

## **Safety Culture Maturity in Petrochemical Companies in Brazil – The View of the Employees**

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A framework to measure safety culture maturity in Brazilian petrochemical companies was formulated. A questionnaire was designed to measure 5 aspects of organizational safety indicative of 5 levels of cultural maturity in Brazilian industry. The questionnaire was completed by the employees (N=147) of 15 petrochemical companies based in Camacari, Brazil. The reliability of the questionnaire was checked and the Cronbach's  $\alpha$  for each dimension range from  $\alpha = 0.635$  to  $\alpha = 0.832$ , demonstrating good reliability of the measures used. The research findings demonstrated that the companies studied showed characteristics of different levels of safety culture. The framework was found to be practical to use, making it possible to identify levels of safety culture maturity in the context of the Brazilian petrochemical industry.

### **1. Introduction**

Despite Brazil having one of the major oil and gas companies of the world and the largest integrated industrial complex in the southern hemisphere, there is no theoretical or empirical research on safety culture in this industry. The research reported here has the aim of designing a framework and measurement tool to identify stages of safety culture maturity for application in Brazilian industry. It is known that national culture impacts on organisational safety culture (Mearns and Yule, 2008). The safety culture

studies have been typically carried out in Western environments (Guldenmund, 2000) and we have little to guide us when we step outside the comfort zone of the Western cultural environment that has been studied in some detail (Hudson, 2007).

In the research reported here, the concept of safety culture adopted was that of Hopkins (2005) who proposed that safety culture is about organisational collective practices and is a characteristic of groups and of organisations. He argues that it is more useful than the idea of culture as values, because it provides a practical way to bring about culture change. This view of safety culture reinforces the idea that culture is specific to a group or an organization, since the practices in one organization are unlikely to be relevant in their entirety to another. This research focused on aspects of the organisation, such as the support that organizational structure gives for the behaviour of individuals, for example Health and Safety Management rules. These aspects reflect what the organization *has*.

One approach to understanding industrial safety culture is the safety maturity model which has focused on these organizational characteristics and which may be suitable for cultural adaptation in Brazil.

The organizations chosen for the study were the 15 petrochemical companies based in the Camaçari Industrial Complex that began its operation in 1978 and it is the largest integrated industrial complex in the Southern Hemisphere. It is the first planned petrochemical complex of Brazil and it is located in the city of Camaçari, 50 kilometres from Salvador, the capital of the State of Bahia, Brazil.

## 2. Safety Culture Maturity Model

Westrum (1993) created a model to identify types of organisational culture based on how an organisation processes information. In his model, there are three types of culture: Pathological, Bureaucratic and Generative.

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 replacing the label bureaucratic with calculative. Fig. 1 shows the developmental stages of Hudson's (2001) model.

The descriptions of each stage of development of safety culture according to Hudson (2001) 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:** organisations 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 characterised by chronic unease as a counter to complacency.

### 3. Developing Framework

A framework of culture maturity used in this research was based on that developed by Hudson (2001). Hudson's model was slightly modified, by renaming the calculative stage as bureaucratic and the generative stage as sustainable, because these terms are easier to understand and more familiar to the safety managers in Brazil.

The framework to identify the stages of maturity of an organization's safety culture was built from Hudson's (2001) model and from the five dimensions described below.

The dimensions that form the framework to identify the stages of maturity of safety culture in organisations were chosen from the literature on safety culture. A literature review of 25 studies of safety culture was conducted to identify the component dimensions of which the most frequently cited were chosen.

The description for each of the five dimensions was derived from the literature as shown below:

**Information** – Means the organisation has a formal system that allows its employees to inform about any near miss, accidents and so on and the confidence the employees have in the organisation, thus feeling comfortable enough to report these.

**Organisational Learning** – Involves the way the organisation deals with the information, how the organisation analyses the accidents and near misses at the workplace, as well as if the organisation keeps the employees informed about these events.

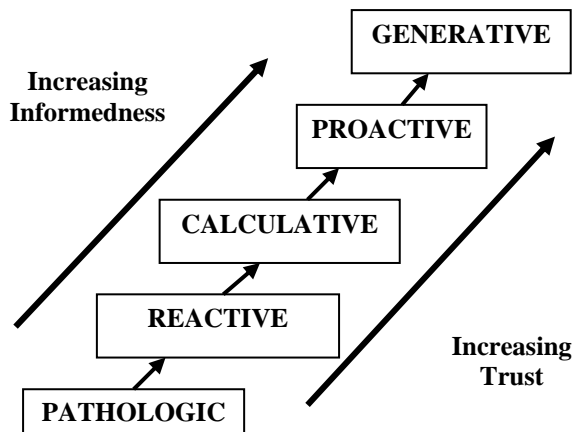


Fig. 1 - Safety Culture Model of Hudson (2001)

**Involvement** – Means how the organisation leads the employees to a growing participation in safety issues, in accident analysis and in reviewing procedures and rules. It also includes if the employees participate in safety committees and safety meetings.

**Communication** – Means how, when and what to communicate regarding safety issues to employees. Also, if there is an open communication channel between employees and managers. It also means if the communication reaches the employees and is understood by them.

**Commitment** – Means the support given by the organisation as far as Health and Safety is concerned: planning, priorities, training, auditing, contractor, rewards, investment, procedures and teaming. It also means there is a Health, Safety and Environment Management System.

The framework describes how each one of the five dimensions is treated in each one of the five stages of the revised model.

#### 4. Method

Each item of the framework was used as a statement to develop a questionnaire to investigate how each one of five dimensions 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. The questionnaire has 22 questions and 102 items in total. For each question, the respondents were required to select the item that best represented the position for their company.

The questionnaire was answered by 147 employees of the 15 petrochemical companies of the Camacari integrated industrial complex. This study is part of one research that the safety managers of the 15 petrochemicals companies also will answer the same questionnaire about safety culture maturity.

#### 5. Results

Table 1 shows the percentage of answers from 22 questions for each one of the five dimensions from 147 employees. If we consider the Camacari integrated industrial complex as if it was one organisation, it presents characteristics from the lowest stage (pathological) to the highest stage (sustainable) of maturity of safety culture, although it is clear that the modal (most frequent) choice is for proactive and sustainable stages.

The striking result is that for these companies, all dimensions present characteristics of the two extreme stages of maturity: pathological and sustainable. All dimensions present characteristics of all five stage of maturity of safety culture.

*Table 1 – Maturity of safety culture scores*

	Pathological	Reactive	Bureaucratic	Proactive	Sustainable
Information	5%	1%	6%	61%	27%
Organisational Learning	2%	3%	9%	26%	60%
Involvement	3%	1%	14%	29%	53%
Communication	2%	1%	12%	59%	26%
Commitment	1%	6%	17%	45%	31%

The questionnaire has a good reliability with following Cronbach's  $\alpha$  for each dimension: information:  $\alpha = 0.635$ , organizational learning:  $\alpha = 0.726$ , involvement:  $\alpha = 0.622$ , communication:  $\alpha = 0.730$  and commitment:  $\alpha = 0.832$ .

## 6. Discussion

There are several possible reasons for the modal (most frequent) choice being the proactive and sustainable stages. First, the companies studied have been working on improving safety for along time and have achieved a high level of safety performance. The lost-time accident rate at the Camacari integrated industrial complex is one occurrence for every million man-hours worked, compared with 17 occurrences for other industries in Brazil. Therefore pathological and reactive stages of maturity of safety culture may now be almost extinct for them.

Second, as already mentioned, all companies studied are based on Camacari integrated industrial complex and they work with a Central Committee. This Committee has a role of promoting, integrating and stimulating collective actions for all companies of the integrated industrial complex. One of these actions refers to the practice of health and safety in the industrial complex as a whole. Moreover there are external rewards for increasing motivation for safety, because the Central Committee rewards the companies with best safety performance.

Third, one important point is the presence of communities located nearby the complex. The companies are aware of the risk they represent to those communities (such as: explosion and leak of toxic gas) and tend to develop the highest safety performance.

Finally, it may be that the statements included in the framework and in the questionnaire do not accurately reflect the stages of maturity of safety culture that they were designed to measure. However, to test the dimensional validity of the framework (e.g. information) would need to have an independent means of the assessing each of the dimensions. To examine validity of the maturity stages would require a test such as showing that the maturity scores were correlated with companies' safety records. It is showing that the maturity scores were correlated with companies' safety records. It is also important to apply the framework to other kinds of industry. If the framework can be shown to make sense to organisations in other industries, its theoretical basis will be strengthened by the support of its content validity.

The different stages of maturity found in this Brazilian sample are consistent with the safety culture maturity concept in that safety culture does not develop simultaneously in all companies and in all dimensions. Hudson and Willekes (2000) found similar results in the oil industry in other countries, e.g. Oman.

The organisational culture does not extend equally into all parts of the organisational system and does not exert a consistent effect. Actions to improve safety culture may exert stronger effects in some areas than others or they may not exert effects simultaneously in all areas. Differences between the different stages of safety culture have to be taken into account when trying to improve performance. It is crucial to know where the organisation is in relation to its culture if you want to change it. This finding means also that an organisation may not assert that it has a safety culture without having passed through all the stages of maturity of safety culture and reached the stage in which safety is an overriding priority. A safety culture can only be considered seriously in the later stage of development (Hudson et al., 2000).

## 7. Conclusion

The maturity model concept is useful because it enables organisations to establish their current level of maturity and the actions required to reach the next level. It can assist organisations in (a) establishing their current level of safety culture maturity and (b) identifying the actions required to improve their culture.

The measurement framework developed is intended to provide a useful diagnostic tool for safety managers who need to be able to easily identify certain organizational characteristics. There is a lack of empirical research on these tools in the literature. The presence of these characteristics could indicate the stage of safety culture maturity the company is at and if necessary, strategies can be adopted to improve it. The model of Hudson (2001) and the revised framework were found to be practical, familiar and easy to identify levels of maturity of safety culture in the context of the Brazilian petrochemical industry.

The possible application of the safety culture framework to other industries and countries should be done carefully. If the framework can be shown to make sense to organisations in other industries, its theoretical basis will be strengthened by the support for its ecological validity.

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