Dedicated to innovation in aerospace

PUBLIC

NLR-CR-2016-228 | September 2016

ASC-IT: Seven steps to improve your safety culture

ASC-IT asks the questions – we help you to find the answers

CUSTOMER: Netherlands Aerospace Centre

NLR – Netherlands Aerospace Centre

Netherlands Aerospace Centre

NLR is a leading international research centre for aerospace. Bolstered by its multidisciplinary expertise and unrivalled research facilities, NLR provides innovative and integral solutions for the complex challenges in the aerospace sector.

NLR's activities span the full spectrum of Research Development Test & Evaluation (RDT & E). Given NLR's specialist knowledge and facilities, companies turn to NLR for validation, verification, qualification, simulation and evaluation. NLR thereby bridges the gap between research and practical applications, while working for both government and industry at home and abroad.

NLR stands for practical and innovative solutions, technical expertise and a long-term design vision. This allows NLR's cutting edge technology to find its way into successful aerospace programs of OEMs, including Airbus, Embraer and Pilatus. NLR contributes to (military) programs, such as ESA's IXV re-entry vehicle, the F-35, the Apache helicopter, and European programs, including SESAR and Clean Sky 2.

Founded in 1919, and employing some 650 people, NLR achieved a turnover of 73 million euros in 2014, of which three-quarters derived from contract research, and the remaining from government funds.

For more information visit: **www.nlr.nl**

Dedicated to innovation in aerospace

EXECUTIVE SUMMARY

UNCLASSIFIED

ASC-IT: Seven steps to improve your safety culture

ASC-IT asks the questions – we help you to find the answers

REPORT NUMBER
NLR-CR-2016-228

AUTHOR(S)
A.D. Balk

REPORT CLASSIFICATION
UNCLASSIFIED

DATE
September 2016

KNOWLEDGE AREA(S)
Aviation safety
Safety culture

DESCRIPTOR(S)
Safety culture
ASC-IT

Problem area

To keep their status of high performance organisations, stakeholders in the aviation industry are continuously investing a large amount of effort to preserve and improve their high level of safety. Ineffective Safety Management Systems, safety initiatives that remain without effect, a stubbornly high incident/ accident rate or absenteeism, or a well-set ambition to improve safety; all can be traced to opportunities for safety culture improvements.

However, many aviation organisations struggle to comprehend the concept of safety culture, assess their current safety culture and actually improve it. So what approach should be taken by the aviation industry to improve safety culture?

Description of work

The Netherlands Aerospace Centre (NLR) has developed a seven step safety culture improvement approach, founded on all common key elements of the main existing and emerging views on safety culture.

Starting point is a safety culture assessment with the Aviation Safety Culture Inquiry Tool (ASC-IT). ASC-IT uses a common safety culture framework which applies to the entire aviation sector, enabling benchmarking opportunities. This is unlike other tools that are aimed at specific types of organisations and based on different theories, making benchmarking impossible, which moreover appear to be complementary to each other. This safety culture framework has been developed by conducting a scientific review of the main existing and emerging safety culture frameworks.

The results of the seven step safety culture improvement approach range from expert advice about follow-up steps and potential interventions, to assistance in the change management process to accomplish actual changes in safe behaviour and safety performance.

Results and conclusions

The safety culture improvement approach has proven itself in numerous safety culture assessments and improvement projects in the aviation industry across Europe, South-East Asia, Australia/New Zealand and Africa.

Applicability

The safety culture improvement approach is applicable to all organisations in the aviation industry.

NLR
Anthony Fokkerweg 2
1059 CM Amsterdam
p) +31 88 511 3113 f) +31 88 511 3210
e) info@nlr.nl i) www.nlr.nl

Dedicated to innovation in aerospace

NLR-CR-2016-228 | September 2016

ASC-IT: Seven steps to improve your safety culture

ASC-IT asks the questions – we help you to find the answers

CUSTOMER: Netherlands Aerospace Centre

AUTHOR(S):

A.D. Balk NLR

NLR - Netherlands Aerospace Centre

NLR has given permission to publish this report.
The contents of this report may be cited on condition that full credit is given to NLR.

CUSTOMER	**Netherlands Aerospace Centre**
CONTRACT NUMBER	**-----**
OWNER	**NLR**
DIVISION NLR	**Aerospace Operations**
DISTRIBUTION	**Unlimited**
CLASSIFICATION OF TITLE	**UNCLASSIFIED**

APPROVED BY :																			
AUTHOR						**REVIEWER**						**MANAGING DEPARTMENT**							
A.D. Balk						J.W. Smeltink						Aerospace Operations Safety Institute							
DATE	1	0	1	0	1	6	DATE	1	0	1	0	1	6	DATE	1	2	1	0	1	6

Contents

This page is intentionally left blank.

1 Safety culture is the basis of improvement

Because of the inherent risk in aviation, the aviation industry is not only bound to strict legislations when it comes to safety, but also often realises the importance of good safety records for the continuity of business. While air traffic demand increases, the aviation industry is challenged to maintain, and even improve the current level of safety. To keep their status of high performance organisations, stakeholders in the aviation industry are investing a continuous amount of effort to preserve and improve their high level of safety.

Safety improvement programmes or Safety Management Systems (SMS) create the starting point to bring an organisation's safety record to a higher level. However, the success and functioning of such programmes or systems largely depend on the maturity of the safety culture within the organisation. Ineffective SMS, safety initiatives that remain without effect, a stubbornly high incident/ accident rate or absenteeism, or a well-set ambition to improve safety; all can be traced to opportunities for safety culture improvements.

The full advantage and benefits of safety improvement programmes and SMS are assured and secured in a sound and mature safety culture. This has been acknowledged by leading aviation associations like the International Civil Aviation Organization (ICAO), European Aviation Safety Agency (EASA), International Air Transport Association (IATA), Civil Air Navigation Services Organisation (CANSO) and EUROCONTROL. They have all picked up safety culture as an essential area for further development, creating a strong urge for the aviation industry to get to grips with safety culture and to improve it.

Irrespective of the purpose to conduct a safety culture assessment and initiate a safety culture improvement programme, many aviation organisations struggle to comprehend the concept of safety culture, assess their current safety culture and actually improve it.

So what approach should be taken by the aviation industry to improve safety culture?

To answer this question, the Netherlands Aerospace Centre (NLR) has developed a seven step safety culture improvement approach, founded on all common key elements of the main existing and emerging views on safety culture.

Starting point is a safety culture assessment with the Aviation Safety Culture Inquiry Tool (ASC-IT). ASC-IT uses an aviation-specific safety culture survey founded on a common safety culture framework, which enables benchmarking opportunities across the aviation industry. The common framework makes ASC-IT applicable to the entire aviation industry, unlike other tools that are aimed at specific types of organisations and based on different theories, making benchmarking impossible, which moreover appear to be complementary to each other. The safety culture framework has been developed by conducting a scientific review of the main existing and emerging safety culture frameworks.

Currently, NLR's benchmark database contains data from 25+ organisations with a size of 50 to 25.000 employees and an aircraft fleet from 8 to 130+ aircraft.

The results of the seven step safety culture improvement approach range from expert advice about follow-up steps and potential interventions, to assistance in the change management process to accomplish actual changes in safe behaviour and safety performance.

Some key elements of the ASC-IT surveys:

- *Response rates up to 88%;*
- *Completion time is 15 minutes on average;*
- *For succeeding assessments, consistent succeeding surveys are used;*
- *Surveys are kept consistent for a fixed period to secure the benchmarking facility;*
- *Surveys are now available in English, Dutch, Vietnamese and Turkish, and can be further translated dependent on customer needs;*
- *Statements are rated by the respondents at a 5-point scale from fully agree to fully disagree.*

2 What do our customers say?

In the past 10 years, ASC-IT has been applied worldwide across the aviation industry. Figure 1 provides an indication of the range of application.

Figure 1: ASC-IT worldwide range of application

Experience has learnt that every organisation needs a dedicated and tailored approach in assessing and improving its safety culture, since not only national cultures differ, but organisational cultures even more so. ASC-IT anticipates on this by applying an advanced profiling strategy, in which enablers and disablers for safety culture improvements are identified, originating from the national or organisational culture. Complementary, several cross-checks have been incorporated in the ASC-IT safety culture improvement approach. For example, outside Europe, regular cross-checks are performed with safety representatives to verify whether the proposed approach and interventions would be indeed effective in their national and organisational culture.

"I wish to use this medium to appreciate the company for making safety their priority and that all staff should be safety conscious at all time."

"I thought the survey was relevant to my job, and I'm encouraging my colleagues to participate also."

The dedicated and tailored approach of the ASC-IT safety culture improvement approach has resulted in ASC-IT being available in Dutch, English, Vietnamese and Turkish. This way of making the survey accessible and comprehensible for all participants has resulted in response rates up to 88%, which is considered extremely high for this kind of surveys.

Notwithstanding the fact that each organisation has its specifics that define its safety culture, the common safety culture framework allows for analysis and comparison between organisations, sectors and countries. Although results are organisation specific and secured, some common safety culture features can be noticed.

In large organisations, often a so-called 'perception gap' can be seen between the safety culture perceptions of management and the workforce. This may provide an indication of management sitting in an ivory tower without being adequately informed about the risks and challenges in the daily operations, or management being better informed than the workforce about safety and interventions to improve safety. The safety culture assessment and its follow-up intend to reveal the causal factors for this perception gap. In smaller organisations, however, the safety culture perceptions of management and workforce are more aligned. This is primarily due to the fact that managers have dual roles in the organisation, e.g. both captain and manager of the training department.

"The assessment is very useful for our organisation since it is important to know what employees think about safety at work."

All organisations in the aviation industry deal with issues related to just culture. This safety culture dimension often receives the lowest rating of all safety culture dimensions. This is primarily due to the fact that in general, the workforce do not feel rewarded when they make a real effort to improve safety, and that investigations into incidents or accidents do not reach such a level of detail to reveal underlying causes.

"I believe this survey will bring about good discussion and action to improve our already fine safety culture."

A commonly seen bottleneck for safety reporting systems is an underperforming feedback process on safety reports. Shared experiences are: a lack of accurate feedback and good response on safety reports and that safety reports are not always taken seriously.

One of the elements with regard to adequate responses to safety reports relates to the verification whether corrective actions have indeed been effective. This effectiveness check is either not performed, or remains unknown and invisible to both management and workforce.

Nearly all organisations assessed in the aviation industry display a high awareness of work-related risks, a proactive attitude in facing new risks and adequate attention to safety to keep aware of the risks in the daily operations.

Some safety culture features are more sector-specific. For example, Ground Service Providers and Maintenance & Repair Organisations often have to deal with perceived shortages in resources (either personnel or equipment) and time pressure. This, in turn, shapes safe behaviour in daily operations.

Another intervention that shapes safe behaviour and safety culture perceptions is training in which safety is addressed. Most safety culture assessments reveal that the safety culture perceptions of those who have been trained on safety issues within the last 2 years are higher for all safety dimensions than those who have been trained less recently.

"I think this survey is a great way to remain focused on building and ingraining a safety culture. I would be very pleased to read and review the results in due course."

The various re-assessments that have been conducted reveal that safety culture evolves in time after interventions have been implemented. A positive evolvement of specific safety culture dimensions provides verification that safety culture interventions have indeed been effective. A negative evolvement of specific dimensions, however, indicates that other interventions need to be developed, or that the scope of existing interventions has to be widened to e.g. reach other departments or organisational layers.

"We are glad that we organised the safety culture assessment with NLR."

3 Seven steps for a tailored approach

With ASC-IT as starting point, a detailed insight into the safety culture of an organisation is provided, revealing its strengths and weaknesses, and thereby providing opportunities for improvement.

ASC-IT identifies improvement areas and indicates which barriers are impeding the effectiveness of safety management systems or other safety improvement programs. Also, by using ASC-IT, organisations have the possibility to benchmark their safety culture and to monitor safety improvements.

As shown in figure 2 ASC-IT comprises seven steps, which are executed by experts in the fields of safety culture and safety management:

Figure 2: Seven steps of the safety culture improvement approach

A general explanation of each step is provided below.

Step 1: Intake & profiling

ASC-IT always starts with a personal intake to fine-tune the process with the customer. During the intake, the purpose, background and approach of the safety culture assessment will be discussed, as well as the best means to inform the target group about their participation. Obtaining support among participants is essential in reaching high response rates to the safety culture survey.

The intake comprises the following elements:

- Purpose and desired output
- Scope of the assessment
- Timeline
- Use of incentives and reminders
- Use and frequency of progress reports
- Means of reporting

ASC-IT uses advanced profiling of the organisations' national and organisational culture to make safety culture interventions most effective. This advanced profiling strategy reveals enablers and disablers for safety culture improvements, which originate from the national or organisational culture. Such a background check already puts specific safety culture elements into perspective, as certain attributes of national or organisational culture have proven to influence safety culture. By putting the safety culture maturity levels into a broader perspective, ASC-IT not only provides better insight into an organisation's safety culture, but moreover helps to specifically tailor the interventions to obtain durable safety culture improvements.

Step 2: Launch

ASC-IT is an online tool. When all e-mail addresses of the proposed target group have been delivered by the customer, the safety culture survey is launched on the agreed starting date. Participants receive a personal, attracting invitation by e-mail, tailored to the customer's organisational culture. They only have to activate the link to access the online survey.

Step 3: Support

As soon as the safety culture survey has been launched, progress is monitored. Regular progress reports will be sent, containing for example the actual response rate. If considered necessary, the survey approach is adjusted to increase the response rate. This is done, for example, by sending reminders or offering additional incentives to participants. Of course this is done in consultation with the customer.

Step 4: Analysis

After conclusion of the safety culture survey period, the raw data is processed, analysed and interpreted by experts in the fields of safety culture and safety management. This experienced team draws conclusions and makes recommendations relevant, tangible and workable for the customer.

Step 5: Report

Based on the analysis, an ASC-IT investigation report is generated. The report comprises the following elements:

- Background, origin, objectives, etc.
- Approach
- Results
- Conclusions and recommendations

Wherever possible, the report is enriched with figures and tables to show the most important results at a single glance. Next to general impressions of the safety culture of your organisation, there is great attention to detail and specific results for each safety culture statement. This level of detail enables to develop targeted interventions. The expert team not only provides a report which explains the assessment results, but also provides tangible leads for your organisation to start improving the safety culture.

Step 6: Advice

Completion of the safety culture assessment takes the form of a personal presentation of the analysis to the customer. Especially the interaction with the customer enables to assess the results and make them more profound. In this session, the expert team will advise about follow-up steps and potential interventions.

Step 7: Aftercare

Support from the expert team provides added value in the development and monitoring of follow-up steps and interventions. Assistance may be provided in various elements of the change management process all the way from establishing priorities and targets (depending on effectiveness, benefit, feasibility) based on the findings of the survey and interviews, to accomplishing actual changes in safe behaviour and safety performance. This is why the expert team likes to discuss with the customer what kind of support is requested to develop, plan and realise the follow-up steps as a result of the safety culture assessment.

4 How ASC-IT asks the questions

4.1 Objectives

The ASC-IT objectives are to make an organisation's safety culture transparent, to identify strong and weak elements of the current safety culture, and thereby to provide opportunities for improvement. An ASC-IT safety culture assessment will not only provide detailed insight in the safety culture of the organisation as a whole, but also highlight differences in perceptions about safety culture between different parts of the organisation, for example between Management and Operational levels, between departments, or between subsidiaries. Also, and perhaps even more importantly, the use of the safety culture framework on which ASC-IT is built, reveals the causal and circumstantial factors underlying the various safety culture maturity scores found. This detailed level of insight and understanding is necessary to be able to formulate and successfully implement specific and well-focused improvement measures and to be able to monitor their impact in a meaningful way.

4.2 Added value

ASC-IT provides a large number of distinguishing features:

- Ease of use and high quality are the connecting thread in the implementation and use of ASC-IT. It follows an easy approach, comprised of an online survey linked to an advisory process.

- With as much as 21 indicators, a detailed assessment is made of the perceptions about the current safety culture of the organisation as a whole and of specific departments or target groups.

- The perceptions are assessed anonymously at the individual level. This makes the results less susceptible to group- or performance pressure from the team or department. The effort to participate is small; employees are not assigned to additional, time consuming tasks.

- ASC-IT provides the safety culture maturity at several levels: for the organisation as a whole, for each department/team/location/target group, and for each safety culture dimension and indicator. This enables internal comparisons, but also creates benchmarking opportunities.

- For each target group, potential safety culture weaknesses are identified. In an aftercare programme, in consultation with the target group, interventions may be developed to improve the safety culture.

- Since ASC-IT is applied organisation-wide and across departments, potential differences in safety culture perceptions between departments/target groups are identified, enabling the development of specific, targeted interventions. This creates a single, mature safety culture, in which for example employees address each other's behaviour.

- ASC-IT uses a top-down and bottom-up approach. Top-down to prevent that safety culture weaknesses are overlooked and to ensure that responsibilities for interventions are assigned to people who decide about

budget and resources. Bottom-up to ensure that employees are involved in developing interventions that are both relevant and tailored to the target group, thereby gaining more support for their implementation.

- ASC-IT uses an advanced profiling strategy to identify national and organisational enablers and disablers for safety culture improvements, resulting in specifically tailored, effective interventions.

- The integral ASC-IT approach (the safety culture framework) describes the relation between the various safety culture dimensions, resulting in effective, well-prioritised interventions.

- The ASC-IT analysis may be related to elements of Safety Management Systems, with the potential to increase their effectiveness. ASC-IT complements information contained in Safety Management Systems, which provides additional insights leading to an in-depth understanding of an organisation's safety culture.

- ASC-IT is applied and analysed by specialists in the fields of safety culture and safety management. Their experience provides added value in the potential development and support of safety culture interventions.

- Frequent ASC-IT safety culture assessments, for example once a year, have the advantage that trends in safety culture may be identified and that the effectiveness of safety culture interventions may be verified.

4.3 Capabilities

On-going research activities[1] consisted of the development of ASC-IT to its current capability, based on the theoretical framework described in the next section. ASC-IT has the capability to provide:

- A reliable safety culture assessment service to the aviation industry;
- An opportunity for all personnel to express their views on safety culture and ways for improvement, irrespective of the size of the assessed organisation;
- Means to monitor improvement processes;
- Safety culture benchmarking opportunities in all sectors of the aviation industry.

4.3.1 Safety culture survey

ASC-IT is developed in the form of surveys, tailored to seven categories of organisations present in the aviation industry: airlines, airports, Ground Service Providers, Maintenance & Repair Organisations, Air Navigation Service Providers, Civil Aviation Authorities and manufacturers.

The safety culture assessment is applied by means of a survey for the following reasons:

- Anonymity in survey completion increases the likelihood of receiving honest answers on sensitive issues;
- A great number of participants can be invited;

---

[1] *Montijn C., Balk A.D., ASC-IT – An Aviation Safety Culture Inquiry Tool; Development from theory to a practical tool, NLR-TR-2009-241, January 2010*

Balk A.D., Montijn C., Development of an aviation-wide safety culture assessment tool, paper presented at the 10th International Probabilistic Safety Assessment & Management Conference, Seattle, June 2010

- Application and analysis can be performed in a relatively short time with a small effort;
- Safety culture interventions can be monitored by means of re-assessments;
- Different organisations can be assessed in a similar way.

The core of ASC-IT consists of 2 sets of 63 statements that relate to the safety culture dimensions and indicators presented in table 1. Since the occupation, the operational environment and the vocabulary vary within an organisation, specific lists of statements have been developed for management and the workforce. The statements used in both sets correspond, although the wording of some of the statements has been adapted to reflect the operational context of the workforce. Each of the 21 safety culture indicators is rated by means of 3 underlying statements. Each statement has to be rated on a five point Likert scale; a rating of 1 corresponding to the lowest level of safety culture, a rating of 5 to the highest. The 1 to 5 ratings provided for each statement, safety culture indicator or dimension, correspond with Hudson's safety culture maturity levels, which are further explained in section 5.4. Ratings for each safety culture dimension are derived by averaging the ratings of the indicators that belong to a specific dimension.

It is noted that the objectivity of the results of a survey is highly dependent on the willingness of the respondents to answer truthfully. To prevent respondents from "just clicking through" to reach the end, some of the statements are formulated such that a positive answer would lead to a low score.

ASC-IT uses web-based surveys. Distribution is done in accordance with agreed terms and tailored as indicated by the customer to the various target groups. Invitations to fill out the survey may be personalised and confidentiality is assured for any situation.

Some key elements of the ASC-IT surveys:

- Completion time is 15 minutes on average;
- For succeeding assessments, consistent succeeding surveys are used;
- The surveys are kept consistent for a fixed period to secure the benchmarking facility;
- Surveys are now available in English, Dutch, Vietnamese and Turkish, and can be further translated dependent on customer needs;
- Statements will be rated by the respondents at a 5-point scale from fully agree to fully disagree.

4.3.2 Benchmarking

Statements used for the assessment are selected and composed to inhibit a common language for the target groups to be assessed. This common language creates a valuable benchmarking possibility. Benchmarking will provide the opportunity to learn from organisations which have a leading position in safety culture management. Ultimately this benchmarking will seriously help to consolidate high levels of safety cultures throughout the aviation industry.

Because ASC-IT assessments have already been conducted at a range of aviation organisations, ASC-IT is able to benchmark safety cultures against that of similar organisations not only at an overall maturity level, but also at the level of the underlying safety culture dimensions and indicators. ASC-IT's international track record includes several (flag carrier) airlines, Business Aircraft Operators, helicopter operators, airports, multinational and local Ground

Service Providers[2], Maintenance & Repair Organisations, Cargo Handlers, Civil Aviation Authorities and is also extending its reach to Healthcare organisations and construction firms.

NLR manages the benchmark service that provides a means to compare an organisation's level of safety culture with the overall level of safety culture in the same market sector, other market sectors, or the overall safety culture maturity level in the aviation industry. The reliability of the benchmarking service will grow with the number of results included.

Currently, NLR's benchmark database contains data from 25+ organisations with a size of 50 to 25.000 employees and an aircraft fleet from 8 to 130+ aircraft.

[2] *EASA. https://easa.europa.eu/essi/ecast/wp-content/uploads/2011/08/Aircraft-Ground-Handling-and-Human-Factors-NLR-final-report.pdf*

EASA, https://easa.europa.eu/essi/ecast/wp-content/uploads/2011/08/Just-culture-and-human-factors-training-in-ground-service-providers-NLR-TR-2010-431.pdf

5 Safety culture unravelled

A common safety culture framework which is recognisable for all actors in the aviation industry enables to communicate about safety culture, learn from each other and to work on safety culture as a joint effort, e.g. all organisations operating on an airport. Synthesis of leading safety culture concepts and best practices as described in literature form the cornerstones of the safety culture framework[3].

The safety culture framework thus developed has been elected as the best practice for safety culture assessments by the European Strategic Safety Initiative (ESSI). ESSI represents Europe's main stakeholders for its aviation industry, such as EASA, IATA, Airbus, EUROCONTROL, etc.

5.1 Definition

Scientific achievements have resulted in the following high-level definition of safety culture, tailored to the aviation industry:

Safety culture is the set of enduring values and attitudes regarding safety issues, shared among all members at every level of an organisation.

The elaborated version of the definition is as follows:

The safety culture of a group is the set of enduring values and attitudes regarding safety issues, shared among the members of the group. It refers to the extent to which the members of the group:

- *Are positively committed to safety;*
- *Justly evaluate safety related behaviour;*
- *Keep themselves and others informed on safety issues;*
- *Are aware of the known risks and unknown hazards induced by their activities;*
- *Are willing and able to adapt themselves when facing safety issues; and*
- *Are continuously behaving so as to preserve and enhance safety.*

[3] *Piers M., Montijn C., Balk A.D., Safety Culture Framework for the ECAST SMS-WG, March 2009 (http://easa.europa.eu/essi/ecast/wp-content/uploads/2011/08/WP1-ECASTSMSWG-SafetyCultureframework1.pdf)*

5.2 Dimensions

5.2.1 Composition

To support the assessment and management of safety culture, 6 main dimensions of safety culture have been defined. These 6 dimensions represent the cornerstones on which an organisation's safety culture is built and are defined as follows:

- **Commitment** reflects the extent to which every level of the organisation has a positive attitude towards safety and recognises its importance;
- **Justness** reflects the extent to which safe behaviour and reporting of safety issues are encouraged or even rewarded, and unsafe behaviour is discouraged;
- **Information** reflects the extent to which information is distributed to the right people in the organisation;
- **Awareness** reflects the extent to which employees and management are aware of the risks the organisation's operations imply for themselves and for others;
- **Adaptability** reflects the extent to which employees and management are willing to learn from past experiences and are able to take whatever action is necessary in order to enhance the level of safety within the organisation;
- **Behaviour** reflects the extent to which every level of the organisation behaves such as to maintain and improve the level of safety.

The statistical reliability and validity analysis of the safety culture framework was conducted through a series of practical exposures to different operational organisations.

In figure 3, the 6 main dimensions have been combined into a pyramid, showing that behaviour is the top of a much broader iceberg. Each dimension forms the basis of the dimension it supports. This pyramid, the safety culture framework, lays the foundation for an integral approach of safety culture, in which all processes are monitored and analysed bottom-up as well as top-down.

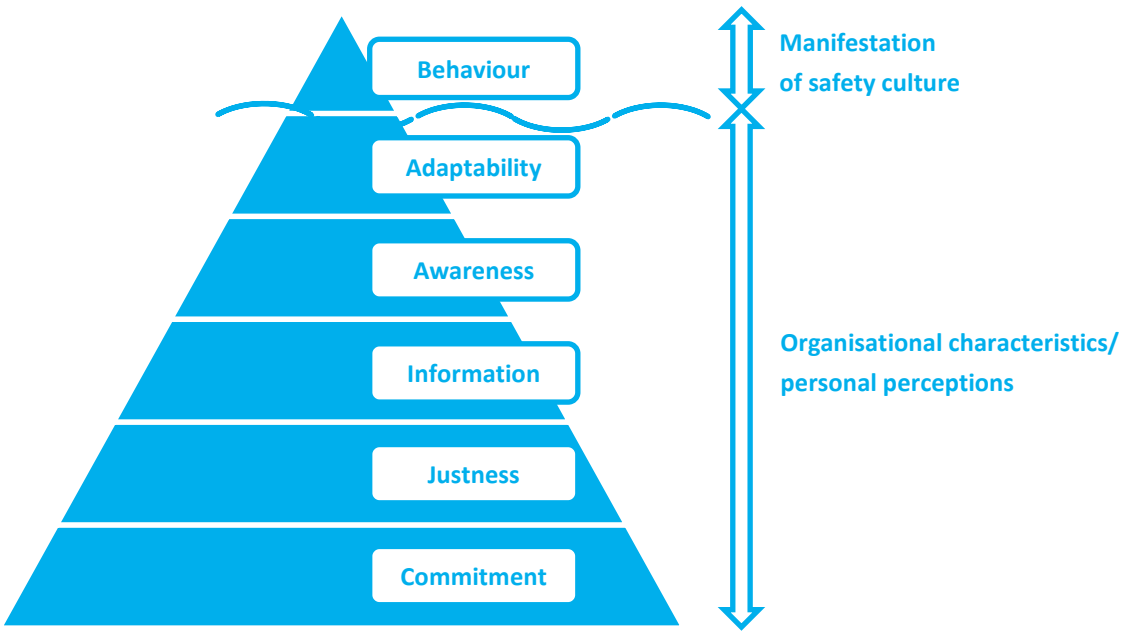

Figure 3: Safety culture pyramid

5.2.2 Hierarchy

In the previous section, the 6 high-level safety culture dimensions were presented in the following order:

1. Commitment;
2. Justness;
3. Information;
4. Adaptability;
5. Awareness;
6. Behaviour.

Although in the characterisation of safety culture all the dimensions play an equally important role, this order does reflect an existing hierarchy which has to be understood in order to develop effective safety culture improvement programmes.

Commitment to safety, the foundation of the pyramid in Figure 1, is a *condition sine qua non* for an organisation to have or to build a healthy safety culture. Indeed, if the organisation's members, starting with management, are not or barely worrying about safety issues, safety will never become a cultural element of the organisation. Only once people become committed to safety, they are able to improve the safety culture along the other five dimensions. The other five safety culture dimensions are therefore founded on commitment to safety.

Justness is the next required dimension for reaching a healthy safety culture, since it helps to create an atmosphere of trust in which the workforce and management are open to talk about safety and are not afraid to report safety issues. Therefore, Justness is a basic condition for the safety culture dimension Information, in which safety information is shared.
However, the effectiveness of developing a just culture is more widespread: A fair evaluation system assesses errors made and applies sanctions when deemed necessary, but its primary purpose is to promote safe behaviour. When this purpose is satisfied, this increases commitment to safety and encourages safe behaviour.

Keeping people trained and well informed about the safety risks they face in the daily operations raises their awareness of safety risks and what role and responsibilities they have with regard to the safety of their own activities. Furthermore, good information makes it possible to learn from safety occurrences and to take proactive action. Information thus is a basic condition for the safety culture dimensions Awareness and Adaptability.

The more aware people are of the importance of safety, the more likely they are to become genuinely committed to safety. Awareness and attention for safety further promote safety-related communication as well as willingness to report safety issues. Therefore, not only do Commitment and Information enhance Awareness, the influence is also reciprocal.

Awareness of the importance of safety leads to "lessons learnt" that have to be implemented. It requires a sufficient degree of adaptability of both the organisation and its personnel in order to implement the changes. The influence between Adaptability and Information is reciprocal: an organisation needs to be well informed in order to be able to adapt to changing conditions, and an adaptable organisation will therefore put in place the elements necessary to become even better informed.

Behaviour, the last dimension, is the manifestation of the other safety culture dimensions, and reflects the practical measures that flow from an organisation's safety culture.

To summarise: Commitment to safety is the primary requirement for safety culture improvements. Without commitment, efforts to improve the safety culture along the other safety culture dimensions will soon diminish. Justness influences the effectiveness of a safety information system, which, in turn, affects building awareness of safety-related risks. Once awareness is created and lessons have been learnt, the adaptability of the organisation defines whether the lessons learnt are implemented to prevent safety occurrences. Finally all safety culture dimensions define how people behave at work with regard to safety. When one or more safety culture dimensions are underperforming, behaviour is influenced accordingly and the organisation is directed away from its goal to maintain a healthy safety culture.

5.3 Indicators

To enable a wide spectrum analysis with detailed recommendations for improvement areas, the 6 safety culture dimensions are further broken down into 21 more detailed and concrete indicators. These indicators are used to assess and analyse the level of safety culture of organisations. Table 1 lists the safety culture dimensions and their underlying indicators.

Table 1: Safety culture indicators

Dimension	Indicators
Commitment	– Management commitment – Personal commitment – Investment in safety
Justness	– Evaluation of (un)safe behaviour – Perception of evaluation – Transferring responsibility
Information	– Safety training – Communication of safety-related information – Safety reporting system – Willingness to report – Consequences of safety reports
Awareness	– Awareness of work-related risk – Attitude towards unknown hazards – Attention for safety
Adaptability	– Actions with regard to safety occurrences – Proactiveness to prevent safety occurrences – Employee involvement
Behaviour	– Job satisfaction – Work situation – Employee behaviour with respect to safety – Mutual expectations and encouragement

5.4 Classification scheme

A linear classification scheme is used to rate an organisation's safety culture in terms of its maturity level. A linear classification scheme creates the possibility to compare safety culture perceptions of e.g. different target groups, organisational levels, departments or locations. To accomplish this, Hudson's linear classification scheme[4] is applied at different levels: i.e. at the organisation, dimension, indicator and target group level. In this scheme, shown in figure 4, safety culture evolves linearly in five steps:

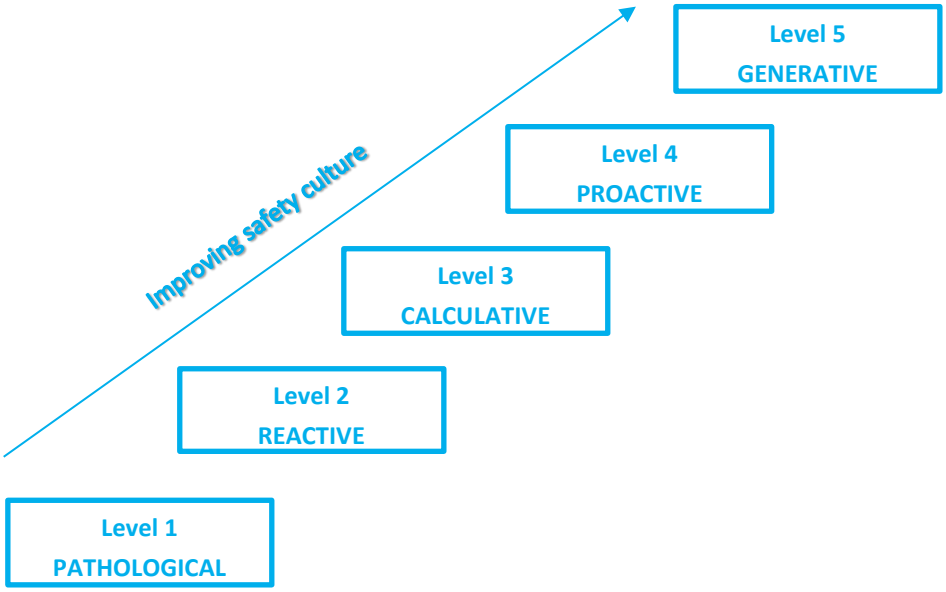

Figure 4: The safety culture maturity levels according to Hudson

Appendix A provides the description of the various safety culture maturity levels and Appendix B describes how the safety culture dimensions evolve along the safety culture maturity levels.

[4] *Hudson P., Implementing a safety culture in a major multinational, Safety Science, 2007, 697-722*

Appendix A Safety culture maturity levels

Hudson's linear classification scheme [Hudson, 2007] is applied at different levels: i.e. at the organisation, dimension, indicator and target group level to rate safety culture in terms of its maturity level. In this scheme, safety culture evolves linearly in five steps:

Level 1 (pathological)

In a pathological safety culture, safety is considered as unimportant and even senseless. Safety plays no role in any layer of the organisation, from top management to frontline personnel. Action is taken only after severe safety occurrences, and only consists of identifying and punishing the directly responsible person(s) without further noticing, let alone investigating, the organisational factors that are likely to have played a role. If safety already is a subject of communication, it is only after severe safety occurrences and for only a short period of time. If there already is any awareness of existing safety risks, there is in general no willingness to do something about them. Employees raising safety concerns are not appreciated, in particular when (other) interests (e.g. profit, efficiency, quality, and environment) are at stake. Safety considerations do not play an important role in the behaviour of frontline personnel. Unsafe behaviour in the benefit of (other) interests is rewarded.

Level 2 (reactive)

In a reactive safety culture, safety is generally regarded as a burden that is imposed from the Authorities. Safety is taken into account to meet the requirements imposed by the regulations. Action is taken only to satisfy the law, or after a safety occurrence, in which case it mainly consists of identifying and punishing the directly responsible person(s). Only if the safety occurrence is severe it becomes object of communication and measures are taken to prevent recurrence. There is only willingness to take action against an existing safety risk when it is too late. Behaviour is barely influenced by safety considerations. Unsafe behaviour in the benefit of (other) interests is allowed.

Level 3 (calculative)

In a calculative safety culture, safety is considered as a factor that has to be accounted for. Safety is taken into account in management's decision making, but in itself safety is not a core value. Action is only taken after a safety occurrence, and next to identifying the person(s) directly responsible, it also aims at investigating the organisational processes that might have played a role. A safety issues reporting system is installed to meet legal requirements, and is only used for gathering information in the aftermath of safety problems. There is a general awareness of the safety risks induced by the operation, and one is willing to take measures if these become too large. The behaviour of frontline employees is influenced, amongst others, by safety considerations. There are situations in which unsafe behaviour in the benefit of other interests is allowed, but in general there is a mutual expectation of safe behaviour.

Level 4 (proactive)

In a proactive safety culture, safety is considered as a prerequisite. Safety is a core value of the organisation and plays an important role in decision making at the management level as well as in day-to-day operations. The safety reporting system is not only used for detecting severe safety issues, but also for issues with less or no impact. Safety reports only have consequences for the person(s) directly responsible if there appears to be intentional actions or negligence. The operations are regularly assessed for safety, and safety measures are thoroughly evaluated after implementation. After a safety occurrence, the first concern of management is to prevent recurrence. After that the person(s) directly responsible often are still pointed out and punished, but responsibility is also assigned to organisational factors. There is a general awareness of the safety risks induced by the operation, and action is taken to reduce these as much as possible.

Level 5 (generative)

In a generative safety culture, safety is the core value of the organisation and is recognised as essential for the continuity of the operation. There is a clear line between acceptable and unacceptable behaviour. As long as safety occurrences are not the result of negligence or intention there are no consequences for the person(s) directly responsible. In this atmosphere of trust the safety issues reporting system is widely used and the measures resulting from safety reports are fed back to the parties involved. One is aware of the existence of unidentified safety risks, aware of the fact that the next accident is just around the corner, and keeps a constant level of vigilance with respect to these unidentified risks. Safety is decisive for the behaviour of front line personnel, and unsafe behaviour is never tolerated.

Appendix B Evolvement of safety culture dimensions

	1 Pathological	2 Reactive	3 Calculative	4 Proactive	5 Generative
Commitment	*Safety is nonsense.* Safety is not taken seriously. Safety plays no role in decision making and day-to-day operations.	*Safety is a burden.* Safety is not a core value. Safety plays a role in decision making only to meet the legal requirements.	*Safety is a necessary evil.* Safety is not a core value. Safety considerations are taken into account in decision making.	*Safety is a prerequisite*. Safety is a core value. Safety plays an important role in decision making and day-to-day operations.	*Safety first, second and third.* Safety is a core value. Safety is recognized as an essential for the continuity of the organisation.
Justness	*Culture of fear.* There are no clear evaluation standards with respect to safety related behaviour. Only if demanded by external factors (e.g. public opinion or law) is responsibility for safety occurrences sought. Responsibility for safety occurrences is only sought within directly involved parties.	*Punitive culture.* The evaluation standards with respect to safety related behaviour are not applied consistently. Human errors are not tolerated. Responsibility for safety occurrences is only sought within directly involved parties. The role of organisational factors in safety occurrences is barely recognized.	*Blaming culture.* Evaluation of safety related behaviour follows clear lines. Human errors are not tolerated. Responsibility for safety occurrences is sought in the first place within directly involved parties. Organisational factors are only investigated when obvious.	*Non-punitive culture* Evaluation of safety related behaviour follows clear lines. The distinction is made between human error and negligence or intention. Responsibility for safety occurrences is sought in within directly involved parties as well as within organisational factors.	*Culture of trust* Evaluation of safety related behaviour follows clear lines. The distinction is made between human error and negligence or intention. Responsibility for safety occurrences is sought in the first place within organisational factors. Directly involved parties are only held responsible if there is a matter of negligence or intention.
Information	*Uninformed culture.* Safety is no topic of communication. Safety training is non-existent. There is no safety reporting system. No information on safety occurrences is gathered, let alone transmitted through the organisation.	*Circumstantial information exchange.* Safety is only a topic of communication after severe safety occurrences. Safety training is rare. There is no safety reporting system. Only information on safety occurrences is gathered. There is no feedback on safety occurrences.	*Bureaucratic information exchange.* Safety is only a topic of communication after safety occurrences. Safety training is not part of normal procedures. A safety reporting system is installed because it is required by law. The safety reporting system is only used to gather information in the aftermath of safety occurrences. There is no feedback on safety reports.	*Proactive information exchange.* Safety is a regular topic of communication. Safety training is part of normal procedures. The advantages of a safety reporting system are recognized. The safety reporting system is used to detect safety issues before it is too late. There is no feedback on safety reports.	*Continuous information exchange.* Safety is a main topic of communication. Safety training is extremely important. The safety reporting system is considered as a main part of the organisation. The safety reporting system is continuously monitored to detect safety issues before it is too late. Feedback on safety reports is part of the reporting system.
Awareness	*No safety awareness.* The safety risks induced by the organisation's operation are not recognised or are ignored. No measure is taken against safety risks.	*Passive awareness.* The safety risks induced by the organisation's operation are recognised. No measure is taken against safety risks.	*Selective awareness* The safety risks induced by the organisation's operation are recognised. Measures are taken if the safety risks are too large.	*Active awareness* The safety risks induced by the organisation's operation are recognised. Measures are taken to reduce known safety risks as much as possible.	*Constant vigilance* The safety risks induced by the organisation's operation are a main concern. Measures are taken to reduce known safety risks as much as possible. There is a constant vigilance with respect to unidentified safety risks.

Adaptability	*Rigid culture.* Even after severe safety occurrences often action is not taken. Employees raising safety concerns are not appreciated.	*Conservative culture.* Action is only taken after severe safety occurrences. Employees raising safety concerns are only appreciated if other interests are not at stake.	*Flexible culture* Action is only taken after safety occurrences. Employees raising safety concerns are appreciated, but only taken seriously if other interests are not at stake.	*Adaptive culture* If possible safety risks are revealed, measures are taken. Action is taken after safety occurrences, however small. Employees raising safety concerns are appreciated.	*Learning culture* There is a continuous striving to a better safety level. Employees are stimulated to raise safety concerns.
Behaviour	*Unsafe behaviour is normal* Safety considerations do not affect behaviour. Unsafe behaviour in the benefit of other interests is rewarded.	*Unsafe behaviour is tolerated* Safety considerations barely affect behaviour. Unsafe behaviour in the benefit of other interests is allowed.	*Safe behaviour is expected* Behaviour is affected by safety considerations. Unsafe behaviour in the benefit of other interests is sometimes allowed, but in general there is mutual expectation of safe behaviour.	*Safe behaviour is normal* Safety considerations largely set behaviour. Unsafe behaviour is not tolerated.	*Safety is decisive for behaviour.* The code of behaviour is in the first place set by safety considerations. Unsafe behaviour is not tolerated. Safe behaviour is rewarded.

NLR

Anthony Fokkerweg 2
1059 CM Amsterdam, The Netherlands
p) +31 88 511 3113 f) +31 88 511 3210
e) info@nlr.nl i) www.nlr.nl