How much do Organizations Plan for a Positive Safety Culture? Introducing the Aviation Academy Safety Culture Prerequisites (AVAC-SCP) Tool

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ADV 1 (1): 118–129
DOI: 10.5117/ADV2018.1.008.PIRI

Abstract

Safety culture has been a topic of discussion in safety literature in the past three decades. Since its first mentioning after the Chernobyl accident much have been written about what fosters a positive safety culture within organizations. The Aviation Academy of the Amsterdam University of Applied Sciences conducted a literature review into safety culture development guidelines and identified a list of 37 prerequisites for safety culture development. Existing safety culture assessment tools target to measure the subjective perceptions of the workforce without examining the parameters affecting safety culture. Thus, they cannot be used to provide the organisations with guidance on the action points for improving their safety culture. To accommodate the need for practical guidance to companies, and as part of four-year research into Aviation Safety Metrics, the Aviation Academy has developed the AVAC-SCP tool, which aims to shed light on the planning and implementation for developing a safety culture. Knowledge experts and companies have reviewed the tool as a means to meet various criteria referred to literature with regards to safety metrics. The tool will enable organisations to derive actionable points from the results. A scoring method is included in the AVAC-SCP in order provide organizations with the ability to monitor their performance over time, compare between

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departments, and prioritize changes. The concept, academic background, reviews and other characteristics of the AVAC-SCP are discussed.

Key Words: Safety Culture; Safety Culture Prerequisites; Safety Culture Assessment

1 Introduction

In September 2015, the Aviation Academy of the Amsterdam University of Applied Sciences initiated a research project entitled "Measuring Safety in Aviation – Developing Metrics for Safety Management Systems". The project responds to specific needs of the aviation industry: Small and Medium Enterprises (SME) lack large amounts of safety-related data to measure and demonstrate their safety performance proactively; large companies might obtain abundant data, but they need safety metrics which are more leading than the current ones and of better quality; the transition from compliance-based to performance-based evaluations of safety is not yet backed with specific tools and techniques. The aim of the research was to identify ways to measure safety proactively in scientifically rigorous, meaningful and practical ways without the benefit of large amounts of data and with an emphasis on performance rather than mere compliance. The proposed alternative safety metrics that are under development are based on the concept of Work-as-Done (WaD) and Work-as-Imagined (WaI). The literature (Dekker, 2011; Leveson, 2015) suggests that safety performance is negatively affected by the gap between what must be done (e.g., regulations, standards, assumptions during design and intentions of system operation, procedures, checklists) and what is actually done (i.e. practices on the work floor). The researchers are testing this hypothesis; the greater the gap between WaI and WaD, the lower the safety performance in terms of adverse outcomes [i.e. increased number of (serious) incidents and accidents] in the overarching research.

Kaspers et al. (2016a) identified that there had been a little consensus whether safety culture reflects the way an SMS is operated (i.e. as a safety performance metric), or the effects of SMS on safety performance (i.e. a safety outcome). In addition to these results, the project partners - and companies from industry - have stated that they view safety culture as an important element of their safety management, yet they do not assess safety culture consistently as part of their safety metrics, and if they do, the assessment is not grounded in sound theoretical frameworks (Kaspers et al., 2016b, 2016c). Additionally, previous research (Karanikas et al., 2015)

suggested a framework with a list of prerequisites for a positive safety culture through in various industries. The framework is based on academic literature and industry standards, and the objective is not to provide a means to measure safety culture perception but to gain insights into what prerequisites (i.e. conditions) for building a positive culture are available and implemented within an organization.

It is assumed that complying with the prerequisites is necessary but not sufficient for a positive safety culture. This means that incorporating the prerequisites within the company policies and documentation will provide a minimum effort to establish a positive safety culture but it will not be an exhaustive effort in successfully achieving a positive safety culture. It is also assumed that it is easier to verify whether the prerequisites are met than to assess the level of safety culture because the documentation can be checked for the inclusion of these prerequisites, rather than assessing the perceptions and opinions of employees, which is a subjective measure. Additionally, the prerequisites can provide 'quick wins' for those organisations that wish to improve their safety culture because they enable actionable items. Following from this framework, the current paper describes the need for - and the development of - a safety culture prerequisites assessment tool.

The prerequisites are clustered in six categories following Reason's (1998) typology of safety culture (i.e. just, flexible, reporting, informative and learning sub-cultures) and one additional category (general organisational prerequisites). An example of a prerequisite that an organization can have implemented is: "*Clear responsibilities and accountabilities of all management areas towards safety*" (Karanikas et al., 2015). See Appendix I for an overview of all the prerequisites.

The safety culture decomposition most widely mentioned in the literature and used by the industry is the one suggested by Reason (1998) who proposed that safety culture consists of five subcultures which must be concurrently in place in order to foster such a culture. Reason's concept was complemented by various authors, who elaborated on the scope of each subculture and provided more detailed guidance about their development and maintenance. In addition to the elements per specific subculture, the general prerequisites for safety culture development are described in the literature (Fernández-Muñiz et al., 2002; Gordon & Kirwan, 2004; Nemeth & Hollnagel, 2014; Parker et al., 2006; Saurin et al., 2013; Sellers, 2015; Wiegmann et al., 2002).

The combination of the safety subculture elements and general organisational prerequisites form a set of 37 markers, which comprises the

analysis framework used in this study. This framework is the basis for the tool as described in the next chapter.

1.1 The Aviation Academy Safety Culture Prerequisites Tool

The researchers have developed a tool based on the previously mentioned framework, and the tool combines the 37 prerequisites as described in the previous chapter. The objective of the tool is to gain insight in what prerequisites an organisation has implemented in their own safety plans and to what degree the organisation safety culture plans are operationalised and/or visible, after which organizations have an insight into what safety culture prerequisites remain to be incorporated in their policy.

Each of the prerequisites has been transformed into two questions; (1) one question to be answered by safety managers, by checking his or her documentation whether the prerequisites are present, and (2) one corresponding question for the implementation of the prerequisite, to be answered by safety managers and line managers. These two questions per prerequisite will achieve the aforementioned objective by checking for implementation in the organization's safety plans, and by checking whether this implementation is visible.

An example of the two questions is: (1) *There is a written commitment of management towards safety*, and correspondingly (2) *My commitment towards safety is clearly visible*. These two example questions are part of the "general culture" category. Finally, the perception of the workforce is captured by 10 questions about safety culture perception and targeted at all employees within the company.

1.2 Documentation Analysis

The documentation analysis is to be completed by safety managers and can - for the majority of the questions - be answered with "yes" or "no". Some questions have "partially" included as an option in case the question refers to, for example, "*all organisational levels*". Information from the documentation will indicate whether the question can be answered affirmatively.

1.3 Implementation Survey

The implementation of the prerequisites ("survey questions" from Figure 1) will be completed by safety- and line managers, who will have the following answer options 1) Always, Almost always, Sometimes, Almost never, Never, Does not apply to my role/Haven't experienced so far, or 2) Strongly Agree, Agree, Undecided, Disagree, Strongly Disagree. Depending on the

answer, the score for the answer ranges between 0 and 100 with 25 as an interval.

1.4 Safety Culture Assessment

The perception of the employees is captured through a condensed version of an existing safety culture assessment tool (NLR, 2016), and can be completed by all employees of the organisation. Figure 1 shows a visual representation of the three elements in the tool.

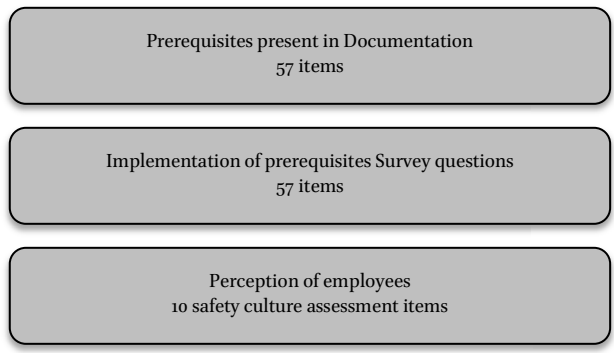

Figure 1 Three elements of the tools capturing the distance between prerequisites planned for in the documentation, its implementation, and the perception of the workforce.

1.5 Scoring

Each element captures a score, which generates an average per subculture category. The gaps between the elements reflect the degree to which there are distances between the planning in the documentation, the implementation, and the perception by the employees. The distances between the scores on the three elements from the tool match the topic of Work-as-Done and Work-as-Imagined, which forms the overarching topic of the four-year research.

These quantified measurements and scoring of the various assessment areas allow monitoring over time, and internal or external benchmarking. Following the industry practice, we used ratios for the degree to which each of the subcultures is met (i.e. values 0% to 100%). We calculate Euclidean distances across all safety culture prerequisites or across subcultures (i.e. the distances calculated within each culture and then combined to a single score).

2 Methodology

The safety culture prerequisites tool was distributed amongst various academic and industry partners for review through various development cycles. In the draft- and the second phase of the development the research team received feedback through interviews with partner companies as well as written reviews from companies and knowledge experts. The tool was subjected to three rounds of review within the research team, across five knowledge experts, three SME, and nine large aviation companies. Also, the metrics' concept was presented to four scientific and six industry conferences, where formative feedback was collected.

3 Results

3.1 Quality criteria

In a previous phase, the researchers have identified several quality criteria to test metrics against (Kaspers et al., 2016a). The partners were asked to provide specific feedback on the quality criteria (see Table 1) to provide their feedback on the tool. Additionally, reviewers could provide feedback on the tool itself.

Table 1 Quality criteria for metrics as described by literature (Kaspers et al., 2016a)

Reflective of the respective theoretical framework
Encompassing systemic views, where applicable
Valid (i.e. meaningful representation of what is measured)
Fulfilment of laws, rules and other requirements, where applicable
Measurable, so to permit statistical calculations
Specific in what is measured
Availability or easiness of obtaining hard or/and soft data required including the quantification of the latter
Ability to set control limits for monitoring the calculated values
Manageable – practical (i.e. comprehension of metrics by the ones who will use them)
Scalable/applicable to the context and area that the metric will be used (e.g., size of the company, type of activities such as air operations, maintenance, ground services, air traffic management)
Cost-effective, by considering the required resources
Immune to manipulation
Sensitive to changes in conditions

3.2 Feedback

The feedback was predominantly positive and in line with the general feedback as described above. Nevertheless, the companies and knowledge

experts have raised some concerns with regards to the following; cost-effectiveness, manageability, the setting of control limits (how much time and effort are required to complete), and the measurability in terms of obtaining meaningful numerical results. Some of these concerns will be resolved once the tool is presented in its intended format: an online tool that will generate a score and actionable items after use. Considering its current form - which is an Excel sheet -, the researchers realise that the tool is cumbersome to use and that the final format will eliminate some of the concerns regarding cost-effectiveness, manageability, and the measurability in terms of obtaining meaningful numerical results. Additionally, including a comprehensive explanation at the beginning should provide a clearer insight into how the results are established, which should lead to understanding the (numerical) result.

4 Discussion

Through the various interviews that were held at the partnering companies, the message was contradicting; the companies are interested in the concept of the objective measurement of planning for safety culture through assessment tool that is based on academic literature. At the same time, the companies have stated that the tool has limitations that need to be overcome before the companies would consider using the tool.

One of these limitations is the academic nature of the tool itself. Some questions were considered vague or overly academic in wording. These issues have been addressed as much as possible by resolving the wording of the question, by adding examples, or simplifying the text, whilst at the same time maintaining close to the original framework.

Another limitation is the length of the tool and the time and resources needed to complete it. Many partners have identified that the tool is thorough and covers safety culture principles and theory. However, companies do not deem the current length of the tool as being pragmatic. Also, the requirement of collecting all relevant documentation beforehand does not enable the companies to assess their planning for safety culture development quickly. Unfortunately, these concerns cannot be addressed within the tool itself as the tool aims to provide an objective and complete picture of the plans made by the organization and therefore should include both the effort needed as well as the resources.

One of the key elements that make this tool unique is the objectiveness of the measurement. As stated earlier, the objective of the tool is not

to measure safety culture, but to gain insights into what prerequisites are planned for, within the organisation, for building a positive culture. These conditions or prerequisites can be found in the company documentation (policies, plans, manuals, procedures, etc.), or have been demonstrated in behaviour (on a case-by-case basis, meeting minutes, briefings, other records/logs, etc.). Originally, the tool was designed to capture these two elements (documentation and behaviour). In this respect, the tool satisfies the objective of the overarching research, which aims to provide insight into the gap between WaD and WaI as an alternative safety metric. However, the perception of safety culture within the organisation of the workforce can be of added value and meaning in the provided information and was therefore included in the tool. Regardless of the efforts from the company to foster a positive safety culture, the perception of the workforce might differ from the implemented conditions of the company. To be able to measure this gap between planning and visibility, the research team has decided to include perception as the third element of the tool, in addition to the documents analysis and the demonstration.

As a next step, the tool will again be distributed among aviation service providers with a request to apply an online version of the tool. The purpose is to test the practical applicability and to validate an association between the results of the tool and safety performance.

Acknowledgements

This research is co-funded by the Nationaal Regieorgaan Praktijkgericht Onderzoek SIA (Netherlands). The researchers would like to express their deep thanks to the following persons for the expertise, time and efforts put in the current work (in alphabetically ascending order of last name): Job Bruggen (LVNL, NL), Gerhard Coetzee (AirAstana, KZ), John de Giovanni (United Airlines, US), Paul de Kort (SAFEmap Europe, NL), Arthur Dijkstra (KLM Ops, NL), Gesine Hofinger (Team-HF, DE), Richard Hol (Transavia, NL), Dimitrios Karampelias (Athens International Airport, GR), Keith Cartmale (MUAC, NL), ConorNolan and Jessica Browne (Aer Lingus, IE), John Norris (Av8jet, UK), Mark Overijnder (Jetsupport, NL), Dave Rietveld (Helicentre, NL), Gert Jan van Hilten (KLM Ground Services, NL), Jaco vd Westhuizen (ATNS, ZA), Frank Vergouwen (Hill's Pet Nutition, NL).

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Appendix – The Safety Culture Framework

Category	Marker	Explanatory Remarks
General prerequisites	G.1 Management commitment.	Changes start from the top. There is both written and visible commitment.
	G.2 Leadership.	Leadership is valued as a steering factor towards safety culture development. Leaders adapt and shift between target-oriented and transformational styles.
	G.3 Clear responsibilities and accountabilities of all management areas towards safety.	-
	G.4 Safety department is visibly responsible and accountable for safety planning.	-
	G.5 Employees' involvement.	The companies engage employees in planning, monitoring and improvement activities. Broad workforce representativeness minimizes power distance. A bottom-up approach in decision-making is preferred and planned.
	G.6 Non-reliance on past success.	There is no ceiling for safety culture and resilience under a constantly changing environment.
	G.7 Risk management policy.	Decisions about changes and plans are based on a risk management framework, tailored to each level of decision-making.
	G.8 Planning for buffers.	In addition to optimising resources during planning, there is a capacity to cope with the unexpected. This is not seen as resource waste.
	G.9 Rewarding safety initiatives.	Rewarding active and exceptional contribution to safety such as new ideas, voluntary participation in safety plans etc., but not daily performance.
	G.10 Internal communication.	Open communication, questioning attitude and effective conflict management.
	G.11 External communication.	Communication channels with the social authorities and other sectors.
Just culture	J.1 Documented definition of 'acceptable' and 'unacceptable behaviour', accompanied by assumptions, examples, indications, required evidence etc.	Workers and managers know what acceptable and unacceptable behaviour is about, although a clear line cannot be drawn.
	J.2 The decision for attributing unacceptable behaviour is made and agreed by a team including peers.	-

Category	Marker	Explanatory Remarks
	J.3 Practitioners know their rights and duties regarding occurrences.	A list of indicative measures and the cases that these might apply is communicated to employees.
	J.4 Prevention of practitioners' stigmatisation.	In cases of mistakes / errors (acceptable behaviour) that caused adverse outcomes, support is provided to the actors regarding their reintegration.
	J.5 Organisational support in legal disputes.	In cases of "acceptable behaviour" subject to police investigations, the organisation provides legal, financial and psychological support.
Flexible culture	F.1 Recognise the inevitable gap between standard procedures and working practices.	Rules and procedures assume ideal and constant conditions.
	F.2 Control of variability. Policy for managing the efficiency – thoroughness trade-off.	There is agreement on risk thresholds and boundary policies that delegate authority to employees for self-organising. Emergency stop procedures are accessible when safety is compromised.
	F.3 Emergency response and crisis management exercises.	In addition to the planned exercises, the resilience of the system is assessed through diverse unplanned scenarios under different conditions and various actors.
Reporting culture	R.1 Clear policy about reporting.	Definition of "who, what, when, where etc." regarding reporting; communication of potential implications of reporting.
	Characteristics for maximum potential of reporting system (R.2 up to and including R.7): R.2 Voluntary. R.3 Non-punitive. R.4 Protected (confidential). R.5 User-friendly. R.6 Accessible (system close to work-station) R.7 Timely feedback to a reporter.	
Informative culture	I.1 A user-friendly safety information system in place with free access for all employees.	-
	I.2 Content of safety information.	Proactive and reactive type of information; internal and external topics.
	I.4 Information sharing across teams, units and departments.	Dedicated meetings, workshops, safety days etc., tailored to local needs as means to stimulate discussions.
Learning culture	L.1 Learning from failures.	Occurrence and voluntary reports; safety investigation reports and audits results.
	L.2 Learning from success.	Part of safety investigations; promotion of success by managers and leaders.

Category	Marker	Explanatory Remarks
	L.3 Safety training.	Includes general training about safety management in the organisation and specific training about the job.
	L.4 Internal benchmarking.	Lessons from internal comparisons across departments, units etc.
	L.5 External benchmarking.	Lessons from external comparisons (e.g. similar companies, industry sectors, regions).
	L.6 Safety information used to initiate changes.	-