Chapter 1

An Industrial View on Safety Culture and Safety Models

What to Choose and How in the Nebulous “Safety Cloud” of Concepts and Tools?

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Abstract This chapter, co-written by the industrial members of the FonCSI “strategic analysis” group, gives an overview of the various contexts and histories of safety culture/safety models throughout the four industries represented, and summarizes the main questions and issues arising from an industrial point of view. In brief, in a context of high industrial risks—both in terms of process safety and occupational safety—two main topics emerge for discussion: (i) the question of the co-existence of several safety models: what to choose and according to what criteria from the panel of tools available? And (ii) the specific notion of “safety culture”: what more does the concept bring, and how to apprehend it in complex industrial organisations? Eventually, the expression “safety cloud” is used to illustrate the overall feeling of confusion in the industrial world: the current perception is one of a nebulous offer of various models and tools, the choice of which appears difficult to rationalize and adapt to a company’s specifics and local issues. As an introduction to more academic discussions, this chapter thus sets the tone and hopes to shed light on some unanswered industrial questions.

Keywords Industrial • High-risk • Safety • Safety cloud • Safety culture
Safety models

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1 Introduction

In their contexts of high industrial risks, the four companies:

- EDF (Electricité de France), representing the nuclear sector
- SNCF (Société Nationale des Chemins de Fer Français) for the railway sector
- ENGIE (ex GDF SUEZ), a global energy company
- TOTAL, well-known major in the petrochemical sector

share the same concern with safety matters, striving to develop high safety standards that lead to mature safety cultures and the lowest accident rates.

This chapter aims to synthesize the main issues raised by their representatives within the FonCSI “strategic analysis” group in the field of safety culture and models. In Sect. 2, the context and specifics of each of the FonCSI member companies is presented, along with their main search regarding safety aspects. The third section seeks to produce a digest of these issues to provide a common core of questions and needs around the concepts of safety models and safety culture throughout industry.

2 Various Industrial Contexts Leading to Different Histories of Safety Models and Safety Culture Approaches

2.1 *The Nuclear Industry: The Case of EDF*

Safety culture is certainly one of the toughest topics in nuclear safety because it is a matter of improving human functioning in a very technical and regulated industry. Talking about safety culture requires us to keep in mind the accidents of Chernobyl, Tokai-mura or Fukushima, but also to recall the major events at Davis Besse, for example. In a Nuclear Power Plant (NPP), people have to take into account the diversity of situations, deal with multiple-choices and be prepared to face very rare situations. Finally, industrial safety covers a rule-based part and a managed safety aspect which can handle variability and the unexpected.

In EDF, several historical events allowed the safety culture to develop. After Three Mile Island, EDF implemented an independent safety line and regular safety assessments—in order to challenge the operational lines regarding safety. These devices developed questioning attitudes, cross visions, continuous improvement and made safety a priority.

The second step was after the Chernobyl accident where EDF brought human factor specialists into every NPP and engineering unit, in order to reinforce a technical, but also human & organisational approach to developing Human Factor knowledge and methods among managers and employees.

Thus, in the 90s INSAG¹ 4 (INSAG, 1991) & 13 (INSAG, 1999) were used as a foundation to develop the Safety Culture and six levers were developed in particular, in order to implement the Safety Culture.

In the years 2000, other lessons were learned from INSAG 4, including that Safety Culture is not only a matter of individual behaviour, but involves the entire management line. In order to support and to develop the crucial role of managers to improve safety, the nuclear division of EDF produced a safety management guideline, which described what is expected for each level of management and focused on key-principles: safety leadership, staff development and commitment, oversight and continuous improvement, and a crucial practice of “managers in the field”.

In 2013, the decision was taken to boost the EDF Safety Culture approach in light of the Fukushima accident, but also due to a huge renewal of generations and employees and the creation of new international guidelines. In order to boost collective thinking, the agency pyramid was used considering that Safety Culture is the product of the interaction between three dimensions—organisational, behavioural and psychological.

In 2014, a team including corporate and site staff, was set up tasked with building a common representation of Safety Culture for the nuclear divisions. Using the knowledge of international guidelines—the agency and WANO²—and, taking into account the EDF nuclear fleet features, this team described Safety Culture via six themes, divided into around thirty sub-themes and some one hundred items.

Then, the way to use the guidelines and to develop Safety Culture were organised into three pillars:

1. skills development, focusing on young recruits; with videos, tutorials to pass on history, and active techniques with case-studies and coaching;
2. daily communication on Safety Culture;
3. collective Safety Culture assessment in order to encourage debate, collective thinking and stepping back, because Safety Culture cannot be decreed.

Finally, the Safety Culture guideline is developed with dedicated site actions.

Safety Culture also depends on professions. The objectives are to discover what these sub-cultures are, with their related beliefs and assumptions, and to think about how they can fit with the dedicated guide and the other tools. Indeed, experience shows us that it is not always relevant to use a very detailed and formal safety culture because it does not fit with all professional safety cultures and can be hard to manage if there are too many items.

In order to overcome these difficulties, collective meetings are developed in EDF NPPs. In these meetings, a simple graphic representation of safety culture is used as a “projective object” to help people to imagine what the main characteristics of their own professional safety culture are. This representation also helps participants to

¹International Nuclear Safety Group.

²World Association of Nuclear Operators.

perceive what the weaknesses of their safety culture are and what are the best ways to strengthen it. A simple formalized safety culture where its main items can be understood and accepted by everyone, becomes a “common language”.

Moreover, these collective meetings can become spaces for debate where members of several professions (operators, maintenance technicians...) can explain their safety representations, their activities, their risks and methods for solving them.

The “projective objects” used in these meetings bring an interpretative flexibility to the concept of safety culture. It becomes a “boundary object” which can facilitate the understanding between professions and managers and can help them to coordinate their diversities in order to create consensual approaches.

2.2 The Railway Industry: The Case of the SNCF

2.2.1 Brief Presentation of the SNCF

In 2015, France’s Rail Reform Act created the new SNCF Group, a unified public service company that now generates €31.4 billion of revenue in France and in 120 countries around the world. Today’s SNCF consists of three state-owned industrial and commercial enterprises—SNCF, SNCF Réseau and SNCF Mobilités.³

About 155,000 employees work in the French railway sector of the SNCF Group. Many professions are concerned by safety issues: drivers, signallers, shunters, rolling stock maintenance staff, infrastructure maintenance staff, traffic dispatchers, conductors, etc.

2.2.2 Organisation and General Issues in Terms of Health and Safety

Two of the three enterprises of the SNCF Group are confronted with industrial risks:

- SNCF Réseau in its activities of maintenance and development of the national railway network as well as traffic dispatching;
- SNCF Mobilités in its activities of railway undertaking delivering transport services for passengers and freight loaders.

Thus, they hold a safety authorisation (Réseau) or a safety certificate (Mobilités) granted by the French national safety authority for railway, the EPSF.⁴ The authorisation or certificate covers all the risks related to railway operations, vis-à-vis

³The industrial context taken into account in this chapter is composed of all the railway activities in France. It does not include other modes of transport operated by the SNCF Group nor the railway operations overseas.

⁴EPSF: Etablissement Public de Sécurité Ferroviaire.

passengers, workers, subcontractors, outsiders, freight or environment. Non-railway risks are regulated by the requirements of the labour code.

Inside the SNCF Group, safety functions are allocated according to this legal, industrial and organisational framework. SNCF Réseau and SNCF Mobilités are in charge of devising their own safety management system and implementing it after approval by EPSF. This responsibility implies a strong involvement of managers in safety matters. Managers are supported by safety specialists located in every major profession of the company (drivers, signallers, maintenance, etc.) and at every managerial level (frontline, middle and top management).

The safety division of SNCF, known as the “safety system division”, provides the whole SNCF Group with common principles and a range of management tools. It also puts the expertise of its teams at SNCF Group’s disposal for technical, organisational or managerial issues related to interfaces between the network and trains.

The serious accidents which occurred in recent years as well as a high rate of occupational accidents have led the SNCF Group to carry out an in-depth review of its safety policies and methods.⁵

There has been an examination of the top-down oriented managerial approach that is strongly focused on exclusive compliance with rules and the supposed positive impact of the sanction, as well as the place of safety in strategic and operational decision-making processes. The “in-silos” way of functioning has also been highlighted.

An apparent paradox emerged: although SNCF has been working for more than 20 years in the human and organisational fields, the main findings of the experts’ committee diagnosis pointed out the lack of a “Human” dimension in the safety system.

2.2.3 Needs Going Forward

This fundamental reflexion led to an ambitious program to produce deep changes in the safety culture. The SNCF Group is engaged in a profound overhaul of its safety management that involves taking a different view on what builds safety on a daily basis, on the place of rules, on human performance, on the role of expertise. It is a question of transforming the safety culture of the 155,000 employees of the SNCF Group.

What are the levers and appropriate references in order to reach such an ambitious goal? Is a safety management the starting point or the awaited output? Or both? Does a good safety culture exist which would be obvious to everybody and could be used as a target for all employees?

⁵This review has been pushed by an international experts’ committee which was appointed by the executive committee of the Group.

2.3 *The Energy Industry: The Case of ENGIE*

2.3.1 Brief Presentation of ENGIE

ENGIE stems from the fusion in 2008 of Gaz de France and SUEZ, grouping together natural gas activities and infrastructures on the one side, and energy services and power facilities on the other. Today, ENGIE is focused on its three core businesses of Electricity, Natural Gas and Energy Services to support and develop a new vision of energy for the world: sustainable energy available to everyone.

Acting as a major stakeholder in the international energy industry, the ENGIE Group employs more than 154,000 people worldwide with operations in 70 countries generating an annual revenue of €69.9 billion (2015).

2.3.2 Organisation and General Issues in Terms of Health and Safety

The ENGIE Group is organised into twenty-four Business Units (BU) managing their activities independently, and five transverse “Métiers” providing support on key activities. As part of the Corporate functions, the Health and Safety Directorate provides support and guidance for the BUs, with three core missions: (i) steering and promotion of Health and Safety culture, (ii) functional line support and facilitation, (iii) return of experience and oversight.

The Group’s international presence leads to a multiplicity of contexts and cultures in the various countries of implantation. Its multiple activities result in wide disparities in terms of risks, and therefore risk management, be it process safety or health and safety matters. As a consequence, in order to embrace all the local contexts and activities’ specifics, the Group’s H&S policy is built around a common thread and toolbox with sufficient autonomy being given to the BUs to manage risks.

Lastly, two main company cultures still tend to co-exist after the recent fusion of Gaz de France and SUEZ, the latter showing for example more immediate application of the rules set at the corporate level than the former, being more prone to discussions and local reinterpretations. This historical trait is reinforced by the type of risks managed, major hazards arising from the gas infrastructures.

2.3.3 Culture and Safety Models: Several Approaches and Tools

Historically, many theories and concepts as well as tools in terms of health and safety have been used, mostly coming from external sources (academic work or consultants), that are today more or less attractive and have more or less proven their worth.⁶

⁶These include, for example, the Bird pyramid, Reason’s Swiss cheese model, the root cause analysis... with the primary concern of preventing accidents.

In the early 2010s, an interest for human and organisational factors and the concept of “safety culture” started to emerge amongst ENGIE’s safety functional line, leading to:

- human and organisational factors approaches, for example in GRDF (Gas Distribution Network BU) as early as 2008, with a consultant;
- safety culture approaches, between 2010 and 2013 with the help of ICSI⁷ performing safety culture diagnoses in six entities (gas and energy services).

These approaches were backed by the Group’s R&D center, which provided support on the post-diagnosis phase with various HOF tools such as HOF accident analysis methods, just sanction and reward policies, managerial visits, workshops on collective mindfulness, etc.

In parallel, the Group’s H&S direction developed a toolbox of guidance and support on several axes such as life-saving rules and commitment, safety training, sub-contracting, etc., all of which contribute to the Group’s main goal in terms of safety: *“make our safety and health culture evolve towards a proactive and shared culture.”*

2.3.4 Needs Going Forward

With the recent input of internal R&D and external consultants from the perspective of Human and Organisational Factors, the concept of “safety culture” has grown widely amongst the Group’s safety functional line, mostly stemming from the ICSI diagnosis program. Indeed, the term has been taken over by the corporate level in its safety ambition: *“towards a proactive and shared safety culture”*.

Yet, several questions remain for the Group in terms of approach. Should there be one single model for the whole Group leading to a certain level of standardization, or, given the complexity and variety of activities, should there be as many models as there are different activities?

The question also arises of the difference in treatment of process safety aspects and general health and safety aspects. Usually, these two aspects tend to be managed by different entities. Should it be different for the sake of enhanced performances? Or are we dealing with two separate dimensions?

2.4 The Petrochemical Industry: The Case of TOTAL

2.4.1 Energy Company

Total is a major energy player committed to supplying affordable energy to a growing population, addressing climate change and meeting new customer

⁷Institute for an Industrial Safety Culture (Toulouse, France).

expectations. With operations in more than 130 countries, Total is the world's 4th ranked oil and gas company and a global leader in solar energy with SunPower. With 96,000 employees committed to better energy, Total is an integrated oil and gas company, from upstream to downstream (exploration and production, refining, marketing and developing new energy for the future).

2.4.2 The Way to Reach a High Level of Safety Performance

After years of improvement in safety performance by dealing with technical aspects of safety and implementing Safety Management Systems, analysis of major accidents and high potential incidents has led to the conclusion that there were still aspects to improve in these two domains but also in the field of human behaviours.

More than 15 years ago, it was decided to establish a Safety Culture position at corporate level in order to start some programs for Human and Organisational factors integration. At the beginning, these programs were based on behavioural approaches but quickly moved to a Safety Culture approach: integration of key factors that influence the way people think and the way they act.

The Safety Culture program still consists of analysing the Safety Culture components of an affiliate in order to strengthen them and to improve its safety performance. This program, built with ICSI and a sociologist from North America, is based on a diagnosis tool, established with four types of Safety Cultures: fatalistic culture, trade culture, managerial culture and integrated culture. The integrated Safety Culture is considered as the target for Total entities in the world, which have to take into account the local contexts and specifics of their organisation and metier to establish their own program.

2.4.3 A Strong Safety Model Is Expected

Local communities/authorities and international stakeholders expect Total, as a major in the oil and gas industry, to establish a strong company safety model. Thus, the Total Safety standards and the Safety company model must be implemented to ensure a high level of risk management in every entity, whatever the affiliate, its location in the world, the branch and its metier. Such top-down programs, typical signs of a managerial Safety Culture model, are not always consistent with the variability and adaptation principles, which come from academics and have led to the Corporate Safety Culture program, including the fact that each affiliate has to establish its own Safety Culture plan adapted to local specificities and fulfilling local needs.

2.4.4 Culture Prospective Broader Than Safety

As soon as a Total affiliate starts to analyse and to strengthen its Safety Culture, it has to deal with leadership aspects of the management line, organisational aspects including sociological considerations like relationships between people and groups of people within the entity, management methods, involvement of employees, resources and competencies and also the specific context of the entity. These factors are key components influencing the Safety Culture but are components of the organisational culture of the Company or of the entity at local level.

Therefore, some managers in the company wonder if entities have to perform specific Safety Culture programs or if the company must establish a Company Management Model, including Safety and other areas of risk as well.

3 A Common Core of Questions and Needs Around the Concepts of Safety Models and Safety Culture Throughout the Industry

Considering these various industrial contexts, it is possible to gather a common core of questions and expectations around the topic of safety models and cultures. The following paragraphs try to provide a digest of the main issues at stake from an industrial perspective.

3.1 How to Make One's Way Through the Numerous (Safety) Models Available in the Academic or Consulting Worlds?

3.1.1 Co-existence of Several Safety Models: What to Choose and According to What Criteria, in the Nebulous "Safety Cloud" of the Academic and Consulting Worlds?

The first, dominant issue seems to be the multiple offer existing around safety models and tools. Various schools of thought exist within the academic world: to date, an exhaustive view—if ever possible to produce—seems to be lacking of the various models available. In addition, how does the concept of "safety culture" position itself in relation to other safety concepts or models, such as organisational models (for example Resilience, HRO, etc.)?

In short, it appears that companies are surrounded by some sort of nebulous "safety cloud" from which they pick up various tools and ideas, following the trends of the moment sometimes without much consistency. In this context, the question becomes: what to choose (in terms of content) from the different existing

models/tools? and perhaps more precisely *how*, i.e. according to what criteria, should the relevant model(s) be chosen for one company?

Finally, the very purpose of safety models themselves are questioned: are (good) safety organisational models sufficient to ensure safety? In other words, can the target models used guarantee that safety results will be improved in the end? And if so, linking back to the specific concept of “safety culture”, what is the relevance of using this notion? What more does it bring?

Ultimately, should the model used for diagnosis and analysis be differentiated from the target safety model, used as a goal? Indeed, using the same model as both a target and a diagnosis tool to monitor progress might lead to bias in the way safety is apprehended.

3.1.2 Should There Be a Global, Homogeneous, Model, or Several Models Adapted to Local Specific Features?

One of the most relevant question for the industry is whether there should be a single model of safety culture for one whole Group or if a firm should manage a variety of safety culture models. And if an industry has to deal with a diversity of models of safety culture, how should these be managed and how can they be articulated with a more formal one?

In-depth analysis of the Chernobyl accident by IAEA⁸ experts (1986) showed a lack of safety principles in design and production pressure, non-respect of operating procedures or lack of preparation in crisis management. Meanwhile, the root cause was a lack of safety culture and personal dedication, meaning a lack of safety thinking and absence of an inherently questioning attitude. If the INSAG 3 of IAEA (1988) described Safety Culture as

A very general matter, the personal dedication and accountability of all individuals engaged in any activity which has a bearing on the safety of nuclear power plants,

the Nuclear Industry had to wait for the INSAG 4 (1991) to detail the Safety Culture. This guideline considered Safety Culture as

That assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance.

After this industrial definition, scholars tried to formulate their own version considering safety culture as the part of the organisational culture which influences attitudes and behaviors, increasing or decreasing risks (Guldenmund, 2000). Indeed, several scholars formalized safety culture as an interaction of three components: a psychological (and sociological) component gathering perceptions and values about safety; a behavioral component gathering workers and managers’

⁸International Atomic Energy Agency.

behaviors and attitudes; a structural component including formal and informal organisation.

Meanwhile, industrial managers decided that they could not remain at this level of generality and began to detail and formalize safety culture in their industry. Later, for the nuclear industrial sector, a number of institutions including WANO, IAEA, NRC⁹ created a guidance document called “Common Language” (in 2014). This document listed and detailed the Safety Culture attributes sorted by categories and components. This “common language” and safety culture guidelines helped several nuclear operators to formalize and detail their own safety culture.

If a detailed formalization can help to describe the safety culture and help to assess it through surveys, several examples show that there is not one single safety culture in an organisation.

Indeed, in addition to present a formalized and homogenous component described in documents, a safety culture in an organisation can present several informal professional components which gather skills and representations, locally developed in situation. Moreover, these professional safety cultures can be different or divergent. So, improving safety culture implies combining together several safety cultures in an organisation and to coordinate these professional safety cultures with a more formalized and homogenous one. How can this be achieved?

Furthermore, how can an organisation coordinate a homogeneous model with local situations?

In conclusion, safety culture is embodied in formalized and homogeneous documents and in several and informal professional safety cultures. The challenge is not to favour one of these options or to confront one another but to articulate both of them. In fact, a formalized safety culture can be a global common language which should be appropriated by professions and their managers in order to describe their own safety cultures, or to focus on their main characteristics or weaknesses. After that, managers can try to articulate these professional cultures and the formal safety culture.

3.2 How to Apprehend the Safety Culture Notion?

3.2.1 Safety Culture: What for, and for What?

Where is safety culture located in the risk management landscape from an industrial point of view? Is it a medium of a virtuous transformation of the organisation, a brick amongst others, necessary for good safety, just a tool of characterisation of a human group that is useless for an industrial, or something else?

For the industrial world, safety culture has become a subject of reflexion, of debate, of action and ... of internal and external communication. Is the awaited effect on safety in line with this spending of resources and energy?

⁹Nuclear Regulatory Commission.

Another question arises rapidly. Which “safety” are we speaking about: safety of the industrial process or safety of the workers? Will strengthening the safety culture have the same impact on industrial safety and on occupational safety?

In fact, the distinction that has to be made is perhaps between minor and frequent accidents with simple scenarios on the one hand, and serious and rare accidents with complex scenarios, on the other. The level of integration of these two types of safety, the combination of policies and the choice of methods must take into account the benefits, the results and the objectives of both.

3.2.2 Safety Culture in Projects and International Aspects

Construction projects in industries are usually not located in the original country of the main company managing the project. Many different contractors can therefore be involved with employees coming from many different countries. According to the high level of risks related to some project activities, a strong Safety Culture or a Safety Model is expected from the stakeholders and the shareholders in a short time, because projects have to be successfully implemented within a few years.

In this respect, the objective of project management team is to reach a high level of safety performance right from the beginning of the project. In that sense, is there any existing specific Safety Model or Safety Culture program for projects?

If so, can industrial companies use the same method in different countries? As Safety Culture is influenced by components like location, company culture or the metier, which culture(s) predominate: trade, country, company? Is privileging one of them a good way to improve the Safety Culture? If yes which one?

Eventually, how can the notion of safety culture of the main company managing the project be extended to suppliers and subcontractors? And what about our own activities as contractors or shareholders for other partners with different kinds of culture?

4 Conclusion

As part of the FonCSI “strategic analysis” group on safety models and safety culture, representatives from four high risk-industries (EDF, SNCF, ENGIE and TOTAL) have shared their common issues and questions in the field. Considering their respective contexts of high industrial risks, both in terms of process safety and occupational safety, a certain number of topics arose for discussion, presenting so many challenges for the academic world.

Firstly, many safety theories, concepts, or models coexist today, which are more or less appealing and/or directly useful to the industry. How to choose from the available panel? And based on which criteria? For example, several safety approaches or models exist: what exactly do they comprise? What is the approach to take according to a given context (and *is there* one best way?)?

Should a unique model be considered, or several? Between a homogeneous safety model and a multiplicity of local models, what is the best option? What more does this notion bring?

Above all, the specific topic of “safety culture” emerges: how does this concept position itself with regards to other theories or concepts in the “safety cloud”? Can it link safety at the workplace and technological risks? And, again, how do specific local contexts and cultures influence safety outcomes?

So many questions left in suspension, the answers of which would shed light on operational decisions and safety strategies in the industrial world. Academics and Consultants, our friends, the floor is yours: make the sun emerge from behind the (safety) clouds!

5 Disclaimer

The views and opinions expressed in this chapter are the sole responsibility of the authors and may not reflect those of the companies they work for.

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