

SAFETY CULTURE AND ITS INFLUENCE ON SAFETY

KULTURA BEZPIECZEŃSTWA I JEJ WPŁYW NA BEZPIECZEŃSTWO

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Abstract: *Safety culture is a well-known concept in different industries worldwide, in particular in the nuclear field. Safety culture is recognized as an important factor in achieving high levels of safety performance. Although there is a wealth of information relating to safety culture, there is still no universal definition or model. Thus, the appropriate definition for the respective area such as nuclear, aviation or maritime has to be determined. However, the essence of safety culture is the ability and willingness of the organization to understand safety, hazards and means of preventing them as well as to act safely. Safety can only be achieved through the use of reliable structures, components, systems, and procedures as well as plant personnel committed to a strong safety culture.*

Keywords: *culture, safety culture, assessment, safety*

Streszczenie: *Kultura bezpieczeństwa jest dobrze znaną ideą rozpowszechnioną w wielu gałęziach przemysłu, w szczególności w obszarze energetyki jądrowej. Kultura bezpieczeństwa jest uważana za ważny czynnik pozwalający na osiągnięcie wysokiego poziomu bezpiecznego działania obiektów przemysłowych. Choć istnieje wiele źródeł informacji dotyczących kultury bezpieczeństwa, to ciągle nie ma uniwersalnej definicji tego pojęcia czy jego modelu. Tak więc konieczne jest określenie definicji kultury bezpieczeństwa w odniesieniu do poszczególnych obszarów takich, jak energia jądrowa, lotnictwo czy marynarka. Jednak najbardziej istotną cechą kultury bezpieczeństwa jest zdolność i chęć każdej organizacji do rozumienia zasad bezpiecznego działania, istniejących zagrożeń i sposobów działania pozwalających na ich uniknięcie i na działanie w sposób bezpieczny. Bezpieczeństwo można osiągnąć jedynie w przypadku stosowania niezawodnych konstrukcji, elementów składowych, systemów i procedur, a także przy silnym zaangażowaniu się personelu zakładu w działania na rzecz kultury bezpieczeństwa.*

Słowa kluczowe: *kultura, kultura bezpieczeństwa, ocena, bezpieczeństwo*

1. Introduction

To improve safety many organisations focus on the technical aspects of the engineering systems or the implementation of health and safety systems.

Over the years both of these have led to significant improvements in workplace safety. However, as safety experts estimate that 80–90% of all industrial accidents are attributable to ‘human factors’. It is now widely accepted that the most effective way to further reduce accident rates is to address the social and organisational factors that influence safety performance. There is a growing realisation that the general likelihood of an accident occurring depends not just on the actions of individual employees but also on the safety culture of the organisation.

Therefore, the implementation of safety culture in an organization has become an increasingly important issue for high risk industries. A high level of safety performance is essential for business success in intensely competitive global environment. The most important objective is to protect individuals, society and the environment by establishing and maintaining an effective protection against the respective hazards. This is achieved through the use of reliable structures, components, systems, and procedures, as well as plant personnel committed to a strong safety culture.

Similarly, a safety culture is that aspect of a corporate culture that has to do with the organization’s worldview about safety: it is what the organizational leaders really believe about the importance of safety, demonstrated by their personal emphasis and their actions.

The safety culture of an enterprise comprises the beliefs, attitudes, norms and work practices of management & employees. Safety culture refers to what an organisation is like in terms of safety and health, it includes aspects such as managements’ attitude and actions about safety and, in particular, the attitudes and beliefs of individuals and groups at work concerning the perceived magnitude of risks and the necessity and practicality of preventative measures. Good safety culture means giving the highest priority to safety and implies a constant assessment of the safety significance of events and issues.

Although there is a wealth of information relating to safety culture, there is still no universal definition or model. Safety culture has been defined in a variety of ways including:

- ideas and beliefs that all members of the organisation share about risk, accidents, and ill-health,
- a set of attitudes, beliefs or norms,
- a constructed system of meaning through which the hazards are understood.

The levels of culture go from the very visible to the tacit and invisible. Figure 1 shows a multilevel model of culture that was developed by Edgar Schein [1].

To understand safety culture in its entirety, we must identify the artefacts, espoused values and basic assumptions that form the totality of the concept of culture as it applies to safety. Examples will be given for each of the three levels (see Table 1).

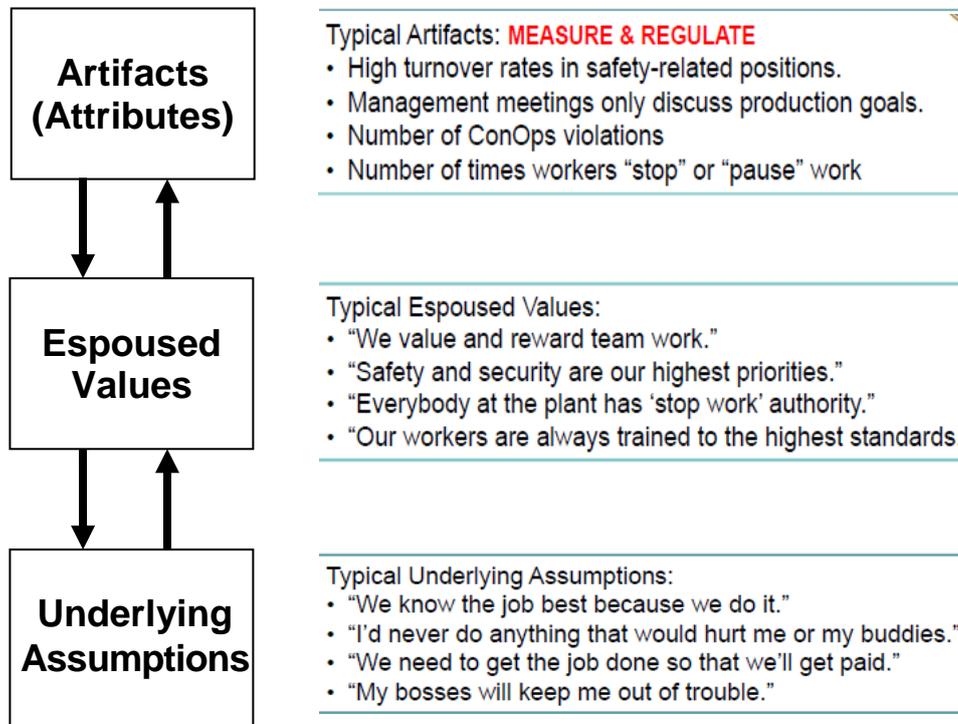


Fig. 1. Three levels of culture according to [1]

The examples in Table 1 are illustrative only as the application of the three levels model to a specific organization would reflect the uniqueness of that organization. It also allows logical links to be made between the artefacts, espoused values and basic assumptions.

Logical links will not be apparent in the illustrative examples shown in Table 1, as it is not derived from any particular organization.

Safety culture has also been described as being related to the “maturity level which characterizes the way an organization deals with safety aspects” [2].

In Figure 2, a safety culture maturity model is presented according to [3]. It is stated that as safety culture maturity improves also safety performance improves. Moreover, it is proposed that an organization improves safety culture and performance by moving upwards in the maturity model through five levels (from pathological to generative), by building on the strengths and removing the weaknesses of the previous level.

This model can assist organisations establish their current level of safety culture and identify the actions required to improve their safety culture thus providing a structured safety culture improvement process. The maturity model concept has already been seen as appropriate to safety culture development within the offshore oil and gas industry [4].

Table 1. Examples for the levels of safety culture.

Level	Example
Artefacts	
- objects	Safety policy statement
- language	Zero lost time accidents
- stories	The day the boss broke his ankle
- rituals	Safety award presentations
- behaviour	Use of safety equipment
Espoused values	
	Safety is the top priority
	Zero tolerance for safety deficiencies
	Blame-free work environment
	Errors are learning opportunities
Basic assumptions	
	Accidents are caused by carelessness
	Some people are accident-prone
	Risks have to be taken to achieve targets.
	Safety can always be improved
	Accidents are avoidable
	Properly designed plant is inherently safe

However, the essence of safety culture is the ability and willingness of the organization to understand safety, hazards and means of preventing them as well as to act safely. Safety culture can be viewed as a multilevel phenomenon of organizational dimensions, social processes and psychological states of the personnel. Implementing, maintaining and improving safety culture requires continuous evaluation.

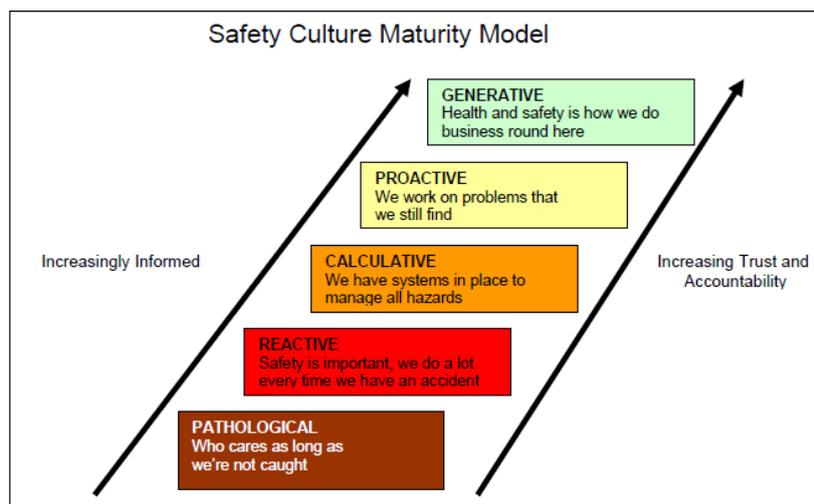


Fig.2. Safety culture maturity model.

As mentioned above, 80 - 90 % of all industrial accidents are attributable to social and organisational factors. These can be addressed at first by a sound and solid safety management system comprised of stable and reliable processes and procedures including an evaluation and self-improvement process. Furthermore, the behaviour and actions of the individual and the group operating and carrying out the safety management system are essential. As set out above, the behaviour of humans is driven by their basic or underlying assumptions emerging in exposed values and finally in artefacts such as objects and behaviours, altogether comprising the safety culture. Thus, the inherent trait of a strong safety culture is the achievement to have the people of an organisation behaving in the desired safety-orientated way compelled not by external requirements but by their own individual basic assumptions. Therefore, good safety culture manifests itself in a behaviour which is safety-orientated no matter what the circumstances and prevents humans from neglecting safety while moving them to take decisions and actions that are safety-orientated. So to foster a good safety culture is to foster a higher level of safety.

These statements were endorsed by the INPO that developed and conducted a safety culture survey in most of the nuclear power plants of the USA and correlated the outcome with indicators for safety performance. The result was a measurable relationship between the level of safety culture and the performance of nuclear power plants [5].

2. Current Status of Safety Culture in the Nuclear Field and Other Areas

In the nuclear field safety culture is discussed and applied since 20 years. Nevertheless organizations in the nuclear field have not yet made sufficient progress in implementing and assessing safety culture. Furthermore a major challenge still is to acquire the most appropriate way of regulatory oversight taking into consideration the national culture and the existing regulatory framework. Consequently, activities on national and international level are ongoing to find a common understanding of the possibilities to further develop the regulatory oversight of safety culture in order to foster safety culture in the nuclear facilities. Moreover, the implications of the regulator on the safety culture of the licensee have to be taken into account.

The term 'safety culture' first appeared in the initial report by the International Atomic Energy Agency (IAEA) following the Chernobyl disaster. Since that time, inquiries into many major accidents such as in the Mexican Gulf (Deepwater Horizon blow-out) in 2010 and at Fukushima in Japan in 2011 when a magnitude 9.0 earthquake off the coast of Japan and the resulting tsunami caused extensive damage at the Fukushima Daiichi nuclear power plant have found faults in the organisational structures, safety management systems and the prevailing cultures, throwing the importance of safety culture into the spotlight.

There is often a delay between the development of weaknesses in safety culture and the occurrence of an event involving a significant safety consequence.

The weaknesses can interact to create a potentially unstable safety state that makes an organization vulnerable to safety incidents.

Within the nuclear industry, there have been a number of high profile cases in different parts of the world that have been linked to a weakened safety culture. Both the organization (which could be a specific plant) and its regulators must pay attention to signs of potential weakness.

A lesson learned in all industries was that safety culture can have a strong impact on industrial risk. The accident causes showed a mixture of multiple failures of technical, human, administrative, management and safety culture deficiencies, which could penetrate the multiple barriers of plant safety systems. A high percentage of the observed failure causes and deficiencies were latent. That means they were hidden still to the event of accident. The nature of latent failure explains the fact that a high number of failures could accumulate unnoticed in complex industrial systems before the event of accident. The investigations - all of these severe accidents - indicate an accumulation of latent failures in combination with active failures.

3. Possible Measures to Enhance Safety Culture

Nowadays it is generally agreed that the general likelihood of an accident occurring depends on the safety culture of the organisation.

Consequently creating a positive safety culture is recognised as an essential aspect of effective safety management in any workplace. Safety culture is determined by the values and priorities placed on all aspects of safety by everyone at every level of an organisation, and how people behave on a day-to-day basis. Organisations with a strong safety culture have less accidents and incidents, as everyone's behaviour is aligned towards the common goal of avoiding harm to people.

An organisation that decides to improve its safety culture should follow a systematic, closed-loop process [6]. A typical enhancement process of safety culture in an air traffic management organisation is presented in Figure 3.

The first step consists of defining what safety culture is and understanding what is meant by safety culture. This requires identifying the characteristics of safety culture to look at, and their sub-components. These first two steps are important because to measure safety culture effectively, an organisation must define and describe what it is attempting to measure. The next (3rd) step of the process enters the assessment stage, where the organisation carries out or commissions a survey to measure its own safety culture. Surveys and other techniques contribute to the identification of strengths and weaknesses of the safety culture (4th step). On the basis of this assessment an Action Plan is developed (5th step), and then actions are effected to improve safety culture (6th step).

After a reasonable period (e.g. at least two years), safety culture can be assessed again iteratively to determine if the situation has improved. The iteration timeframe depends on the time required to carry out the assessment, the definition of the plan and the time to put in place all the actions of the plan and mature the enhancement.

- safety culture in aviation has traditionally a very strong focus on safety, which is strongly regulated by international treaties, and forces a strong safety culture of the pilots of airplanes and of the controller at the tower,
- safety culture in the maritime area is also depending on the safety culture of the respective shipping company and of the captain and his crew, also following international rules which are not as strong as in the case of aviation,
- safety culture in road traffic has to take into account two totally different issues: on the one hand again truck companies and bus companies exist which could foster traffic safety culture for their employees instead of giving priority, e.g., to keep the deliver time even by violating the required rest periods; on the other hand the majority of people participating in road traffic are individuals and they have to be made aware that their attitude of driving strongly influences their own safety but also the safety of the others on the road.

For all these different types of fields where safety culture plays an important role it should be noted that also the regulator and the respective local authorities have to develop and maintain their safety culture.

4. Assessment of Safety Culture

The assessment of safety culture is key to identifying a companies' current level of safety culture (known as its maturity or development level) in order to identify how to learn and improve. There are a number of different assessment methods including:

- safety attitude surveys (using questionnaire to elicit workforce attitudes),
- safety management audits (using an audit process and trained auditor to examine the presence and effectiveness of safety management systems)
- safety culture workshops (involving a cross-section of the workforce to consider perceptions of the safety culture and elicit improvement ideas)
- safety performance indicators (analysing data on indicators such as the number of safety tours performed or near miss data).

A safety culture assessment allows an organisation to better understand how its people perceive safety and the company's approach to safety management. It allows the organisation to identify both strengths and weaknesses that then enable it to continuously monitor and improve its approach to safety.

There are a variety of methods for assessing safety culture, and each method has its own relative strengths and weaknesses.

However, internationally there is great similarity in the process used to assess safety culture. Typically the first step of the process is to identify the important safety norms or safety aspects of working at a plant by using focus groups. These groups consist of a mixture of employees from different parts of the plant. The results from the focus groups are used to compile a questionnaire. The focus group is given the opportunity to review the questionnaire.

The next important stage is to test the questionnaire on a small sample population. The questionnaire is then refined before being administered to the whole or a significant part of an organization. The analysis and interpretation of the results of a questionnaire survey normally require the assistance of specialists. An important step is the timely feedback of results to participants. The final stage is the preparation of a safety culture improvement plan based on the results of the assessment. The implementation of the plan should be pursued with the same effort as other key business plans.

To review the culture of an organisation it is essential to go beyond checking that procedures are in place, to elicit an understanding of underlying beliefs and attitudes to find out what people really think. It is important to understand perceptions of hazards by eliciting views on

- perceptions of risks, of the effectiveness of safe working procedures and of control measures in general,
- their perception and assessment of their own & others beliefs, attitudes and behaviour,
- steps taken to eliminate or minimise sources of conflict between production and safety,
- steps taken to identify individuals behaviour and erode any peer approval of risk taking,
- status, importance and effectiveness of safety officers and committees,
- quality of the safety training.

Safety culture assessment differs from other types of assessment in that it requires a deeper understanding of the underlying organizational and cultural issues behind what is explicitly observed and reported.

A safety culture assessment thus will not lead to a clear-cut and easily actionable result, but will lead to an increased understanding of why different safety related issues appear, and will provide insight into what may be done in order to achieve improvements in safety culture.

A recent example of an independent oversight assessment of safety culture for a nuclear military plant is given in [8], describing in the results explicitly the positive observations and areas in need of attention for nine topics like leadership, work processes and questioning attitude.

One possibility in the nuclear field is to enable an external review of safety culture by a team of experts, e.g. led by the IAEA. This safety review service reflects the expressed interest of Member States for methods and tools for safety culture assessment. Currently, respective independent safety culture assessment guidelines are under preparation by IAEA as well as a report on how to perform safety culture self-assessments.

5. Concluding Remarks

The strengthening of safety culture in an organization has become an increasingly important issue for high risk industries. The most important objective is to protect

individuals, society and the environment by establishing and maintaining an effective protection against the respective hazards. This is achieved through the use of reliable structures, components, systems, and procedures, as well as plant personnel committed to a strong safety culture. Current approaches of regulators to safety culture differ widely depending on the national culture and the existing regulatory framework as well as on the focus. Moreover the implications of the regulator on the safety culture of the licensee have to be taken into account when choosing an approach.

Initiatives to improve safety culture need to be sensitive to the influences of national and organizational cultures; the diversity of cultures will require a variety of approaches to apply the principles of safety culture. The range of approaches is expanding as countries participate in the international sharing of experience in the development of safety culture. Some countries have organized regional safety culture workshops or forums to share information. In the nuclear field, the IAEA has also been instrumental in encouraging the sharing of experience and good practices. This will assist and accelerate the development of safety culture internationally. Also on national level enhancing safety culture is still seen as an important task of nuclear regulators (see e.g. [9], [10] and [11]).

To form a highly developed safety culture the following suggestions can be given:

- establishing a firm policy for safety both at the licensees and the regulator,
- developing the ability to monitor changes in the organizational structure,
- implementing concepts for the maintenance of know-how,
- maintaining and developing safety on an international level, and
- monitoring the safety performance.

The safety health of any organisation is the product of two key elements [6]:

- quality and execution of the systems and processes implemented to deal with risk and safety-related information (the safety management system which may or may not be formalised), and
- safety culture which includes people's shared values, beliefs, and attitudes about safety.

These two elements combine to characterise the way that people behave within their organisation, the 'behavioural norms' as shown in Figure 4.

Therefore, safety management system and safety culture are interdependent with the safety management system embodying the competence to achieve safety, and safety culture representing the commitment to achieve safety. The outcome of these features is an adequate cognisance, referring to the organisation's correct awareness and understanding of the threats to its operations, which in turn shapes behaviours towards safety.

The following list shows how to improve safety management system through principles inherent to safety culture as applied in the aviation area:

- consider the safety management system as a 'living system' that should reflect best industry practice matched against the particular needs of the respective air navigation service provider,

- review the content of the safety management system regularly, drawing on new ideas and current best practice,
- strengthen the safety management system using internal feedback from the primary sources of safety data within your organisation (occurrence and confidential reports, safety forums etc.),
- conduct a gap analysis to identify areas where the safety management system could be improved. These often surround issues like incident reporting, stress and fatigue management and competence in safety science,
- make sure there is a clear focus on risks associated with human factors. These are known to contribute to the majority of accidents, yet are often less well-understood in technology-based industries.

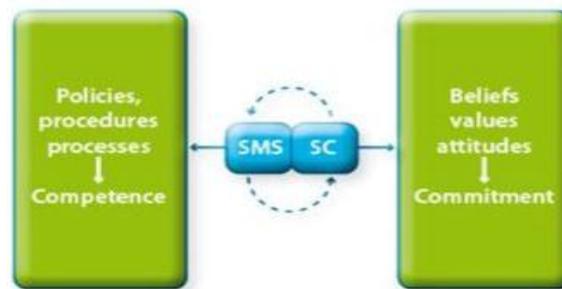


Fig. 4. Interdependence between safety management system (SMS) and safety culture (SC) in an organisation.

The relationship between safety culture and safety management systems is still a focus of research and therefore not yet widely defined. There are three main concepts describing the connection of safety culture and safety management systems. These are complementary rather than contradictory and build on each other.

Currently, a research project is started by the BMU to develop and test a tool for assessing safety culture on the federal level. The goal of the project is a short guide for the regulatory authorities to assess the safety culture of the operators of nuclear power plants in Germany in an objective, transparent, speedy and standardized way. This research project has a length of three years and shall be completed in autumn 2014.

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