security, which has to assume all the costs of the benefits for the injured worker or for the family in the case of death. Labor-related accidents have an extremely important social dimension, being a central problem in contemporary societies. The mitigation of these phenomena requires a profound scientific knowledge of safety culture.

With the knowledge of the safety culture maturity, managers of the organization are able to prioritize efforts and resources to the areas needing improvements in terms of safety culture. Hence, this model is an important instrument of the labor risk management system.

This article presents the results of research on the stages of safety culture maturity and risk management maturity in three different types of economic segments established in Bahia, Brazil: petrochemical, footwear and cable TV. In order to identify both the maturity of the safety culture and risk management maturity, a model and questionnaire developed by Gonçalves et al. (2010) was used. The questionnaire was answered by 346 workers from 28 researched organizations: 17 petrochemical, 05 footwear plants and 06 cable TV companies.

## 2 Safety culture maturity and risk management maturity

According to Schein (2004), there are three stages of organizational culture evolution: Founding and Early Growth, Midlife and Maturity/Decline. In an organization's Founding and Early Growth stage, the main cultural thrust comes from the founders and their assumptions. At the midlife stage, the leaderships do not have the same options as the founder and owners. At this stage, the culture defines leadership more than leadership creates culture, all organizations undergo a process of differentiation as they grow and can work on subculture, and the objective is to socialize the culture. At the Maturity/Decline stage, the continued success creates strongly held shared assumptions and thus a strong culture. Each stage requires different culture change mechanisms and different leadership requirements.

Westrum (1993, 2004) created a model to identify types of organizational culture based on how an organization processes information. In his model, there are three types of culture: Pathological, Bureaucratic and Generative. He considers the flow of information the most critical issue for organization safety.

According to the International Atomic Energy Agency (IAEA, 2002a), three stages of development of safety culture seem to occur in organizations. Each stage involves a different awareness of the effect on safety of human behavior and attitudes. The characteristics of each stage are described below. They may be used by an organization to diagnose which stage reflects its current state most accurately.

At stage 1, an organization sees safety as an external requirement and not as an aspect of conduct that will allow it to succeed. The external requirements are those of government, the legal framework and the regulatory bodies. There is little awareness of the behavioral and attitudinal aspects of safety. Safety is seen as a technical issue, to be achieved by compliance with rules and regulations.

An organization at stage 2 considers safety to be an important organizational goal, even in the absence of external requirements. Although there is growing awareness of behavioral issues, this aspect is largely missing from risk management, which generally concentrates on technical and procedural solutions. Safety is dealt with in terms of targets or goals, with accountabilities for achieving the goals specified. Organizations at this stage often discover that after a period of time, when safety trends have improved, a plateau is reached. At stage 3 an organization has adopted the idea of continuous improvement and applied the concept to safety. There is a strong emphasis on communication, training, management style and improving efficiency and effectiveness. People within the organization understand the impact of cultural issues on safety. The three stages should not be considered as totally distinct. It is possible for an organization, at any one time, to exhibit characteristics associated with several, or all, of the stages (IAEA, 2002a).

Fleming (2001) developed a model of maturity of safety culture with the objective of helping organizations identify the level of maturity of their safety culture. His model was based on the capability of maturity models used in software engineering organizations and has five levels of maturity: emerging, managing, involving, cooperating and continually. There are ten elements, namely management commitment and visibility; communication; productivity versus safety; learning organization; safety resources; participation; shared perceptions about safety; trust; industrial relations, job satisfaction and training. An organization's level of safety culture maturity is determined on the basis of the ratings on these elements. Deciding which level is most appropriate is based on the average level achieved by the organization being evaluated. It is proposed that organizations progress sequentially through the five levels, by building on the strengths and removing the weaknesses of the previous level. Fleming's (2001) safety culture maturity model is only of relevance to organizations that fulfill a number of specific criteria that include:

- an adequate Risk management System
- technical failures are not causing the majority of accidents
- the company is compliant with health and safety law
- safety is not driven by the avoidance of prosecution but by the desire to prevent accidents.

Both Fleming's (2001) safety culture maturity model and stages of maturity of safety culture proposed by AIEA (2002a) were developed as a diagnostic tool. Yet, they are models that lack empirical evidence to support them, since no available data indicate that all organizations follow a sequential maturation and also that the use of averages to determine the level of maturity is appropriate. Fleming (2001) himself cautions that his safety culture maturity requires a significant amount of research before it can be used in this way.

Hudson (2001) also proposed a safety culture maturity model, based on the one originally developed by Westrum (1993) for the evolution of safety culture from the Pathological first stage through to an idealistic end-stage called Generative. Two additional levels, reactive and proactive, were initially proposed by Reason (1997) as extensions of Westrum's original typology. The model extended to five stages in a sequence and replaced the bureaucratic label with calculative. Figure 1 shows the developmental stages of Hudson's (2001) model.

The descriptions of each stage of development of safety culture according to Hudson (2003) are as follows:

**Pathological:** safety is a problem caused by workers. The main drivers are the business and a desire not to get caught by the regulator.

**Reactive:** organizations start to take safety seriously but there is only action after incidents.

**Calculative:** safety is driven by management systems, with much collection of data. Safety is still primarily driven by management and imposed rather than looked for by the workforce.

**Proactive:** with improved performance, the unexpected is a challenge. Workforce involvement starts to move the initiative away from a purely top down approach.

**Generative:** there is active participation at all levels. Safety is perceived to be an inherent part of the business. Organisations are characterized by chronic unease as a counter to complacency.

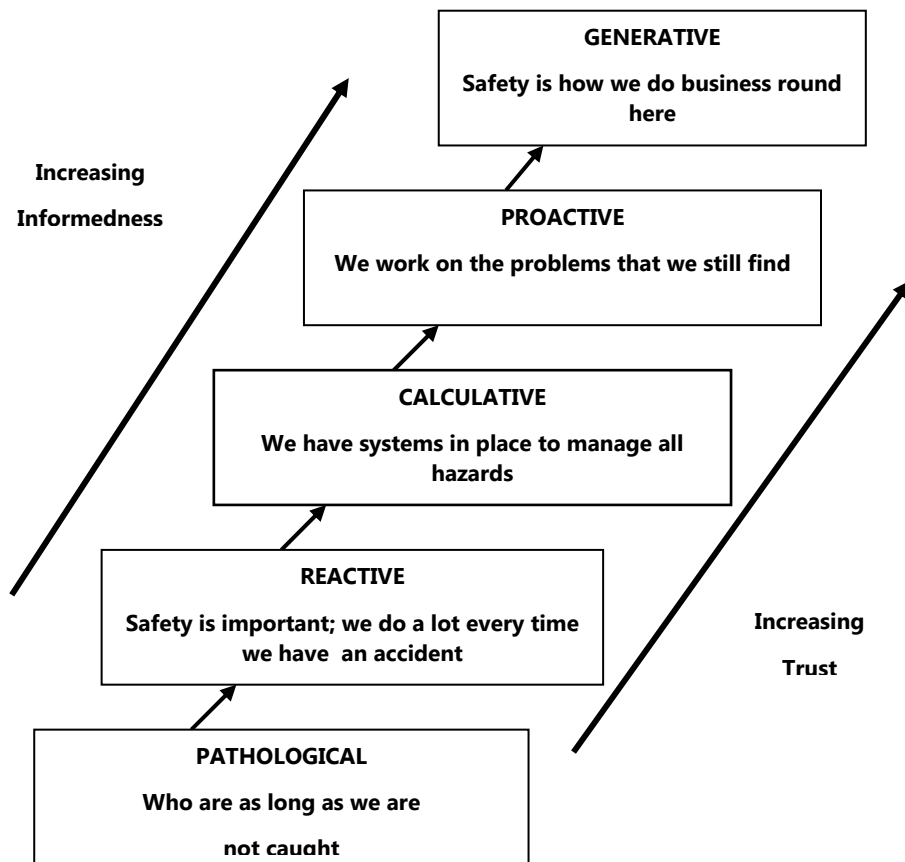


Figure 1 - Safety Culture Model of Hudson. Source Hudson (2001)

Parker et al. (2006) then designed a framework that could be used by organizations to understand their safety culture maturity using Hudson's (2001) model. The framework was developed through interviews with 26 senior oil executives working in a range of multinational oil companies and contracting companies. Interviewees were asked to describe how an oil company would function in terms of 11 tangible and seven less tangible aspects of safety culture following a distinction pointed out by Zohar (2000). Tangible or concrete aspects included the system for benchmarking and auditing safety performance, and the way in which work is formally planned. Less tangible or abstract aspects involved the perceptions of the workforce.

They broke down the qualitative descriptions of this framework into their constituent statements and used them to develop a questionnaire to investigate workforce perceptions of safety culture (Lawrie et al., 2006). Fifty-nine out of 500 employees (11.8%) participated in the study which took place at a refinery and chemical plant. According to the authors, the responses of the questionnaire allowed an assessment of how far the statements formed statistically coherent factors and results showed that some, but not all, of the descriptions of the levels of safety culture were statistically reliable when broken down and submitted to principal components analysis. In general, the items grouped together in ways that did not contradict the 5-level framework. In other words, the respondents did not perceive features from the more advanced levels of safety culture (generative and proactive) associated with a less advanced level (reactive and pathological).

Goncalves et al. (2010) applied the framework and the questionnaire developed by them to identify safety culture maturity in 23 petrochemical companies in Brazil. According to them, the questionnaire presented good reliability and framework may give both managers and researchers an overall assessment of safety culture in an organization or a set of organizations when they do not have time and resources to study a

large company or many companies simultaneously, because the framework can be easily applied by managers. In the frameworks that Gonçalves developed, Hudson's model was slightly modified, by renaming the calculative stage as bureaucratic (as in Westrum's (1993) model) and the generative stage as sustainable, because these terms are easier to understand and more familiar to safety managers in Brazil.

### 3 Material and Methods

In the present study the concept of maturity was also applied to risk management, the objective was the comparison between the safety culture maturity and risk management maturity. Both Hudson's model and the framework developed by Gonçalves et al. (2010) were used to identify the risk management maturity and the safety culture maturity, in 28 industrial organizations in Bahia, Brazil. This model was chosen because is more suitable for use in Brazil than Fleming's (2001) model because the criteria to use it (e.g. an adequate Safety Management System, technical failures not causing the majority of accidents, the company is compliant with health and safety law) constrain it for general use in Brazil and the three stages of development of safety culture of the IAEA (2002a) are not sufficiently comprehensive. To identify the risk management maturity Gonçalves' s framework was slightly modified by replacing the commitment dimension with the risk management, where it is described as : the support given by the organisation as far as safety is concerned: planning, priorities, training, auditing, contractor, rewards, investment, procedures and teaming. (DeJoy et al., 2004; Flin et al., 2000; IAEA, 2002b; Olive et al., 2006).

The development of the framework and the questionnaire has been described in detail elsewhere (Goncalves et al., 2010). Each item of the framework was used by Goncalves and colleagues as a statement to develop the questionnaire to investigate how each one of five dimensions (information, commitment, communication, organizational learn and involvement) was treated in the organisations studied . The number of questions for each one of five dimensions varied with the number of items in the framework . Each item represented one stage: 1 – Pathological, 2 – Reactive, 3 – Bureaucratic, 4 – Proactive and 5 – Sustainable. For each question, the respondents were required to select the item that best represented the position for their company (Goncalves et al., 2010). Table 1 shows one question with five items relating to the five levels of maturity for the dimension information.

Table 1 – One of the questions with five items for information dimension

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**QUESTION 1 - Relating to how the unusual events (near miss, accidents...) are reported...**

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1. The unusual events which occur in the organisation are not reported by the employees.
  2. Only the serious accidents are reported by the employees.
  3. All the unusual events which occur in the organisation are reported by the employees.
  4. Most of the unusual events which occur in the organisation are reported by the employees.
  5. Most of the unusual events which occur in the organisation are not reported by the employees.
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The sample of workers to answer the questionnaire was of the stratified random type, based on samples defined by the following criteria: all the areas of the researched companies (production, maintenance and administration) should be represented; the selected employees should not occupy management or supervision positions and should not be from outsourced companies. Each company presented a list of employees in compliance with this criterion and some selected randomly by the researcher to answer the questionnaire. If, for any reason, an employee was not able to answer the questionnaire (vacation, leave of absence, absent on that date), a substitute was chosen.

The questionnaires were applied to the selected employees from each company on a previously set date and time. The selected employees were assembled in a room in the company, and the researcher

described the purpose of the research and how they were chosen. The questionnaire was then distributed among the parties present and the process of filling out explained, in order to obtain reliable answers. The participants were also informed that it was not necessary to identify themselves on the questionnaire in order to guarantee the anonymity of the participants. Once the questionnaires were answered, they were returned to the researcher. The average time for filling out the answers was of 30 minutes.

## 4 Result

The questionnaire was applied in 28 companies, of which 17 were petrochemical companies, 5 footwear industries and 6 cable TV companies. Table demonstrates the quantity of employees answering the questionnaire for each type of company.

Table 2: Number of employees per type of company

Type of company	Number of employees
Petrochemical	172
Footwear industry	112
Cable TV	62
Total	346

Figure 2 presents the results of the answers of employees from the footwear industries and the results of the answers of employees from petrochemical companies. The Figure 2 shows the percentage of answers from 22 questions of questionnaire from 284 employees. The results demonstrate that the characteristics of the bureaucratic and proactive stages are dominant in the footwear industry, while in the petrochemical industry the characteristics of the proactive and sustainable stages are more present. The footwear industries also present more characteristics of the pathological and reactive stages than the petrochemical companies.

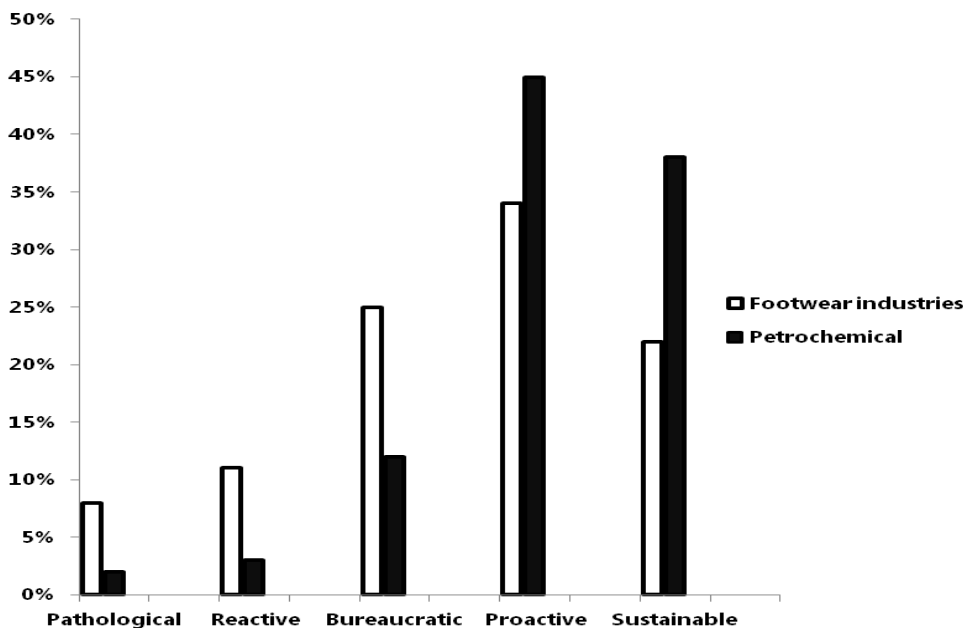


Figure 2 - safety culture maturity in petrochemical companies and footwear industries

Figure 3 presents the results of the answers of employees from cable TV companies and the results of the answers of employees from petrochemical companies. The Figure 3 shows the percentage of answers from 22 questions of questionnaire from 264 employees. It can be observed that in the cable TV companies the most frequent characteristics are from the pathological stage of safety culture maturity, while in the petrochemical companies the proactive stage characteristics prevail.

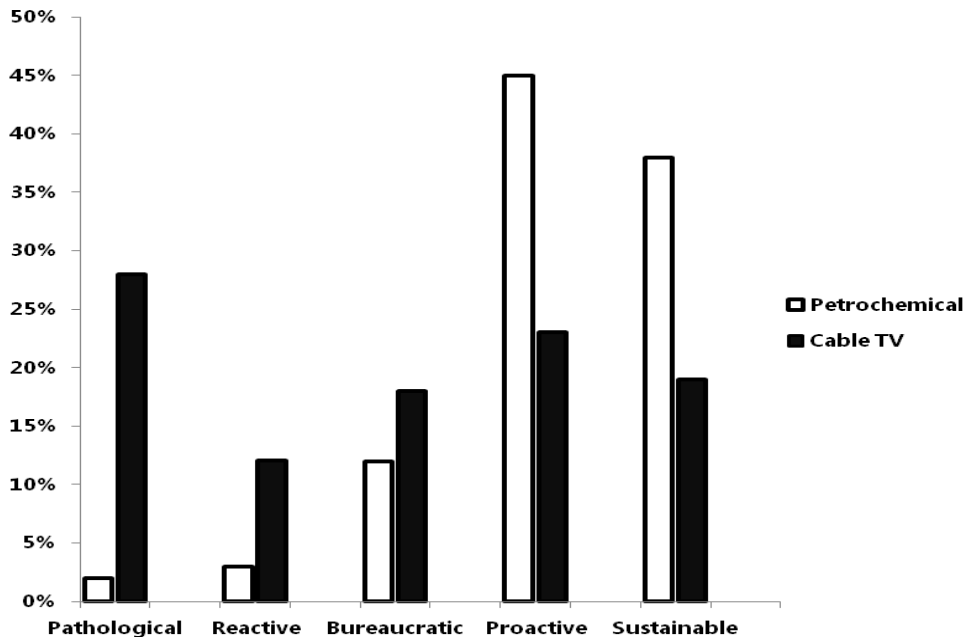


Figure 3 - safety culture maturity in petrochemical and Cable TV

Figure 4 presents the results of the answers of employees from cable TV companies in comparison with the answers from footwear industries and petrochemical companies. The Figure 4 shows the percentage of answers from 22 questions of questionnaire from 346 employees. The cable TV companies present characteristics of the pathological stage when compared to the footwear industries and petrochemical companies. The petrochemical companies present more characteristics of the proactive and sustainable stages than the other segments under analysis, while the footwear industries are located in the intermediate maturity stages of safety culture, bureaucratic and proactive. These results also show that a company can be at different stages of maturity of safety culture.

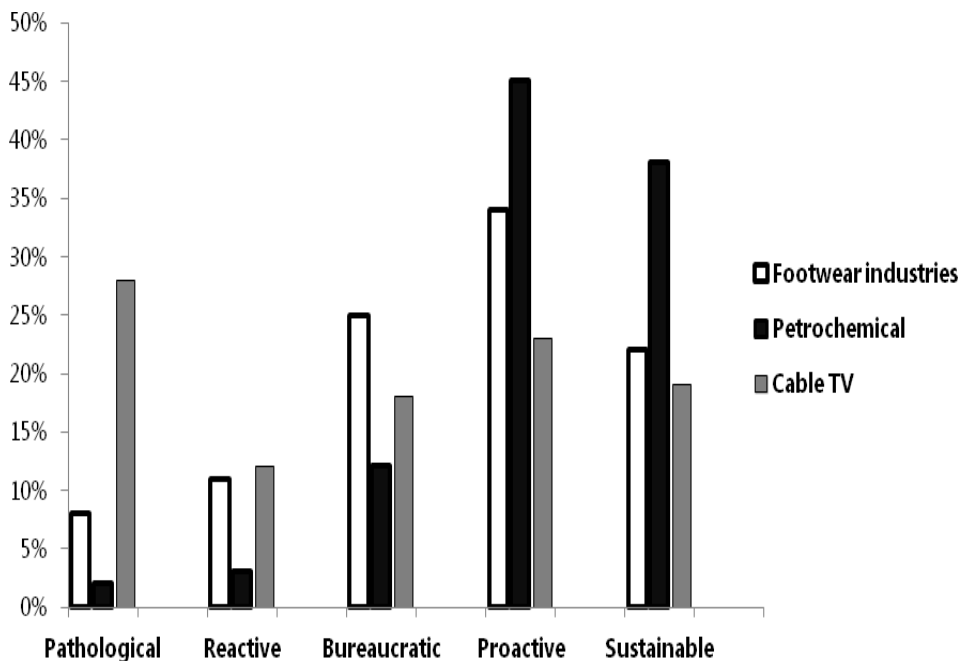


Figure 4 - safety culture maturity in cable TV, footwear and petrochemical companies

The results of the answers from the survey done by the employees in relation to risk management maturity are presented in Figure 5. The Figure 5 shows the percentage of answers from 14 questions of

questionnaire about risk management maturity from 346 employees. According to those results, proactive stage characteristics are more frequent in risk management of the petrochemical companies, while the middle stage characteristic (bureaucratic) is the modal (most frequent) choice in footwear industries. The most frequent characteristics are at the extreme lower end of maturity (pathological) in cable TV's risk management. These results also show that a company can be at different stages of maturity of risk management.

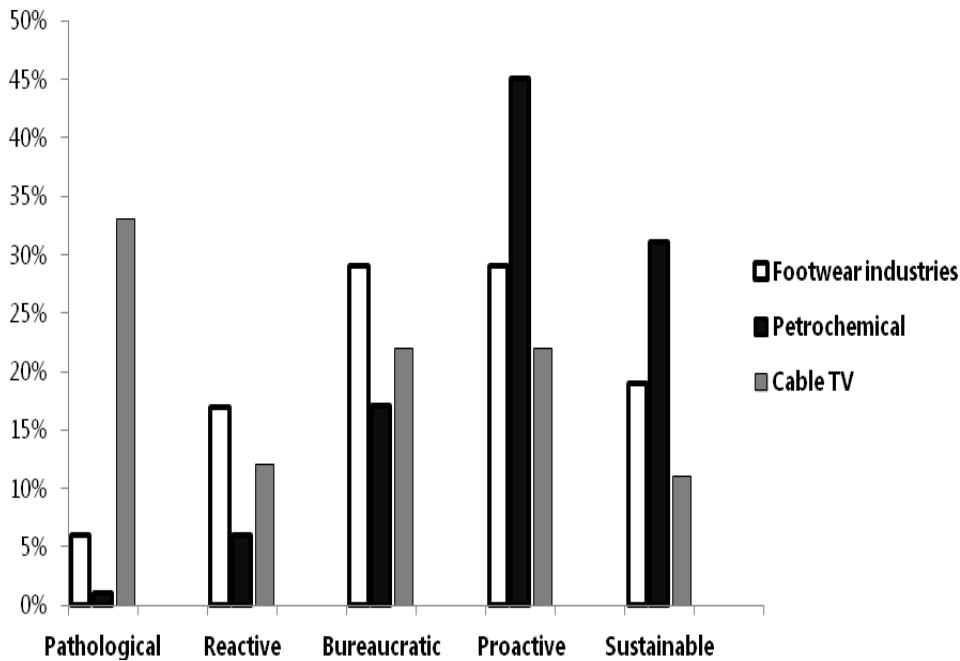


Figure 5 - risk management maturity in cable TV, footwear and petrochemical companies

## 5 Discussion

Petrochemical companies have been established in Bahia for over 30 years. Despite the risks involved, the petrochemical industries are not among the ten economical activities with the highest rates of labor accidents typical in Brazil and Bahia, specifically within the last five years (Bahia, 2007; Brazil, 2008; Conceição et al, 2003; Gonçalves; Ramos, 2010). According to information from the Industrial Fomentation Committee of Bahia, with which the petrochemical companies are associated, the rate of loss of time caused by labor-related accidents in the studied petrochemical companies is of one occurrence for every one million worked man-hours, compared to 17 occurrences in other industries in Brazil. The hypotheses for these results are the development of the petrochemical industries, within the last 20 years, with large companies of national capital, use of advanced technology, high level of automation and implementation of a risk management system.

The footwear industry in the Northeast of Brazil gained strength as of the beginning of the nineties, with the immigration of large footwear industries from the south and southeast to this region. The footwear industry, conditioned by the nature of the work process, intensive manual labor has, as its basic characteristic, the cost competitiveness of this productive factor. The fact that the industries face difficulties in the automation of certain phases of the productive process, such as cutting, sewing, assembly and finishing, generates the necessity of having a large number of workers. Consequently, the footwear industry tends to present low salary levels, high personnel turnover, and simplification of the work and constant use of non-qualified workers (Silvestrin; Triches, 2008). Although some of the larger companies modernized their technological park at the end of the 20<sup>th</sup> century, the national footwear industry, and especially the industry in Bahia, continues to present manual workmanship characteristics, with obsolete machinery and without protection against work-related accidents (Silvestrin; Triches, 2008). These factors have contributed towards a high rate of labor accidents in the sector during the last few



years in Bahia. In 2008 it was the sector that presented the highest register of labor accidents in the state of Bahia and in the last five years it has been rated within the five economic activities with most labor accidents (Brazil, 2008; Gonçalves; Ramos, 2010).

The cable TV industry began to be established in Brazil in the second half of the nineties, when it was still incipient, but as of the year 2000 it began to grow and in 2011 the number of employees in the sector tripled in relation to the beginning of the decade. Nevertheless, the Risk management System did not evolve in the same proportion; consequently, the risk management is still incipient, although there is no available literature on information of the situation of the sector in Bahia.

The different safety culture maturity stages found in this research in the three segments under study are congruent with the evolution of the sector in relation to safety system management. The petrochemical companies have over 30 years in operation and have, throughout the years, been developing a structure (committees, automation of activities, equipment and management systems) guided towards safety. Presently, it is possible to assert that the initial stages of pathological and reactive safety culture maturities are almost extinct in the petrochemical segment, because due to the complexity of the processes themselves, and the risks involved in the petrochemical activities, these stages are unacceptable. The cable TV industry is in a safety culture maturity which presents many characteristics of the pathological stage, with an incipient risk management system. The footwear industry is in an intermediary phase, with characteristics of the bureaucratic stage of safety culture maturity, and still presents problems in risk management.

## 6 Conclusion

The present research demonstrated that the economic sectors in different states of safety culture maturity have also risk management systems in different stages and that Economic sectors which are more advanced in safety culture maturity stage also have a stronger risk management system. These results indicate that safety culture can contribute for risk management to prosper.

According to literature presented above the established safety culture is crucial for the risk management System to prosper, be successful and have a good performance, because it is in a context where a safety culture exists that attitudes and behavior of the individuals in relation to safety are developed and persist. It is for this reason that the safety culture concept has received so much attention, because the management systems will function better in organizations where a safety culture maturity has been developed.

The results show that safety culture maturity and risk management maturity are related, this is a contribution to development of the field and a academic finding, because that relation between safety culture maturity and risk management maturity have existed only empirically and in the literature. Furthermore, in this research the concept of maturity was also applied to risk management, this is also a contribution to development of the field.

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