Skills, knowledge and senior managers' demonstrations of safety commitment.

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Abstract

Senior managers' safety commitment is emphasised in the safety literature as a crucial influence on organisational safety. Yet there is little understanding of the characteristics that underpin their ability to engage in behaviours that demonstrate safety commitment. This study investigates the contribution of problem-solving, social competence and safety knowledge to such behaviours. Senior managers (N=60) from European and North American air traffic management organisations participated in interviews consisting of open questions designed to trigger safety knowledge and descriptions of behaviours that demonstrate safety commitment as well as scenarios designed to trigger problem-solving and social competence. Reliable scores were generated through systematic scoring procedures involving two independent coders. The results indicated that problem-solving, namely the number of issues and information sources considered when understanding problems and generating ideas to solve a problem were positively related to demonstrations of safety commitment. The ability to perceive others was also found to correlate with safety commitment, whereas safety knowledge was not associated with behaviours that demonstrate safety commitment. It is proposed that training and guidance designed for senior managers should focus on their problem-solving abilities and perception of others in order to support them in demonstrating safety commitment.

Skills, knowledge and senior managers' demonstrations of safety commitment

As leaders of organisations, senior managers crucially contribute to organisational safety (Michael, Evans, Jansen & Haight, 2005). Reviews of the safety climate literature (Flin, Mearns, O'Connor & Bryden, 2000; Guldenmund, 2000, 2007; Shannon, Mayr & Haines, 1997) identified 'management' and their attitudes and behaviours as one of the most frequently measured safety climate factors. The predominant attribute deemed to be crucial for management's influence on organisational safety in the literature is their safety commitment. Neal and Griffin (2004) define management's safety commitment as "the extent to which management is perceived to place a high priority on safety and communicate and act on safety issues effectively" (p. 27). Two meta-analyses report management commitment to safety as not only the most frequently measured, but also one of the most influential organisational factors for safety performance and injuries (Beus, Payne, Bergman, & Arthur, 2010; Christian, Bradley, Wallace, & Burke, 2009).

Studies measuring safety commitment have construed this concept as reflected in five aspects of management action. These are managers' decision- and policy-making (Andriessen, 1978; Cohen, 1977; DeJoy, Schaffer, Wilson Vandenberg & Butts, 2004; Warack & Sinha, 1999; Zohar & Luria, 2005) and their active involvement and communication with the workforce (Cohen, 1977; Dedobbeleer & Beland, 1991; Harper, Coredery, de Klerk et al., 1996; O'Toole, 2002; Simard & Marchand, 1997; Warack & Sinha, 1999; Zohar & Luria, 2005). Other studies have focused on management's influence on organisational practices (Hansez & Chmiel, 2010; Yule, Flin & Murdy, 2007; Zacharatos, Barling & Iverson, 2005) and their safety values (Griffin & Neal., 2000; Rundmo & Hale, 2003) as reflecting safety commitment.

The theme of safety commitment also appears alongside ineffective leadership, lack of appreciation of responsibility for safety and a lack of feedback and continuous reinforcement

from the top, as senior managerial contributions to accidents in investigation reports (Baker, 2007; BFU, 2004; Sheen, 1987). Most recently, the President's report (2011) on the BP Deepwater Horizon accident in April 2010, which killed 11 people and caused substantial costs and environmental damages states: "The critical common element is an unwavering commitment to safety at the top of an organization: the CEO and board of directors must create the culture and establish the conditions under which everyone in a company shares responsibility for maintaining a relentless focus on preventing accidents." (p. 218).

Senior managers are generally under-researched in the leadership (Zaccaro & Horn, 2003) and safety literature (Flin, 2003). Although leadership at lower organisational levels has been studied extensively, such insights are not always applicable to the senior level, where positions differ crucially from lower levels (Hambrick, 1989) and managers at this level are likely to have a distinct influence on safety (Clarke, 1999). Accordingly, a need for research involving senior managers exists.

The majority of research on managers' safety commitment has approached this concept as an expression of concern for safety that is reflected in behaviours, with a particular focus on how employees perceive these behaviours. Such a conceptualisation underlies managerial safety commitment as a central component of safety climate or culture. However, the perception through the eyes of employees is only one upward perspective on the concept of safety commitment. In fact, very little empirical work has investigated what attributes a senior manager possesses that may influence these demonstrations of commitment to safety. Because safety commitment is highlighted as so central to this group's influence on organisational safety, this angle not only offers new theoretical insights but also understanding of practical relevance for the selection and training of senior managers. Consequently, this study investigates the contribution of two skills, problem-solving and

social competence, as well as safety knowledge, to the capability of senior managers to show their commitment to safety.

This investigation involves senior managers working in air traffic management (ATM). ATM is provided by Air Navigation Service Providers whose employees' guide airplanes at airports and en-route to ensure traffic safety and efficiency. In increasingly busy airspaces, these organisations contribute towards flying being one of the safest ways to travel (EASA, 2010). Studying senior managers in this environment enables insights from a group that works at the upper end of the reliability distribution of organisations.

1.1 Skills, knowledge and safety commitment

A focus on skills and knowledge as determinants of behaviours that can indicate safety commitment follows the senior management research's emphasis on individual characteristics as most appropriate to understand this group's influence on organisations (Day & Lord, 1988; Hambrick & Mason, 1984). The consideration of problem-solving, social competence and safety knowledge was guided by the skills-based leadership model (Mumford, Zaccaro, Hardin & Fleishman, 2000) and the specific literature outlined below.

Problem-solving has been defined (Brophy, 1998) as the process of working towards a goal when the means to get there are not known. According to Isaksen and Treffinger (2004), this consists of three stages: understanding the problem, generating ideas and planning the implementation of ideas. In line with descriptions of strategic work (David, 2001), senior managers will especially engage in the first two stages of the problem-solving process in their work, whereas the actual implementation of ideas will be delegated to others. Consequently, senior managerial problem-solving is most likely to crucially contribute to their safety commitment with respect to these two stages. First, the way management approaches safety problems, is proposed to function as a frame of reference for organisational members, which goes on to reflect senior management's commitment to safety (Zohar & Luria, 2005). A

manager who is able to engage with safety related problems effectively, from many angles and aims to gain a deeper understanding of such problems by using multiple information sources, is likely to make decisions that will affect safety positively. Consequently, his or her interest in safety will be evaluated by the workforce as reflecting commitment to safety. Secondly, the ideas a senior manager generates to solve safety problems will shape an organisation's work conditions (e.g. equipment, staffing level, training, awareness campaigns), which are likely to be used as proxies for the manager's safety commitment by the workforce (e.g. Hansez & Chmiel, 2010). Accordingly, it can be proposed that the skill of a senior manager to engage with safety problems effectively will support him or her in showing behaviours that reflect commitment to safety.

Baron and Markman (2000) define social competence as consisting of perceiving others, being able to adapt in social situations, express one's opinion, to persuade others and to be able to induce positive reactions in others. Personable communication of senior managers with the workforce is frequently emphasised as a powerful vehicle for senior managers to convey their safety message (e.g. Harper et al., 1996). Site visits have been suggested as benefitting from high levels of social competence as these provide an opportunity to demonstrate the managers' commitment to safety (Hopkins, 2011).

Two aspects of social competence can be highlighted as being relevant for investigating senior managerial influence on safety: social perception and persuasion. Gardner and Stough (2002) emphasise the ability to understand the emotions of others as being among the strongest predictors of senior managers' effectiveness and this has also been highlighted for the influence on safety (Hopkins. 2011). A senior manager's ability to show active involvement and communicate effectively will be facilitated by their social perception skills. Persuasion can also be particularly relevant for the management of safety, as safety is an abstract goal, for which indicators are not easily defined (Hale, 2009). According to goal setting theory (Locke

& Latham, 1990) safety is a difficult goal to drive individuals towards suggesting the ability to persuade others of the importance of safety contributes to a manger's safety commitment.

Based on the definition of knowledge in the Oxford Online Dictionary, we conceptualise safety knowledge as consisting of facts and information, theoretical and practical understanding, awareness gained by experience as well as background and education in relation to safety. Finkelstein (1992) evaluates expertise and knowledge as one of the main tenents of senior managerial power. To show commitment to safety, a senior manager is likely to require high levels of safety knowledge to act appropriately in relation to safety matters and to communicate related facts to the workforce. Safety knowledge can enable a senior manager to understand safety related information and to draw meaningful conclusions from it, which can guide demonstrations of safety commitment.

Accordingly, we suggest that problem-solving (consisting of understanding problems and generating ideas), social competence (consisting of perceiving others and persuasion) and safety knowledge will be relevant for a senior manager's capability to demonstrate safety commitment. We investigate the relationships of these skills and knowledge with behaviours through which senior managers can show their safety commitment.

2. Method

2.1 Sample

A total of 60 senior managers from 11 air navigation service providers in Europe (10) and North America (1) were interviewed (response rate 79%). The sample consisted of senior managers, either CEOs, direct reports to CEOs or board members (e.g. safety managers, director of operations, head of engineering, head of ATM, head of HR, head of finance and others). The participating organisations covered a broad geographical and cultural range, as well as types of airspaces and different traffic levels (e.g. average number of flights handled daily ranged from 254 to 6500; EUROCONTROL, 2006). Average time in position was 50

months (SD = 51.12 months, ranging from 0.5 months to 240 months). ATM is organised nationally and there is usually one organisation in each country providing air navigation services, some of which are state owned. Although a highly reliable industry, ATM faces incidents that can have severe consequences. Typical incidents are unauthorised penetrations of the airspace (infringements), aircraft deviation from ATM clearance, separation minima infringement (i.e. loss of separation of airplanes), runway incursion and inadequate aircraft separation (EASA, 2010).

2.2 Interview and procedures

Participants were recruited through EUROCONTROL's Safety Culture Programme Manager. Following agreement to participate, two interviewers visited each organisation to carry out structured interviews. The majority of interviews were carried out face-to-face in the participant's office or a designated room and four interviews were carried out over the phone. Average interview duration was 46 minutes (range 17 to 90 minutes). The structured interviews consisted of open questions and scenarios.

Safety commitment. Safety commitment was assessed through an open question (see Appendix). The number of behaviours that participants reported was evaluated as reflecting their repertoire of behaviours. Awareness of different behaviours allows individuals to react flexibly to a range of situations and has been proposed as supporting leaders' effectiveness (Zaccaro, Gilbert, Thor & Mumford, 1991). Accordingly, a more varied understanding of behavioural options is proposed to enable a senior manager to show safety commitment in various ways, allowing him or her to be more effective. The behaviours were identified based on the definition of safety commitment by Neal and Griffin (2004) and counted using rules by Dean, Hender, Rodgers and Santanen (2006). Interrater reliability (ICC; McGraw & Wong, 1996) for the safety commitment rating was .80.

Additionally, the content of the safety commitment descriptions was explored using content analysis (Mayring, 2000). Two raters, who were not involved in the previous analysis of the safety commitment responses, were provided with definitions of the five behaviours identified from the literature as reflecting safety commitment (decision-making, communication, active involvement, influence on organisational attributes and safety values) and coding rules. After independently coding 50% of the questionnaires, the raters evaluated most of the responses that did not fit into the pre-defined coding categories as reflecting interpersonal leadership (transformational and transactional leadership, Bass, 1985; authentic leadership style, Avolio, Gardner, Walumbwa, Luthans & May, 2004) and collaboration with external bodies (e.g. regulators, universities). It was agreed to extend the coding scheme with these additional constructs. The final interrater reliability (Hayes & Krippendorff, 2007) was $\alpha = 0.90$ (95% CI 0.85 to 0.95).

Safety knowledge. Safety knowledge was assessed through three open questions that referred to facts and information, as well as theoretical and practical understanding of air traffic safety (see Appendix). Open questions are regarded as a valid method to assess knowledge (Dochy, Segers & Buehl, 1999). The questions were devised with the help of subject matter experts.

Following the counting rules by Dean et al. (2006), the raters counted the number of issues generated by participants and how many of these issues were correct. Correct responses were identified through statistics from the industry and the safety culture literature. These included the EASA (2010) aviation safety report to determine the most frequent incident types in ATM, a list indicating the contributing factors to loss of separation (HERA) and three safety culture models (Mearns & Kirwan, 2011; Pidgeon, 1991; Reason, 1997). Inter-rater reliability for the safety knowledge ratings ranged between ICC = .85 and ICC = .89.

Two measures of safety knowledge were generated: the number of correct responses (safety knowledge) and the accuracy of the responses (safety knowledge accuracy). The safety knowledge score reflects the overall number of correct responses. The safety knowledge accuracy score represents a quotient of the number of correct responses and the number of overall issues mentioned by participants (similar to a percent correct score, e.g. Knowlton & Squire, 1993)[1]. Cronbach's alpha for the three items that measured safety knowledge was α = .72 and α =.70 for safety knowledge accuracy.

Problem-solving and social competence. Problem-solving and social competence were assessed through two scenarios each (based on Zaccaro, Mumford, Connely, Marks & Gilbert, 2000). Such constructed response measures are described as controlled simulations that produce similar results as highly complex, realistic simulations (Motowidlo, Dunnette & Carter, 1990). By providing two scenarios, observations could be made across two different situations, increasing the content validity of the data. The scenarios were developed and tested in a pilot study with senior managers (N=10). First, the scenarios were generated using triggering response measures and critical incident technique (Flanagan, 1954) with a subsample (n=4). The developed scenarios' validity was then tested with a subsample of senior managers (n=6) using content analysis (Mayring, 2000). Results showed the two problem-solving scenarios primarily triggered responses identifiable by two coders as reflecting problem solving (54% and 71% of responses) and the social competence scenarios primarily triggered responses identified as social competence (62% and 75% of the responses). Because Zaccaro et al. (2000) describe specific questions as facilitating the application of a skill and increasing the reliability of the coding, we prompted participants to aspects of problem solving and social competence.

[1] For instance, when a participant provided three possible contributors to loss of separation, out of which two were correct (i.e. on the HERA list), he or she scored a two on the safety knowledge scale and a 0.66 (2/3) on the safety knowledge accuracy scale.

Table 1 shows two of the four scenarios used in this study as well as the questions used as cues for each type of scenario.

For problem-solving, participants were prompted with two questions to understanding the problem and idea generation (see Table 1). The number of issues and ideas generated by participants that matched with a list of responses provided by two subject matter experts (using counting rules by Dean et al., 2006) were counted. Because Mumford, Vessey and Barret (2008) propose scales accounting for the problem-solving process and the specific domain of the problem as especially suitable measures, the coders further assessed the number of information sources that the participants referred to while working on understanding the problem (e.g. data, other managers, and workforce) and identified for the content of generated ideas as either cultural (e.g. awareness campaigns, visits to the workforce) or technical (e.g. changes to equipment, changes to the airspace design). Inter-rater reliability (ICC) for the problem-solving measures ranged between .74 and .87.

For social competence, participants were prompted with two questions to social perception and persuasion (see Table 1). Perceiving others was assessed by counting the number of possible reasons generated by participants (cf. Jones & Day, 1997) using counting rules by Dean et al. (2006). Within social perception, the coders identified how many of the issues generated were technical issues (e.g. issues with the safety management system, the technical systems involved) and how many were social issues (e.g. stress, conflicts in team or at home). The number of persuasive moves was identified based on the persuasive strategies by Yukl, Falbe and Youn (1993) and counting rules by Dean et al. (2006). Interrater reliability (ICC) for the social competence measures ranged between .75 and .93.

2.3 Results

Previous studies using similar interview methods (e.g. Zaccaro et al., 2000) limited the time that participants had to respond to questions. It was decided not to apply such

constraints as it seemed inappropriate with a multi-national sample of senior managers. The response length was controlled for by calculating a ratio of the number of issues identified by the coders and the number of words in each response for all interview measures. As these ratios were very small, they were then multiplied by 100, to obtain presentable values.

The Kolmogorov-Smirnov test indicated that the data were not normally distributed (D (49) ranging between 0.14 and 0.51; all $p \leq .01$). The selective sample of senior managers and the ratios that were calculated might have contributed to limited variation in the data and a skewed distribution. Accordingly, the data were analysed using non-parametric tests, namely Kendall's Tau.

The correlations shown in Table 2 indicate that three aspects of problems solving were related to safety commitment, namely understanding problems ($r = .31$, $p < .01$), the information sources considered when understanding a problem ($r = .35$, $p < .01$) and idea generation ($r = .19$, $p < .05$). Furthermore, a significant correlation of perceiving others with safety commitment could be identified ($r = .20$, $p < .05$).

Subsequently, we inspected participants' responses for the three aspects of problem-solving and perceiving others that matched with the responses that had been provided by the subject matter experts. Participants most frequently mentioned 'work load' ($f = 22$), 'work conditions' ($f = 19$; e.g. patterns in the traffic, airspace design issues, heat or noise in the control room) 'shift management' ($f = 14$), or 'negotiation of new contracts ($f = 11$) as causing the problem described in the scenario (see Table 3). The most frequently mentioned information sources were 'data figures and reports' ($f = 15$), 'speaking to the controllers' (often the supervisors, $f = 12$) as well as 'involving experts' (such as human factors or health experts; $f = 9$). The types of ideas listed in Table 3 most frequently suggested changes to the shift schedule ($f = 16$) as a possible way to solve this problem, followed by involve the controllers ($f = 11$).

Table 4 illustrates the types of responses that were given for perceiving others. Both these examples illustrate a general pattern in the responses as most participants considered both, issues at work (e.g. being overlooked in a promotion round, no being heard, comments not welcomed) as well as personal issues (e.g. issues at home, health problems) as leading the manager to act this way.

Table 5 shows that 87% of the responses were identified by both raters as the behaviours previously identified from the literature, suggesting that these behaviours captured the data well. Most frequently, participants' responses reflected personal involvement (f = 52), followed by influencing organisational attributes (f = 34) and communication about safety (f = 23). Decision-making (f = 15), leadership (f = 14), showing safety values (f = 7) and collaboration with external bodies (f =6) were indicated less frequently.

4. Discussion

This study considered problem-solving, social competence and safety knowledge as relevant for senior managers' engagement in behaviours that demonstrate their safety commitment. The results suggest problem-solving, namely the number of issues considered when investigating problems, the information sources used to understand problems, the generation of ideas to solve problems as well as understanding others' intentions (social competence) as related to demonstrations of safety commitment. Safety knowledge did not relate to behaviours that reflect safety commitment. Additionally, an inspection of the behaviours that senior managers reported to use to demonstrate safety commitment showed personal involvement, influence on organisational attributes and communication about safety as most frequently referred to behaviours.

Descriptions of senior managerial work emphasise that it requires managers to deal with large amounts of information and describes this aspect as one of the main challenges of their work (Mintzberg, Ahlstrand & Lampel, 1998). Finding the ability to understand problems,

including the consideration of many different issues and sources of information, as related to behaviours that demonstrate safety commitment highlights the centrality of dealing with information to solve problems as also relevant for this group's influence on safety.

'Idea generation' was also related to demonstrations of safety commitment. The content of the solutions generated by participants contained short (e.g. re-organisation of the airspace) and long term solutions (e.g. change the shift management) and focused on cultural or social as well as technical issues. This finding highlights senior managers' safety commitment as related to both aspects of the socio-technical concept of organisational safety (Turner, 1978). Accordingly, demonstrations of safety commitment are likely to benefit from considering cultural issues when solving a problem (e.g. involving the controllers) as well as technological changes (e.g. changes to the airspace). Overall, the relevance of problem-solving found in this study supports Zohar and Luria's (2005) evaluation of this skill as centrally contributing to behaviours that reflect management's safety commitment.

Perceiving others, but not persuasion was related to safety commitment in this study (in line with suggestions by Hopkins, 2011). This illustrates the ability to understand others intentions and emotions as more central to safety related interactions with the workforce and colleagues for senior managers than the ability to persuade them. Persuasion is described in the literature as a core element of leadership (Hogan, Curphy & Hogan, 1994), however this was not found to be the case in relation to safety commitment in this study. It appears that senior managers can more effectively demonstrate their safety commitment by showing concern for others and care about their employee (as described for leadership and safety generally by Zohar, 2010). However, before such a conclusion can be drawn, the following issues should be considered. First, despite the scenario validation, the scenarios might have not allowed participants to apply persuasion, but rather problem-solving using social information (as Zaccaro et al. (2000) had used similar scenarios to trigger social judgement

skills). Furthermore, it is possible that, while persuasion might not be related to behaviours that reflect safety commitment, it might influence organisational safety directly or through other mechanisms.

Although safety knowledge has previously been shown to contribute to safety related performance at lower levels in organisations (e.g. Griffin & Neal, 2000), the results of this study indicated it as not strongly influencing safety commitment at the senior level. It is possible, that safety commitment, as a form of dedication to safety is not driven by knowledge about safety. Knowledge about an issue does not necessarily inform behavioural choices (Hawthorne & Stanley, 2008). The assessment of knowledge used in this study focussed on the retrieval of facts and information and theoretical understanding, but did not include the application of such knowledge, which might have been more relevant to the ability of showing safety commitment.

2.4.1 Strengths, limitations and future research

This study achieved unique access to an under-researched sample in the safety literature (Flin, 2003). The sample represented a good proportion of the targeted group (i.e. just under 30% of all organisations from EUROCONTROL member states). Furthermore, this study was carried out with participants from different nationalities. Research that includes multi-national samples can be evaluated as especially relevant in the 21st century, as more and more organisations operate in more than one culture (Triandis, 2006). Nonetheless, the sample size was small from a data analysis point of view and the study suffered from low power. Accordingly, only correlations and descriptive qualitative results are reported in this study, as the sample size did not allow for more rigorous analysis (such as regression). Furthermore, it was not possible to account for non-linear relationships in our analysis. We propose that the results reported in this study nonetheless, give an indication of the ways in which skills and knowledge might influence safety commitment.

The inter-rater reliability of the findings was ensured through the co-coding of the interviews. Furthermore, the coding of problem-solving and safety knowledge were based on objective criteria. A further strength of this study was the development and validation of measures and scenarios suitable for a senior manager sample. By presenting two scenarios and multiple questions for skills and knowledge respectively, the stability of the responses was considered. Despite the validation of the scenarios, an issue with the social competence measurement pertained to the scenarios' content validity, as these were based on scenarios that had previously been used to assess social judgement skills by Zaccaro et al. (2000).

Because senior managers' safety commitment is usually defined through the way this is perceived by the workforce (e.g. Neal & Griffin, 2004), not using upward appraisal to measure safety commitment represents a weakness of this study. Unfortunately, the participating organizations were not able to provide access to the participants' subordinates. The majority of behaviours described as ways to demonstrate safety commitment in this study matched behaviours that are considered in the literature as behaviours that affect safety commitment perceptions of subordinates. This suggests that the behaviours obtained from senior managers themselves might not be that different from behaviours that their subordinates might view as indicators of safety commitment.

It is unclear whether the results found in this high reliability industry can be generalized to other high reliability industries (such as nuclear power production) or high risk industries (such as oil and gas). Future research should further investigate the influence of traits and skills on safety commitment using a longitudinal design in order to ensure that the relations found in this cross-sectional design follow the proposed direction. Results from this study cannot identify whether skills and knowledge lead to more diverse demonstrations of safety commitment or whether a higher commitment to safety drives acquisition of skills and knowledge relevant to safety.

Finally, future research should consider the influence of organisational structures and characteristics on the ways in which senior managers can impact safety. It is likely that some organisational structures will amplify, attenuate, as well as reduce the impact of senior mangers' safety signals. Managerial latitude of action has been proposed by Hambrick (2007) as a moderator of the extent to which managerial characteristics affect organisations.

4.2 Conclusion and practical implications

Given the relevance of senior managers' safety commitment for organisational safety, this study's investigation of skills' and knowledge's contribution to behaviours that reflect this attitude has practical as well as theoretical implications. The advantage of investigating skills and knowledge is that they are developed through practice (Landy & Conte, 2004), suggesting they can be targeted in interventions. Consequently, this study's findings can provide evidence for training and best practice sharing, as well as future research. According to this study's findings, aspects of managerial problem-solving and social competence should be targeted by safety related guidance or training and can be proposed as a relevant topic for further investigation. Senior managers can be stimulated to develop their ability to understand safety problems, to consider different types of information sources, to creatively generate solutions for safety problems and to be sensitive to others' intentions and issues as this is likely to support their demonstration of safety commitment.

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Table 1

Social competence and problem-solving measures

Social competence You are the CEO of a European ANSP, and the following issue has been brought to your attention. You have recently noticed changes in the behaviour of one of your managers during a Board meeting. The manager does not participate as actively in the meeting as he used to, even when issues relevant to his domain are being discussed. When asked about some of the topics discussed, he does not speak up to clarify his views as he would normally do. His performances on the recently assessed KPIs were adequate. 1. Social perception: What do you think are possible reasons why the manager acts this way? 2. Persuasion: How would you approach the manager and talk to him/her? How do you persuade him/ her?
Problem-solving You are the CEO of a European ANSP, and the following issue has been brought to your attention. Recently controllers in your ANSP complain more about fatigue and you also have noticed that mistakes during clearance have occurred more often. Furthermore, recently more reliance on short term conflict alerts has been reported, and a higher rate of TCAS alerts has been reported. Informally, controllers are concerned that they are pushing the envelope too far, though quarterly reports indicate that incident rates have remained the same. Two of the low-cost airlines have complained about ATC induced delays and 'inflexibility' when responding to pilot requests. 1. Understanding the problem: What do you think are possible issues here? 2. Generating ideas: What ideas do you have, how this issue could be resolved?

Note: Only one of the two scenarios for each skill is presented

Table 2
Correlations

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1. Safety commitment	1.40	0.98											
2. 'Understanding the problem'	0.51	0.35	.31**										
3. 'Understanding the problem' -info sources	0.12	0.16	.35**	.20*									
4. 'Idea generation'	0.73	0.41	.19*	.22*	.05								
5. 'Idea generation' technical	0.23	0.33	.10	.19*	-.10	.28**							
6. 'Idea generation' cultural	0.29	0.28	.09	.06	.22*	.33**	-.02						
7. Social perception	1.31	1.81	.20*	.29**	.04	.05	.12	.12					
8. Technical insights	0.65	0.77	.10	.21*	-.05	.05	.09	.21*	.45**				
9. Social insights	0.53	0.95	.12	.14*	.09	.00	.14	.00	.66**	.17			
10. Persuasion	0.79	0.58	.06	.11	.10	.17	-.02	.26**	.17	.14	.16		
11. Safety knowledge	0.44	0.44	.14	.23**	.16	.19*	.07	.17	.25**	.07	.23*	.16	
12. Safety knowledge accuracy	75.72	19.57	.04	-.03	.06	.01	-.02	.06	.02	-.18	.10	.10	.11

Note: n = 60, * p<.05, **p<.01

Table 3

Examples of responses coded for problem-solving

Understanding the problem
Workload issues (*f* = 22)
Work conditions and environment (traffic peaks, design in airspace, *f* = 19)
Shift management (*f* = 14)
Negotiation of new contracts/ union issues (*f* = 11)
Staff shortages (incl. increased sick calls, *f* = 11)
New system (technology) or procedures introduced (*f* = 9)
Break patterns/ time in front of screen (*f* = 9)
Changes to the shift management (*f* = 8)
Personal conflicts in the teams or with management (*f* = 7)
Traffic complexity (*f* = 5)
Cultural issues (i.e. changes in the reporting culture; *f* = 3)
Information sources
Look for and analyze the data, figures and reports (*f* = 15)
The controllers (*f* = 12)
Experts (*f* = 9)
Data (*f* = 6)
Safety manager (*f* = 3)
Airline reports (*f* = 3)
The unions (*f* = = 2)
Observations & tapes (*f* = 2)
Idea Generation
Improve the shift schedule and look at breaks (*f* = 16)
Involve the controllers to develop a solution together (*f* = 11)
Carry out a safety assessment/ more detailed investigation (*f* = 9)
Re-organize the airspace/ flow control measures (*f* = 8)
Bring in more controllers (*f* = 4)
Specially investigate peaks in the traffic (*f* = 3)
Talk to the airlines/ the costumers (*f* = 2)

Note: Examples are given for the scenario presented in Table 1only (excludes frequencies from second problem-solving scenario); included issues had been mentioned by more than one participant and correspond with subject matter expert list

Table 4

Example quotes for perceiving others

- "Problems at home? Health problems and maybe it is something that he or she doesn't like to speak about until he or she is certain about the position. Maybe some ahem it might be some changes in the management level and ahem he could have anticipated he might be next. That is a possible scenario when someone is quiet. Or ahem or even the communication was cut in a certain way that he tried to speak up several times and he was shut down by the others so he doesn't feel like he is part of the board. So five reasons."

- "He could be ill, he could have domestic problems, he could have had a discussion with somebody where he has been told that his interventions are not welcome ahem he thinks that the risk assessments were not made adequately. To be honest with you there are a million things that could be wrong with this person why he isn't participating, he may believe that he is usually very active at the meetings and he has been told that he is taking up too much time, he maybe told him that his interventions are not relevant, he may be told that whatever, his particular area isn't s important as other areas so whatever, so it is a very human situation."

Note: Examples are given for the scenario presented in Table 1only

Table 5.
Behaviours reflecting safety commitment

Construct	Frequency	Example
Decision-making	15 (10%)	First of all I don't rush towards any conclusions. Until I have an as much as possible full view of the facts. The danger in safety is, to take a very prejudiced decision, based on some very, very weak information.
		Apart from planning what we have to improve, when we have problems, have to change something or to make improvements we think a lot first. We also justify how it will be beneficial for the operations and only after we are very sure that the benefits are more than the risks of this change, we go with this change.
Personal involvement	52 (34%)	We get some of the simplest little issues. You have to deal with them just as if they are the most important thing in that person's life. And you got to talk to them and you have to find out about it.
		I have sleepless nights if something is not running.
		If somebody came here asking me to look at an issue and I asked him to go away I think I would be doing something seriously wrong. I might have to say to them, I can't look at it straight away, is that ok, but I will put it on my list.
Communication	23 (15%)	So some of it is about the conversations that I have so I would always walk into the ops room and ask people how the operation is running,
		But of course it requires *[...]* that I tell them on a regular basis and on the occasion of some projects: Has this been covered, did you look at that, did you make a safety assessment?
Showing safety values	7 (5%)	There is nothing too small and there is nothing too big when you are dealing with safety.
		I would say that some of the values, safety for me is a more a value than a task.
Influencing organisational attributes	34 (23%)	First, I think training is very important, all aspects in relation to safety training for everyone. We send our controllers to all these trainings and workshops.
		Well, we have processes in place: it starts with a safety menu and a safety management system that we have in place.
Leadership	13 (9%)	So the actions are a number of things. One is visibility, being seen, known. The other is being approachable.
		One of them is about being brave, is about standing up and saying: this is what I think might be possible, or this is my view. So you are kind of putting yourself out there. People know you are out there. It is that leadership again, where you are out there and then you start to enrol people in the vision that you have got.
Boundary spanning	6 (4%)	Then we had some studies as well that found, perhaps some surprising attitude statistics, for young people and more experienced people. *[...]* I think this will help more and more to have knowledge in this area and get information from the universities.
		Discussions here involve the unions as well.
		Very important is also cooperation with the director of civil aviation, the regulator and other agencies.

Appendix
Interview questions

Commitment to safety
From your point of view in what ways can you show your commitment to safety?

Safety Knowledge
What are the most frequent incident types in Europe?
What are explanatory factors to loss of separation in Europe?
What are the main ingredients (or components) of the safety culture of your ANSP?