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The influence of leadership on the prevention of safety incidents: on risk reduction, leadership, safety principles and practices

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15 Appendices

15.1 Qualification info of incident investigators

Retrospective review of safety crises				Info concerning reviewers	
I.D. code	Years in safety	Years incident investigator	Number of incident investigations	Sectors of investigations	Tools
1	11	11	30+	Hospitals, health care	Tripod Beta
2	17	17	30+	All Sectors	Timeline, Tripod Beta, STEP, STAMP, HFACS, Prisma, Accimap
3	26	26	30+	Oil&Gas, hospitals, process industry, general infra	Tripod Beta
4	30	25	30+	Tank storage, process industry	Tripod Beta, RCA, many others
5	16	16	30+	All sectors	Tripod Beta, RCA, TopSet, Taproot, SIM, BSCAT, Sologic, 5W
6	18	17	30+	All, except hospitals	Tripod Beta, RCA, TopSet, SIM, BSCAT, Prisma, Sologic, 5W
7	24	22	30+	Rail and general infra	Tripod Beta, Prisma, HRA, Cascade-model, FAM, 5W
8	31	28	30+	Rail	SOAT, FAT, Tripod Beta, Bowtie
9	6	7	30+	All sectors	Local Rationality, FRAM, Tripod Beta, SIM, STAMP, Multi Actor Timeline
10	12	12	30+	All sectors	Tripod Beta, RCA
11	20	20	30+	All sectors	Tripod Beta, RCA, BSCAT, 5W
12	10	10	30+	All sectors	Tripod Beta, SIM, RCA
13	31	31	30+	Oil&Gas, tank storage, process industry	Tripod Beta, FMEA, Deep Learning, TopSet, 5W
14	12	12	30+	All, except hospitals	Tripod Beta, TRACK, TopSet, SIM
15	14	8	30+	Oil&Gas	MSCAT, TopSet, Tripod Beta, Casual Learning
16	13	10	30+	Genral infra, rail	Tripod Beta, 5W, SOAT
17	14	10	>10<20	Rail	Tripod Beta
18	16	10	30+	All sectors	Tripod Beta, TopSet, FRAM, BSCAT, SIM, GBV

TABLE 20 Qualifications of incident investigators

15.2 Guideline for incident investigators

Expert research into the role of leaders in incidents

Objective of this sub-study

This sub-study is part of a research into the role of leaders in the occurrence of safety incidents. This sub-study looks for the way in which leaders (possibly in the background) have influenced the occurrence of security incidents.

Introduction

In my research I use two concepts: A Risk Reduction Process and Safety Leadership orientations.

In order to be able to conduct the review of existing incident analyses in a structured way, some understanding of these two concepts is required. In the section 'References' (on the next page) I explain these terms. If you think more explanation is needed, I will be happy to provide that.

My request

My request to you is to consider in more detail the role and behaviour of leaders who directly or indirectly influenced the origin of an incident you have investigated.

I have sent an example commentary for this purpose.

I am making this request to 15 experts/incident investigators. In order to be able to meaningfully analyse all reviews, as much uniformity as possible in the data is required. To this end I have also sent a template. In it you can post your commentary on the incident you selected. This makes it a fill-in-the-blank exercise, which also saves you time. In a pilot, conducted among three colleagues, it appeared that this fill-in exercise takes about an hour. I am very grateful to you for taking that time for me.

Criteria

You write your comment independently; I am not allowed to get involved in personal bias.

Select an incident with at least the following (potential) consequence: death or permanent disability, or major economic/production loss, or serious environmental or reputation damage.

This incident must have really happened and must have happened in the Netherlands after 2000.

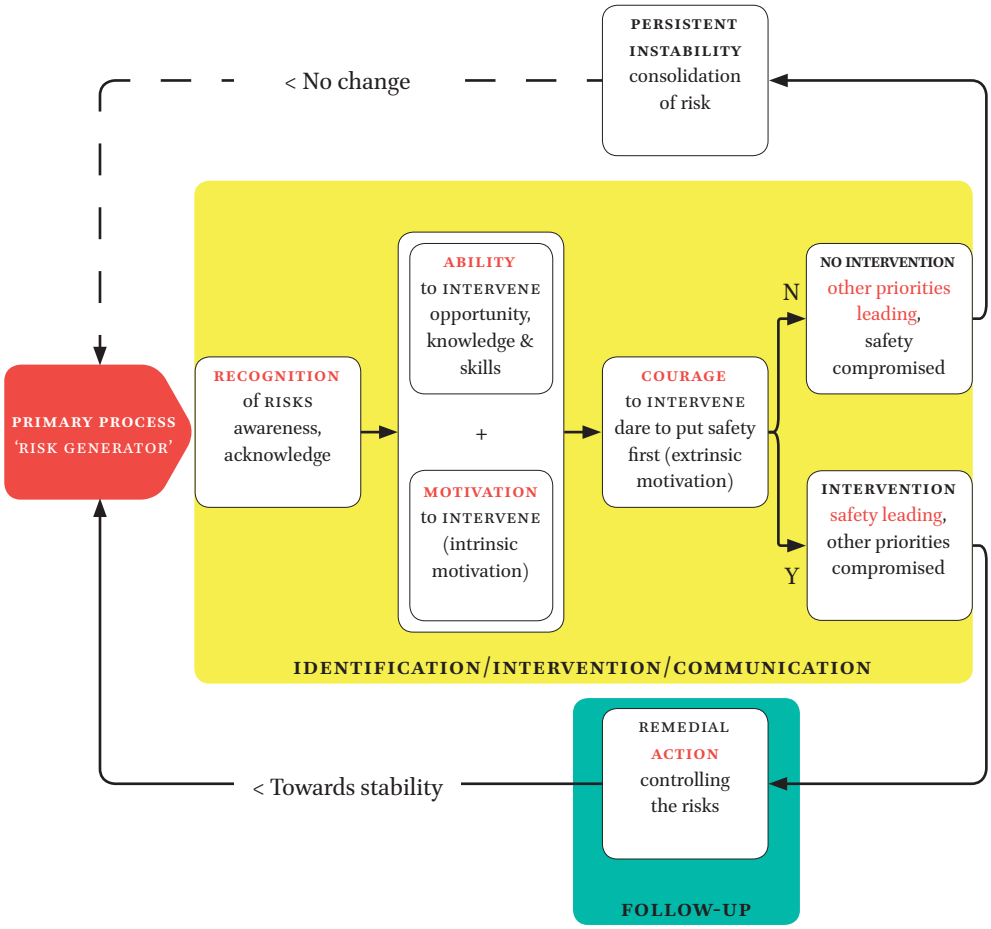
All information must be anonymised, so that the commentary cannot be traced back to people by outsiders.

As a guideline: The scenario of the incident does not have to be more than 1 A4 (half an A4 is even better).

References

The Risk Reduction Process

'Management of safety' means 'reducing risks.' The risk reduction process consists of 5 critical phases: Knowledge, Ability, Motivation, Courage and Doing. To illustrate that process, I use the model below.



If all 5 risk reduction phases are effective, the risks are optimally reduced.

- People recognize the risks (Recognition);
- People are able to intervene (Ability);
- People are motivated to intervene (Motivation);
- People dare to intervene by, for example, interrupting production (Courage);
- Risk-reducing measures are taken in time (Action).

If one or more risk reduction phase (s) does not function optimally, the following situations may arise:

– People do not recognize the risks;
– People are unable to intervene;
– They do not want to intervene;
– People do not dare to intervene;
– Measures are not taken on time.

If that is the case, the basis for incidents has been laid.

Safety Leadership orientations

Leaders (supervisors, managers, etc.) can, on the basis of their role/function in an organisation, have a positive or negative influence on the effectiveness of the above risk reduction phases.

People, including leaders, have personal preferences when it comes to their behaviour. We call these 'orientations.' In this research I limit myself to the following three orientations:

1. Task (The leader mainly focuses on completing the work);
2. Relation (The leader mainly focuses on stimulating good mutual relationships);
3. Self (The leader is mainly self-centred; he thinks highly of himself).

Everyone has something (or more) of all three orientations. The degree to which these orientations are present in us affects how we behave.

In my research I try to determine to what extent the behaviour of leaders has a negative influence on the effectiveness of the risk reduction process. In other words: To what extent does the behaviour of leaders determine the risk of incidents?

Incident review template

Description of the incident

A. Scenario (What happened?)
…… (your text here)

B. What was the (potential) effect (damage/injury)?
…… (your text here)

C. What was the situational context of this incident?
…… (your text here)

D. What underlying causes were there?
…… (your text here)

Matrix for influence of leaders on the risk reduction process

Safety is risk reduction. Disruption of the risk reduction process increases the risk of incidents.

A. Which leaders negatively impacted the risk reduction process that triggered the incident?
B. Indicate for these leaders to what extent they had a negative influence on the effectiveness of the risk reduction phases (Know, Can, Want, Dare, Do).

Explanation: Several choices are possible for each person in terms of risk reduction phase AND degree of influence.

Possible scores per phase: 0 (no negative influence), 1 (very little), 2 (little), 3 (quite), 4 (much), 5 (very much)

N.B. A high score (e.g., 5) therefore means that that person had a very significant negative influence on the effectiveness of the specific risk reduction phase, which increased the chance of incidents. A low score (e.g., 1) means that that person had very little negative impact on that particular phase.

(The grey rows are examples)

Which leader? ↓	RECOGNITION Recognition and understanding	ABILITY Knowledge, skills, and opportunities to intervene	MOTIVATION Internal motivation to intervene	COURAGE Courageous enough to intervene(e.g. by interrupting production)	ACTION Implementation of risk reducing measures
Leader A. (position)	5				3
Leader B. (position)		3		1	5
1. …					
2. …					
3. …					
4. …					
5. …					

Matrix for personal orientations in the behaviour of the leader(s)

Indicate how the leaders, you mentioned in 2, generally behave:

– Task (The leader is focused on completing the work);
– Relation (The leader is aimed at stimulating good mutual relationships);
– Self (The leader is self-centred; he thinks highly of himself).

Explanation: Every person has some of all three orientations (Task, Relation, Self); this is about the degree to which the leaders show the different orientations in their behaviour.

Possible scores per leader: 0 (none), 1 (very little), 2 (little), 3 (quite), 4 (a great deal), 5 (very much)

(Grey lines are examples)

	TASK-oriented	RELATION-oriented	SELF-oriented
Leader A. (position)	3	1	2
Leader B. (position)	1	3	2
1.			
2.			
3. ...			
4. ...			
5. ...			

15.3 Survey questionnaire used in pilot survey

This questionnaire is processed anonymously and we cannot link the information you provide to your person.
Do you give permission to use the information you provide anonymously for scientific research?

- O Yes
- O No In case this is the answer, the session is aborted.

1 **To what extent do the following situations contribute to the occurrence of accidents?**

	(Almost) never	Sometimes	Often	(Almost) always	Don't know
The risks are not known/seen in the workplace	O	O	O	O	O
People are unable to solve the risks in the workplace	O	O	O	O	O
There is a lack of motivation in the workplace to intervene	O	O	O	O	O
The risks are known, but nobody dares to intervene	O	O	O	O	O
Known risks are not always resolved or are resolved much too late	O	O	O	O	O

2 **Who are in the best position to resolve these situations?**

	Board of directors	Management	Local supervision*	Operational staff	Don't know
The risks are not known/seen in the workplace	O	O	O	O	O
People are unable to solve the risks in the workplace	O	O	O	O	O
There is a lack of motivation in the workplace to intervene	O	O	O	O	O
The risks are known, but nobody dares to intervene	O	O	O	O	O
Known risks are not always resolved or are resolved much too late	O	O	O	O	O

* examples of local leadership are: team leader/foreman/workshop foreman/guard chief/trade manager/etc.

3 **Your direct supervisor is:**

- O The director
- O A manager
- O a local leader: e.g., team leader/foreman/workshop foreman/guard chief/trade manager/etc.

4 **Your direct supervisor is:**

- O Man
- O Woman

5 **Consider the manager from the previous question and make your assessment below about his/her behavior**

	(Almost) never	Sometimes	Often	(Almost) always
Listens well	O	O	O	O
Supports and encourages	O	O	O	O
Ensures (maintenance of) a good atmosphere	O	O	O	O
Let employees participate in the discussion and decision-making	O	O	O	O
Encourages active participation from all team members	O	O	O	O
Sometimes comes across as hostile	O	O	O	O
Avoids involvement	O	O	O	O
Is predominant	O	O	O	O
Abusing the good will of others	O	O	O	O
Makes good appearance with the work of others	O	O	O	O
Comes up with ideas and stimulates renewal/innovation	O	O	O	O
Is interested in ideas of employees and deals with them positively	O	O	O	O
Ensures that employees can perform their duties properly	O	O	O	O
Ensures that employees receive the correct information in a timely manner	O	O	O	O
Encourages employees to take joint decisions where possible	O	O	O	O
Is enthusiastic, can get people moving	O	O	O	O
Is honest and sincere	O	O	O	O
Is attentive and gives compliments where appropriate	O	O	O	O
Attaches to status, considers his/her own position in the organization important	O	O	O	O
Trying to give employees what they need	O	O	O	O
Is compassionate, helps where possible	O	O	O	O
Shows understanding if someone, out of prudence, has unnecessarily disrupted production	O	O	O	O
Sometimes overlooks something; is flexible with rules and procedures	O	O	O	O
Radiates confidence	O	O	O	O
Dares to make decisions based on his/her intuition	O	O	O	O
Is individualistic, goes his/her own way	O	O	O	O
has guts; does what he/she deems right, even if procedures prescribe otherwise	O	O	O	O
is patient	O	O	O	O
Is knowledgeable and understands what his/her employees are doing	O	O	O	O
Dares to make decisions	O	O	O	O
Is result-oriented; everything has to give way to meeting deadlines	O	O	O	O
Motivates employees to intervene themselves in case of safety risks	O	O	O	O
Stimulates knowledge development among employees	O	O	O	O
Ensures that necessary improvement measures are implemented	O	O	O	O
Does not compromise on safety; 'safety first!'	O	O	O	O

6 **How long have you been working in this industry?**

- O Less than 5 years
- O 5-10 years
- O 10-15 years
- O Over 15 years

9 **How long have you been working in your current position?**

- O Less than 5 years
- O 5-10 years
- O 10-15 years
- O Over 15 years

7 Your position:
Select one of the following options:

- O Operational staff
- O Local supervisor
- O Support staff
- O Manager
- O Director

10. You are a:

- O Man
- O Woman

8 Have you ever experienced a serious accident at close quarters, at work or outside it?

- O Yes
- O No

11 Your age:

- O Younger than 25
- O 25-35
- O 35-45
- O 45- 55
- O Over 55

15.4 Correlational effect size benchmarks (Bosco et al.)

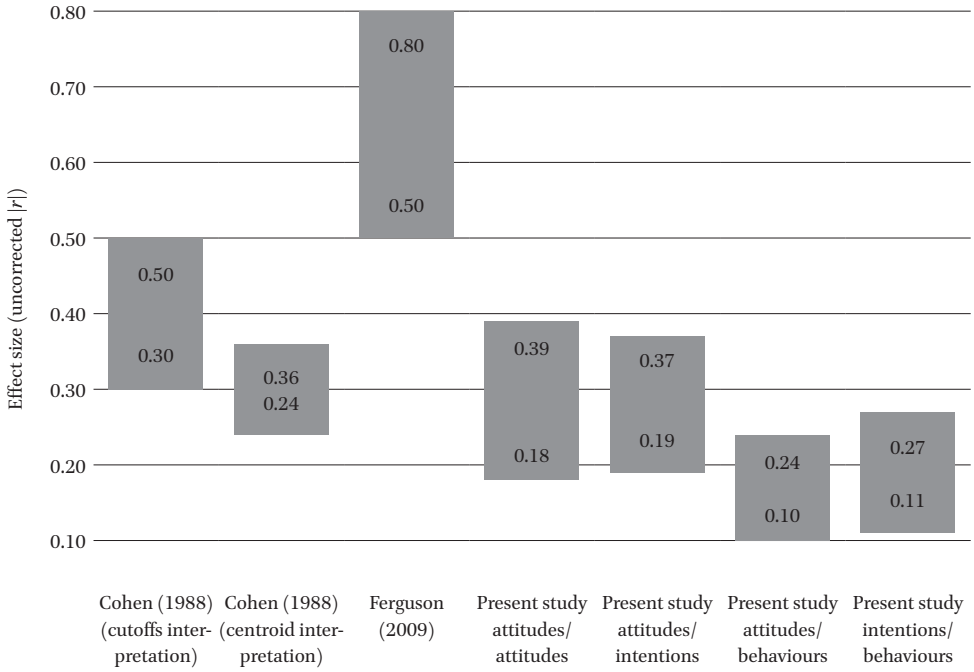


TABLE 21 Correlational effect size benchmarks

15.5 Online prospective survey questionnaire

Welcome to this study of the relationship between leadership and security.

By answering the questions below, you make an important contribution to this research.

Your answers are processed ANONYMOUSLY, so no one can see who gave which answers. It takes about 8 minutes to answer the questions.

We thank you in advance for your participation.

NOTE: This survey is also part of a research at Leiden University.

Do you give permission to use the results of this survey for scientific research?

1 YES, I give permission to use my answers anonymously for scientific research.
2 NO, I do not consent to my answers being used for scientific research. (This choice will automatically end the survey.)

Q3 Thank you for your willingness to participate in this study!

Click on 'Next' for the first questions.

Q4 In which sector do you work?

☐ Tank storage
☐ Hospitals
☐ Railway sector
☐ Mineral extraction (Oil and gas, salt)
☐ Process industry/chemistry
☐ Transport
☐ Maintenance/maintenance
☐ Construction industry
☐ Industry in general
☐ Other, namely .... (Please fill in your sector below.)_____

Q5 What is your age?

Q6 How many years have you been working in this industry/sector? (if less than 1 year, please enter 0)

Q7 What is your current position in this organisation?

☐ Executive/production employee
☐ Manager (team leader/foreman/chief/head/supervisor/supervisor/specialist/etc.)
☐ Advisory staff member
☐ Manager
☐ Director

Q8 How many years have you worked in your current position? (if less than 1 year, please enter 0)

Q9 Have you ever experienced a serious accident up close, at work or elsewhere?
(Note: the term 'serious' is not further defined here: If you considered an accident to be 'serious', this is sufficient reason to answer this question with YES.)
☐ YES, as a victim
☐ YES, indirectly (e.g., as a witness, helper, friend, family, etc.)
☐ NO

Q10 Have you ever interrupted or delayed production for safety reasons?
☐ Yes, I have interrupted production once
☐ Yes, I have slowed down production sometimes
☐ No, I have never done this

Q11 A few situations are described below. Indicate whether these situations are actually the case for you:

	Strongly disagree	**Disagree**	**Slightly disagree**	**Neutral**	**Slightly agree**	**Agree**	**Strongly disagree**	**Don't Know**
In the workplace, people are aware of the local safety risks	○	○	○	○	○	○	○	○
In the workplace, people are able to solve those safety risks	○	○	○	○	○	○	○	○
In the workplace, people are motivated to solve safety risks	○	○	○	○	○	○	○	○
On the work floor, people dare to intervene themselves to solve safety risks	○	○	○	○	○	○	○	○
Known safety risks are resolved in a timely manner	○	○	○	○	○	○	○	○

Q12 A few situations are described below. Indicate for each situation who do you think can best solve that situation? (several people possible)

	Board	Management	Supervisors	Operational staff	Don't know
In the workplace people are insufficiently aware / aware of the safety risks	○	○	○	○	○
People in the workplace are insufficiently able to solve safety risks	○	○	○	○	○
People in the work-place are insufficiently motivated to solve safety risks	○	○	○	○	○
The safety risks are known, but people do not dare to intervene themselves in the workplace	○	○	○	○	○
Known safety risks are not resolved or are resolved too late.	○	○	○	○	○

Q13 Your immediate supervisor is:

☐ The director
☐ A manager
☐ A supervisor (team leader/foreman/chief/head/supervisor/supervisor/manager/etc.)
☐ I do not have a supervisor

Q14 Your immediate supervisor is:
☐ Man
☐ Woman

Q15 Take your immediate supervisor (from the previous question) in mind and give an impression of his/her behaviour below.
Your immediate supervisor...

	Strongly disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Strongly disagree	Don't Know
... is a good listener	○	○	○	○	○	○	○	○
... supports and encourages	○	○	○	○	○	○	○	○
... ensures (maintenance of) a good atmosphere	○	○	○	○	○	○	○	○
... let employees participate in the discussion and decision- making process	○	○	○	○	○	○	○	○
... encourages active participation of all team members	○	○	○	○	○	○	○	○
... sometimes comes across as hostile	○	○	○	○	○	○	○	○
... avoids involvement	○	○	○	○	○	○	○	○
... is predominant	○	○	○	○	○	○	○	○
... takes advantage of the goodwill of others	○	○	○	○	○	○	○	○
... makes a good impression with the work of others	○	○	○	○	○	○	○	○
... comes up with ideas and stimulates renewal and innovation	○	○	○	○	○	○	○	○
... is interested in ideas from employees and deals with them positively	○	○	○	○	○	○	○	○

Q16 Your immediate supervisor...

	Strongly disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Strongly disagree	Don't Know
... ensures that employees can perform their tasks properly	○	○	○	○	○	○	○	○
.. arranges that employees receive information on time	○	○	○	○	○	○	○	○
... encourages employees to make joint decisions where possible	○	○	○	○	○	○	○	○
... is enthusiastic and can get people moving	○	○	○	○	○	○	○	○
... is honest and sincere	○	○	○	○	○	○	○	○
... is considerate and gives compliments where appropriate	○	○	○	○	○	○	○	○
... values status, considers his / her organisational position important	○	○	○	○	○	○	○	○
... tries to give employees what they need	○	○	○	○	○	○	○	○
... is compassionate, helps where possible	○	○	○	○	○	○	○	○
... shows understanding when, out of caution, someone has unnecessarily disrupted production	○	○	○	○	○	○	○	○
... sometimes overlooks something; handles rules and procedures flexibly	○	○	○	○	○	○	○	○
... radiates confidence	○	○	○	○	○	○	○	○

Q17 Your immediate supervisor...

	Strongly disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Strongly disagree	Don't Know
... dares to make decisions based on intuition	○	○	○	○	○	○	○	○
... is individualistic, goes his/her own way	○	○	○	○	○	○	○	○
... has guts, does what he / she considers right, even when procedures prescribe otherwise	○	○	○	○	○	○	○	○
...is patient	○	○	○	○	○	○	○	○
... is knowledgeable, understands what employees are doing	○	○	○	○	○	○	○	○
... dares to make decisions	○	○	○	○	○	○	○	○
... is result oriented; everything has to make way for meeting deadlines	○	○	○	○	○	○	○	○
... motivates employees to intervene in case of safety risks	○	○	○	○	○	○	○	○
... stimulates knowledge development among employees	○	○	○	○	○	○	○	○
... ensures that necessary improvements are made	○	○	○	○	○	○	○	○
... gives safety priority: 'Safety First!'	○	○	○	○	○	○	○	○

Q18 Disruptions in the primary/production process of your I can in the worst-case lead to:

☐ an accident with several fatalities, serious material or environmental damage and reputation damage.
☐ an accident with a fatal outcome or serious material or environmental damage.
☐ an accident resulting in hospitalization.
☐ an accident that leads to an employee's absence.
☐ an accident with minor injury or little material or environmental damage
☐ an incident without injury or material or environmental damage.
☐ I have no idea.

Q19 Have you been taught in any education/training to recognize safety risks?
☐ Yes
☐ No.

Q20 In which training did you learn to recognize safety risks?
☐ Professional training
☐ VCA
☐ Other, namely _____

Q21 In which department/business unit/division/etc. do you work?
☐ To be completed later, e.g., Location A, Terminal B, Factory C, Department D
☐ Other, namely _____

Q22 To what extent do you agree with the following statements:

	Strongly disagree	**Disagree**	**Slightly disagree**	**Neutral**	**Slightly agree**	**Agree**	**Strongly disagree**	**Don't Know**
I feel safe in my organisation.	○	○	○	○	○	○	○	○
There is a real risk of an accident within my organisation.	○	○	○	○	○	○	○	○
In the field of safety, a great deal has gone wrong within my organisation in the past year.	○	○	○	○	○	○	○	○

15.6 General mean scores

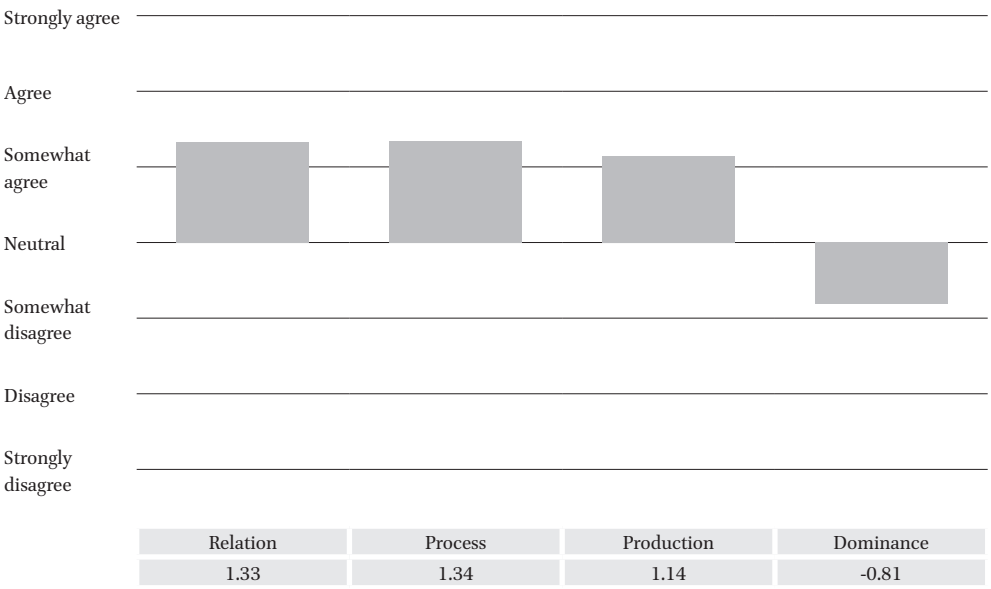
In Chapter 8 we presented the outcomes of the online prospective survey in terms of mean scores. This appendix shows the statistical information underlying the presented outcomes.

15.6.1 *Safety Leadership orientations*

15.6.1.1 General means for Safety Leadership orientations

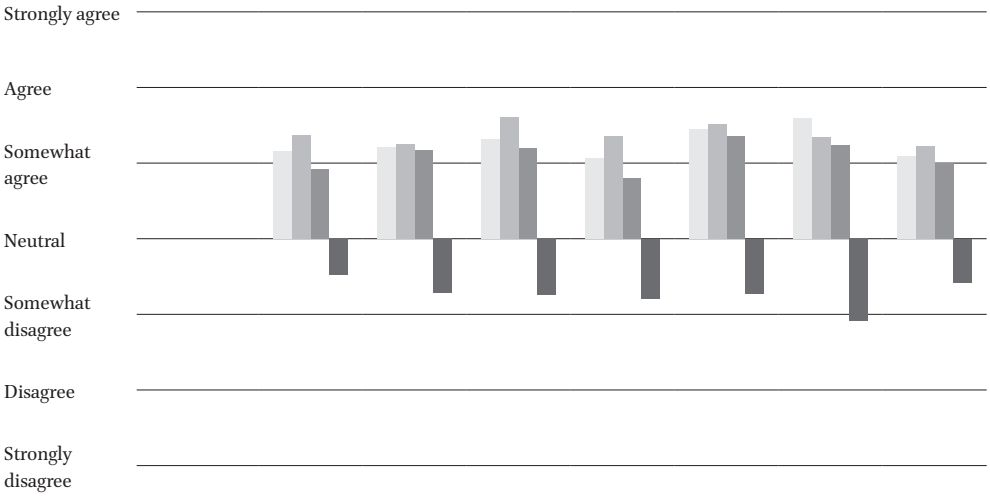
SAFETY LEADERSHIP	Relation	Process	Production	Dominance
Valid	3332	3319	3316	3332
Missing	0	13	16	0
Mean	1.3276	1.3437	1.1370	-0.8121
Std. Deviation	1.19064	1.07288	1.22041	1.13131

TABLE 22 Safety Leadership orientations as reported by general employees



BAR CHART 12 General Safety Leadership profile of all employees

15.6.1.2 Safety Leadership orientations per business sector



		Tank storage (n=185)	Hospitals (n=767)	Process industry (n=128)	Oil & gas (n=414)	Infra general (n=454)	Rail infra (n=1010)	Other (n=374)
	Relation	1.1547	1.2145	1.3169	1.0633	1.4464	1.5910	1.0852
	Process	1.3689	1.2523	1.6087	1.3533	1.5155	1.3360	1.2286
	Production	0.9189	1.1724	1.2031	0.7962	1.3511	1.2350	1.0032
	Dominance	-0.4824	-0.7198	-0.7470	-0.7877	-0.7264	-1.0857	-0.5786

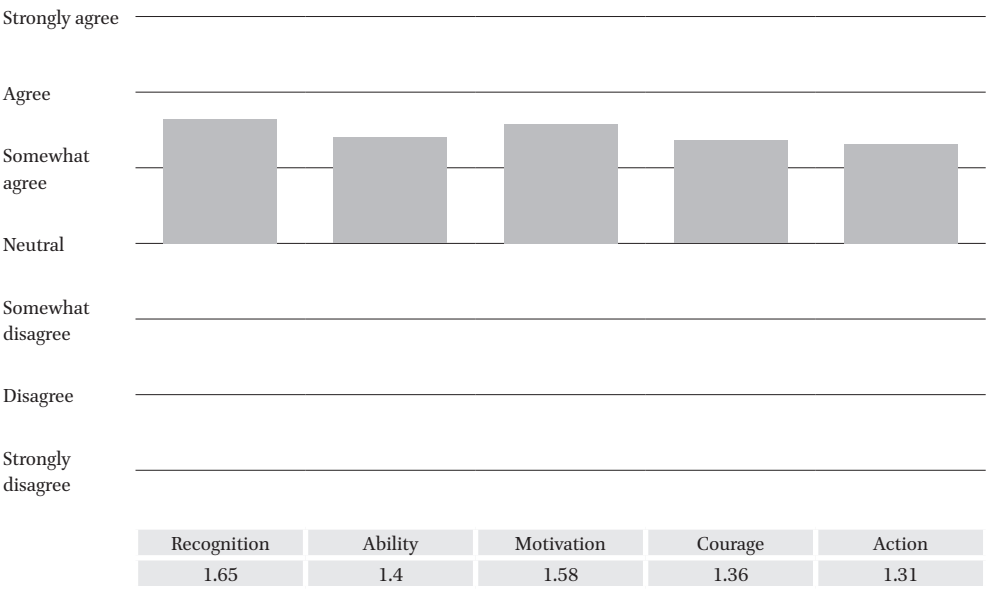
BAR CHART 13 Safety Leadership per business sector

15.6.2 *Risk Reduction Capacity*

15.6.2.1 General means for Risk Reduction Capacity

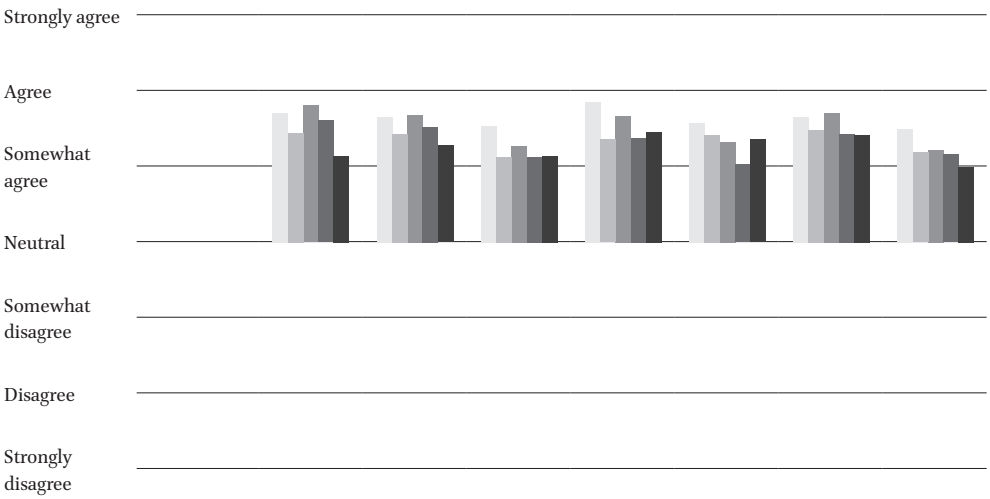
RISK REDUCTION CAPACITY	Recognition	Ability	Motivation	Courage	Action
Valid	3322	3320	3310	3297	3291
Missing	10	12	22	35	41
Mean	1.6508	1.4000	1.5782	1.3588	1.3102
St. Deviation	1.28842	1.27988	1.31422	1.41341	1.45053

TABLE 23 Risk Reduction Capacity as reported by general employees



BAR CHART 14 Risk Reduction Capacity as reported by all employees

15.6.2.2 Risk Reduction Capacity per business sector



	Tank storage (n=185)	Hospitals (n=766)	Process industry (n=127)	Oil & gas (n=414)	Infra general (n=453)	Rail infra (n=1005)	Other (n=373)
Recognition	1.70	1.66	1.54	1.86	1.58	1.65	1.50
Ability	1.45	1.43	1.13	1.36	1.42	1.49	1.19
Motivation	1.81	1.68	1.27	1.67	1.33	1.71	1.22
Courage	1.61	1.53	1.13	1.38	1.03	1.43	1.16
Action	1.14	1.28	1.14	1.46	1.36	1.42	1.00

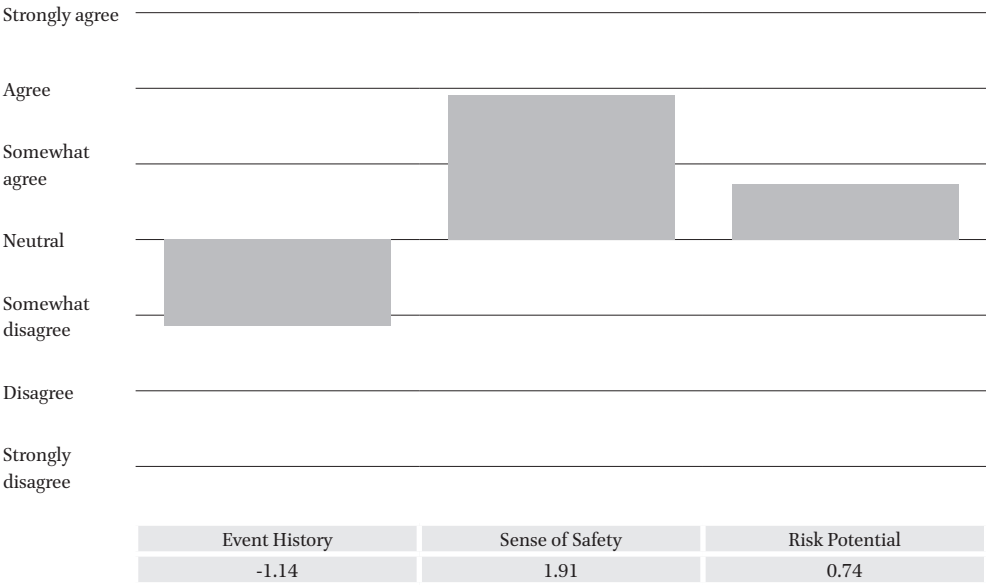
BAR CHART 15 Risk Reduction Capacity per business sector

15.6.3 *Safety*

15.6.3.1 General means for Safety

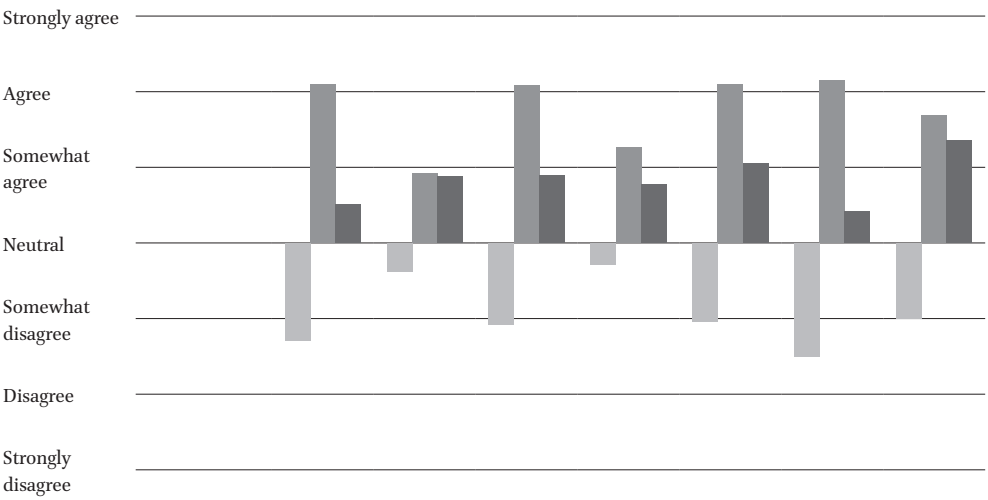
Result	Event History	Sense of Safety	Risk Potential
Valid	1906	2005	1991
Missing	1426	1327	1341
Mean	-1.1443	1.9102	0.7373
Std. Deviation	1.50995	1.24732	1.75591

TABLE 24 Safety as reported by general employees



BAR CHART 16 General safety as reported by general employees

15.6.3.2 Safety per business sector



	Tank storage (n=98)	Hospitals (n=211)	Process industry (n=48)	Oil & gas (n=96)	Infra general (n=436)	Rail infra (n=901)	Other (n=215)
Event History	-1.29	-0.38	-1.08	-0.29	-1.04	-1.50	-1.00
Sense of Safety	2.10	0.92	2.08	1.26	2.09	2.15	1.68
Risk Potential	0.51	0.88	0.89	0.78	1.06	0.42	1.35

BAR CHART 17 Safety per business sector

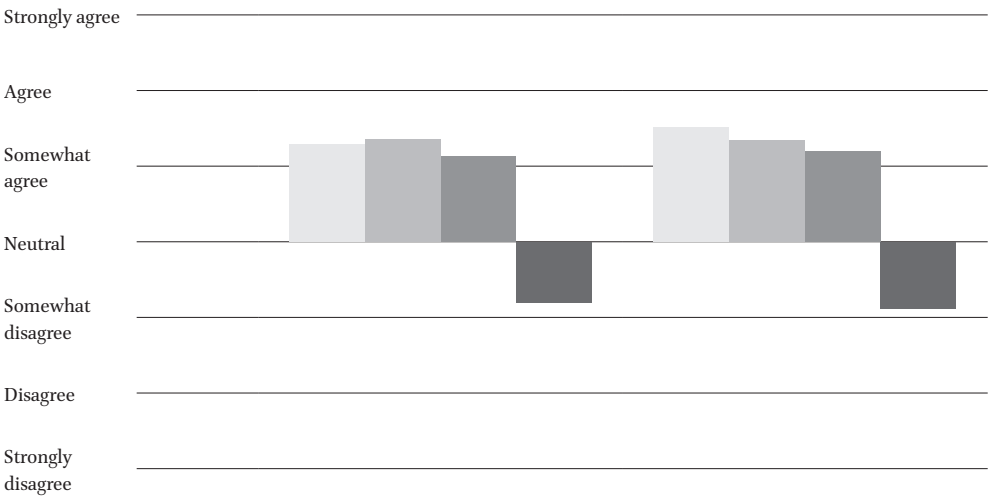
15.7 Mean scores for additional moderator variables

15.7.1 *Mean scores by direct supervisors' genders*

	Frequency	Percent
Male	2578	77,4
Female	720	21.6
Total	3298	99.0
Missing	34	1.0
Total	3332	100.0

TABLE 25 Genders of respondents' direct supervisors

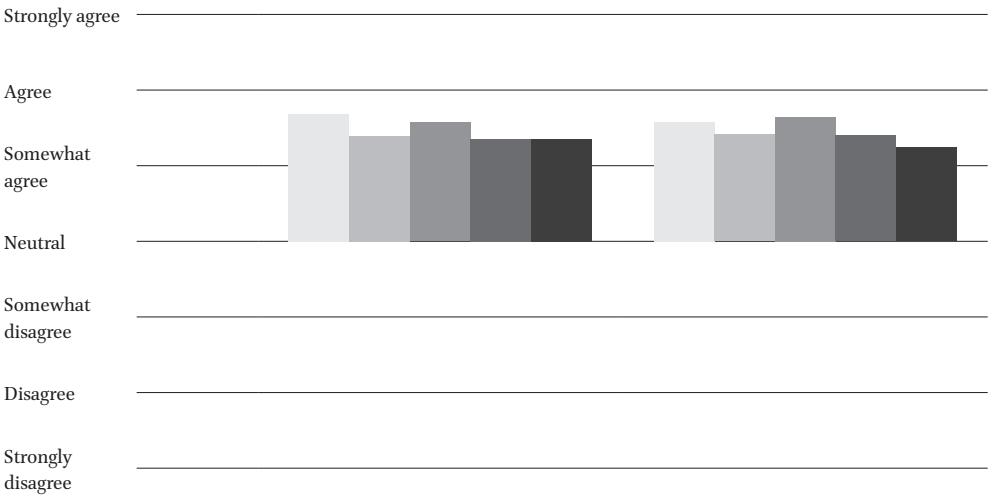
15.7.1.1 Safety Leadership orientations by gender of direct supervisors



		Men (n=2578)	Women (n=720)
	Relation	1.29	1.51
	Process	1.36	1.34
	Production	1.13	1.20
	Dominance	-0.80	-0.88

BAR CHART 18 Safety Leadership by gender of direct supervisors

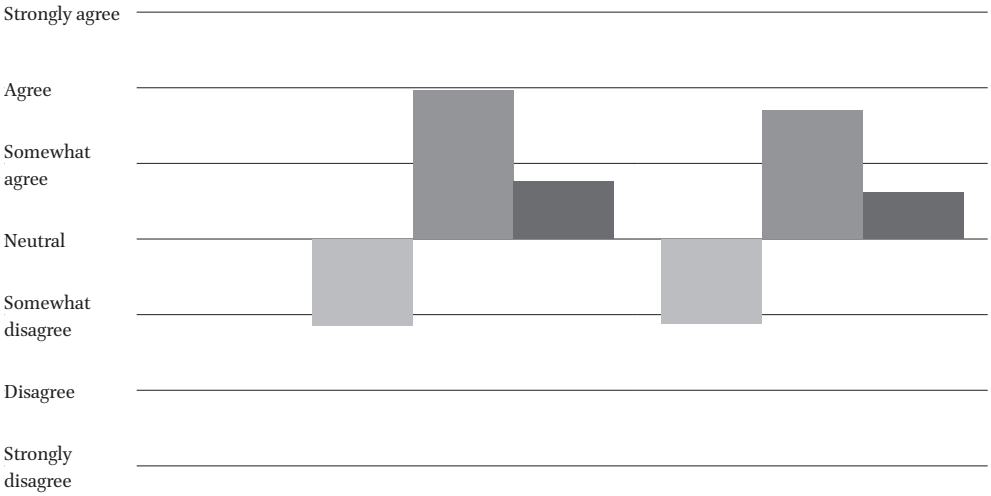
15.7.1.2 Risk Reduction Capacity by gender of direct supervisors



	Men (n=2578)	Women (n=719)
Recognition	1.68	1.58
Ability	1.39	1.41
Motivation	1.57	1.64
Courage	1.35	1.40
Action	1.35	1.24

BAR CHART 19 Risk Reduction Capacity by gender of direct supervisors

15.7.1.3 Safety by gender of direct supervisors



	Men (n=1640)	Women (n=364)
Event History	-1.15	-1.12
Sense of Safety	1.96	1.70
Risk Potential	0.76	0.62

BAR CHART 20 Safety by gender of direct supervisors

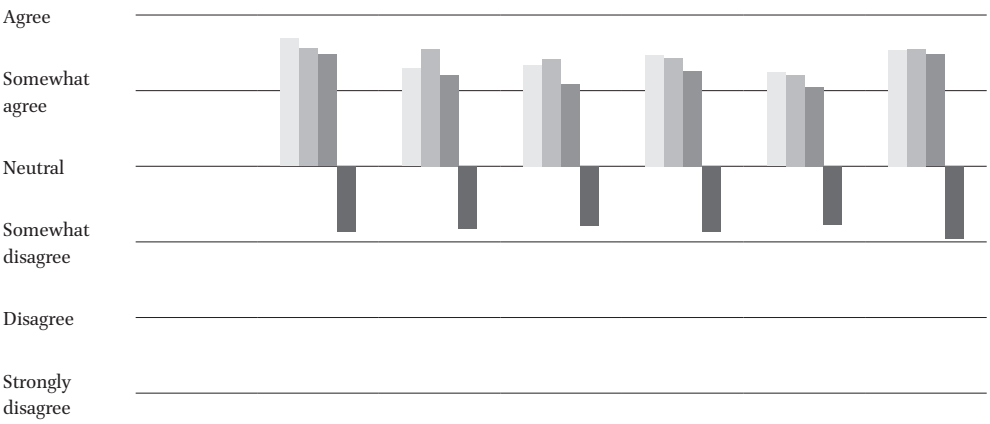
15.7.2 *Mean scores by hierarchical position*

Distribution of hierarchical positions

	Frequency	Percent
Director/Board	41	1.2
Management	340	10.2
Supervisor	657	19.7
Support staff	559	16.8
Operational staff	1539	46.2
Senior staff	181	5.4
Subtotal	3317	99.5
Missing	15	0.5
Total	3332	100.0

TABLE 26 Hierarchical positions of respondents

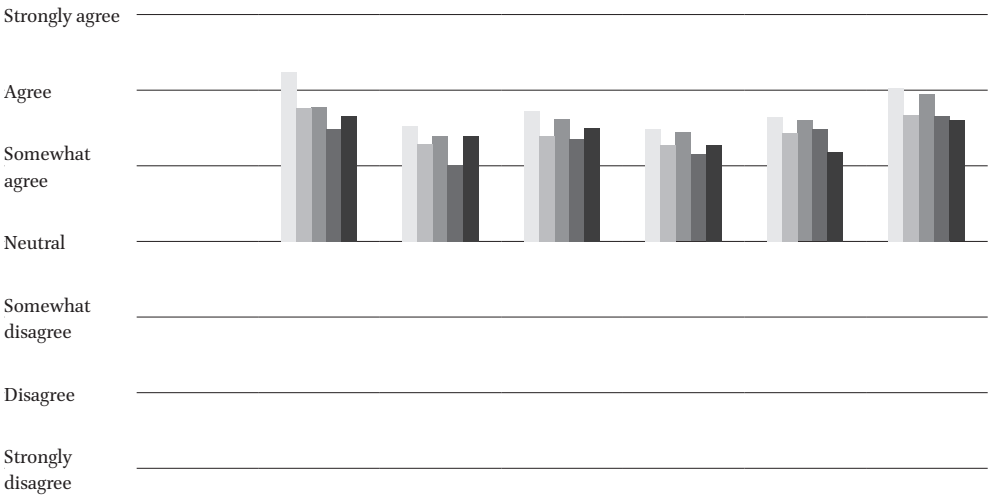
15.7.2.1 Safety Leadership by hierarchical positions



		Director (n=41)	Manage-ment (n=340)	Supervisors (n=657)	Support staff (n=559)	Operational staff (n=1539)	Senior staff (n=181)
	Relation	1.69	1.29	1.34	1.47	1.24	1.54
	Process	1.56	1.55	1.42	1.43	1.21	1.55
	Production	1.48	1.21	1.09	1.26	1.05	1.48
	Dominance	-0.87	-0.82	-0.79	-0.87	-0.78	-0.96

BAR CHART 21 Safety Leadership by hierarchical positions

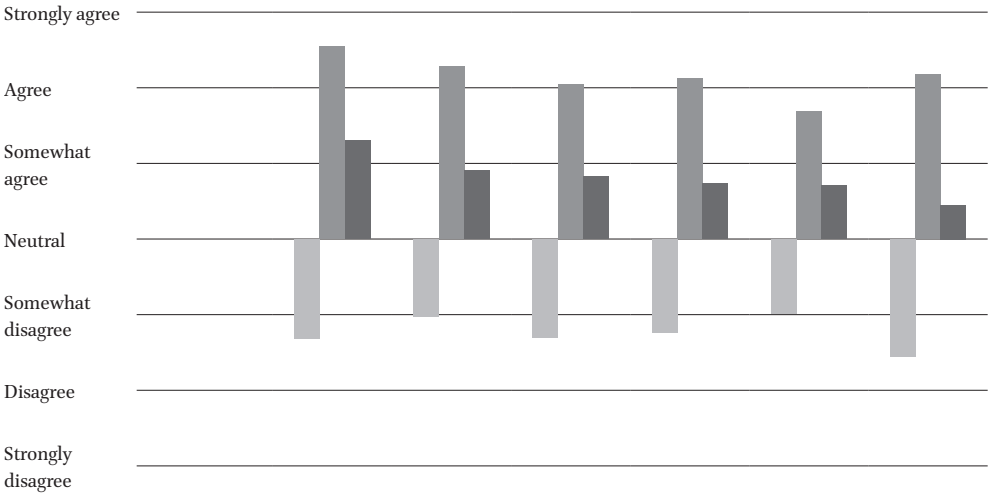
15.7.2.2 Risk Reduction Capacity by hierarchical positions



	Director (n=41)	Manage-ment (n=340)	Supervisors (n=657)	Support staff (n=557)	Operational staff (n=1535)	Senior staff (n=181)
Recognition	2.24	1.53	1.72	1.49	1.64	2.03
Ability	1.76	1.29	1.39	1.28	1.43	1.67
Motivation	1.78	1.39	1.62	1.44	1.60	1.95
Courage	1.49	1.01	1.35	1.15	1.48	1.66
Action	1.66	1.39	1.50	1.27	1.18	1.60

BAR CHART 22 Risk Reduction Capacity by hierarchical positions

15.7.2.3 Safety by hierarchical positions

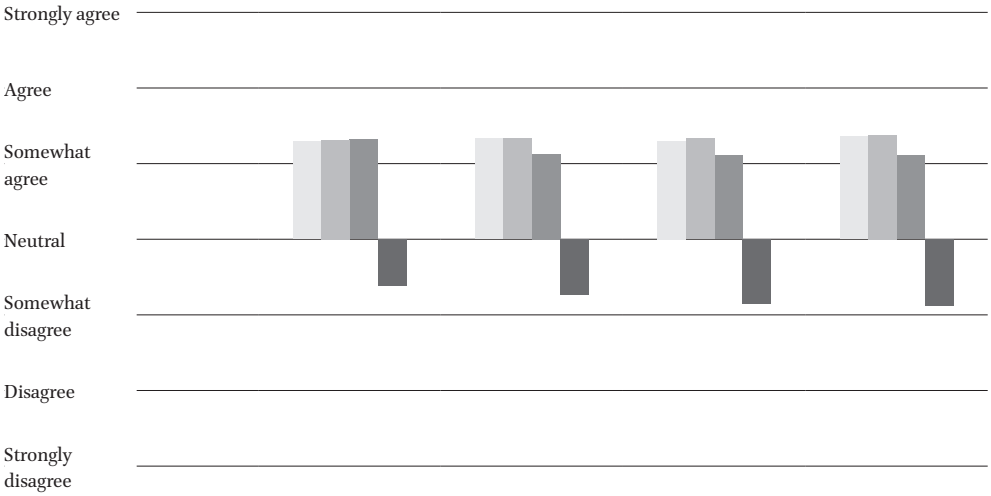


	Director (n=20)	Manage-ment (n=148)	Supervisors (n=366)	Support staff (n=325)	Operational staff (n=962)	Senior staff (n=179)
Event History	-1.32	-1.02	-1.30	-1.23	-0.99	-1.55
Sense of Safety	2.55	2.28	2.04	2.12	1.68	2.17
Risk Potential	1.30	0.91	0.83	0.73	0.71	0.45

BAR CHART 23 Safety by hierarchical positions

15.7.3 *Mean scores by age*

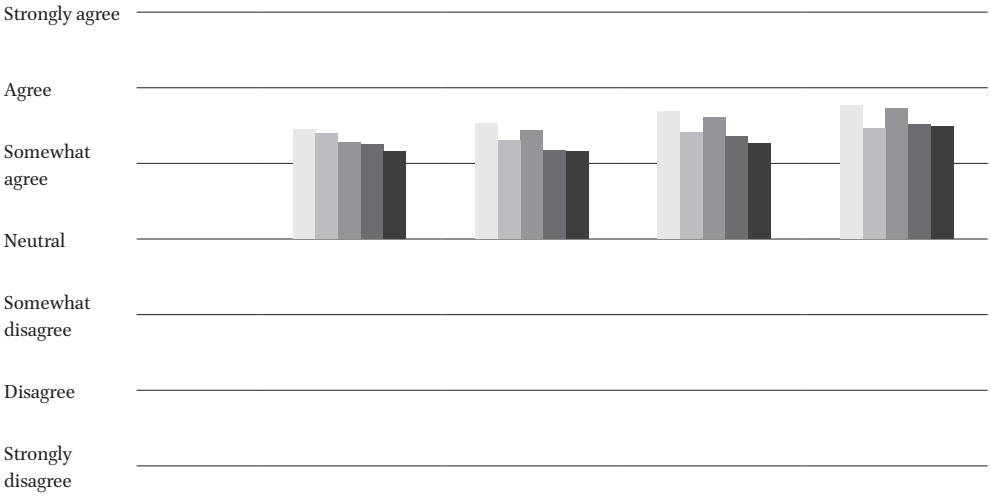
15.7.3.1 Safety Leadership by age



	Age < 31 (n=352)	Age 31–40 (n=737)	Age 41–50 (n=1001)	Age 51–67 (n=1229)
Relation	1.29	1.33	1.30	1.36
Process	1.31	1.33	1.33	1.38
Production	1.32	1.13	1.11	1.11
Dominance	-0.62	-0.74	-0.85	-0.88

BAR CHART 24 Safety Leadership by age

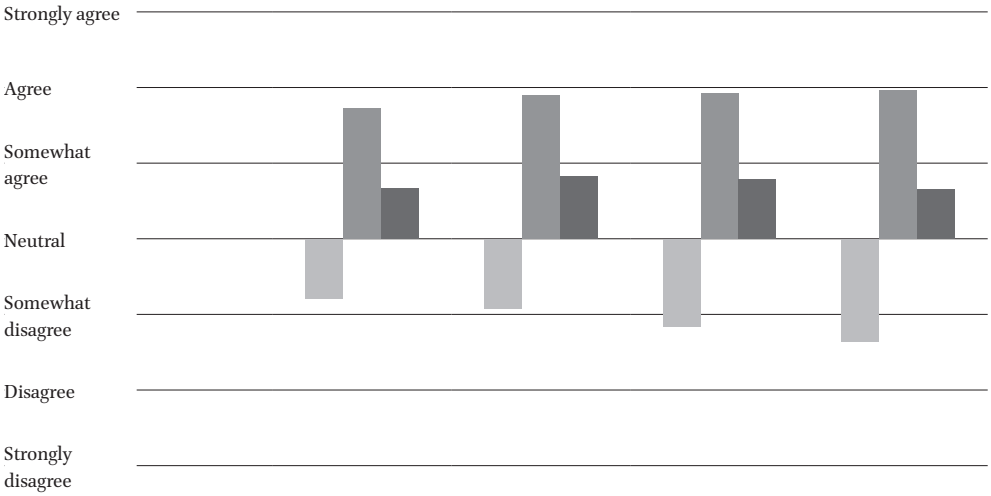
15.7.3.2 Risk Reduction Capacity by age



	Age < 31 (n=352)	Age 31–40 (n=735)	Age 41–50 (n=999)	Age 51–67 (n=1226)
Recognition	1.45	1.53	1.68	1.77
Ability	1.40	1.30	1.41	1.46
Motivation	1.27	1.44	1.61	1.73
Courage	1.25	1.17	1.36	1.51
Action	1.16	1.16	1.26	1.49

BAR CHART 25 Risk Reduction Capacity by age

15.7.3.3 Safety by age

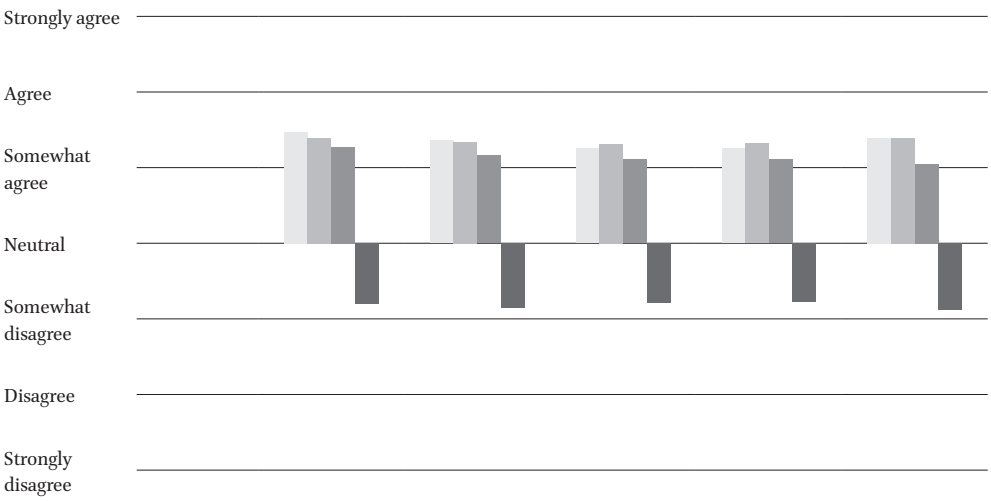


	Age < 31 (n=209)	Age 31–40 (n=439)	Age 41–50 (n=592)	Age 51–67 (n=756)
Event History	-0.79	-0.92	-1.16	-1.36
Sense of Safety	1.72	1.90	1.93	1.96
Risk Potential	0.67	0.82	0.79	0.66

BAR CHART 26 Safety by age

15.7.4 *Mean scores by vocational experience*

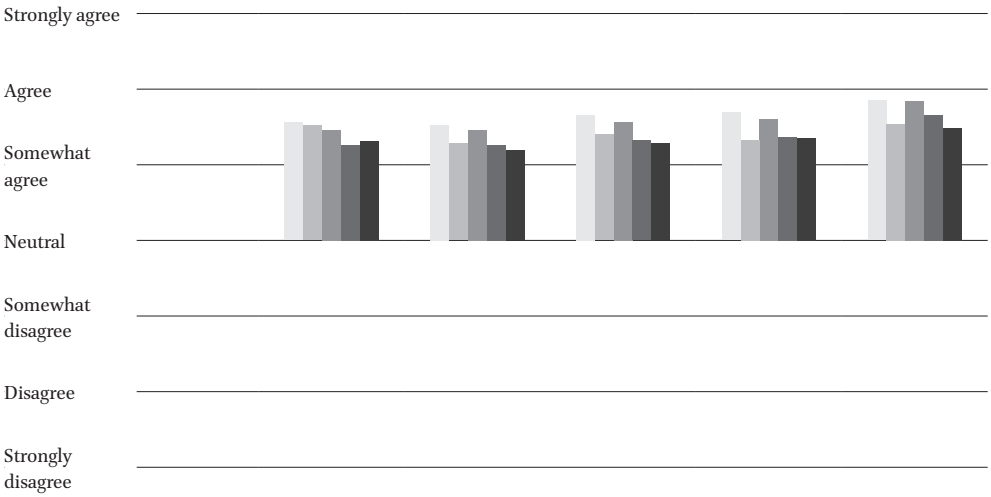
15.7.4.1 Safety Leadership by vocational experience



	0–5 years (n=546)	5–10 years (n=668)	11–20 years (n=883)	21–30 years (n=674)	31–50 years (n=548)
Relation	1.47	1.36	1.25	1.25	1.39
Process	1.39	1.34	1.31	1.32	1.39
Production	1.27	1.16	1.11	1.11	1.05
Dominance	-0.80	-0.85	-0.79	-0.78	-0.88

BAR CHART 27 Safety Leadership by vocational experience

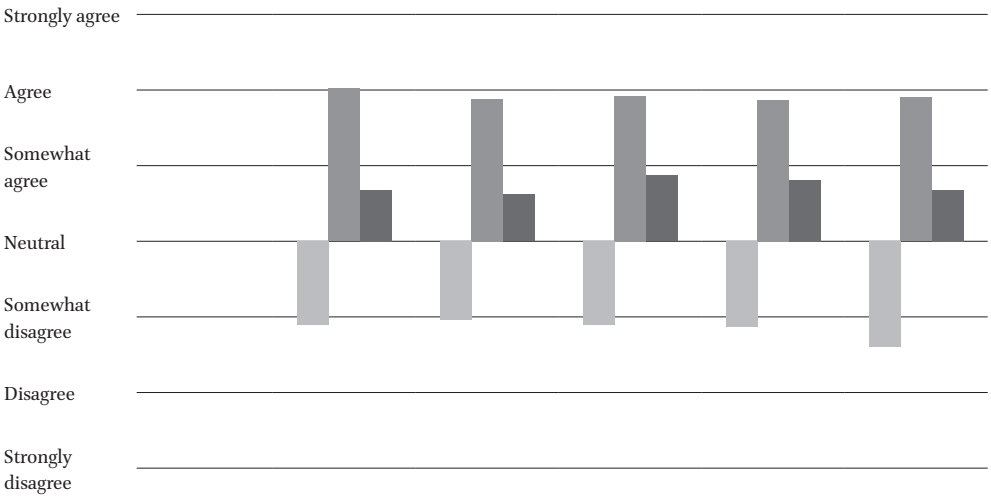
15.7.4.2 Risk Reduction Capacity by vocational experience



	0–5 years (n=545)	5–10 years (n=667)	11–20 years (n=880)	21–30 years (n=672)	31–50 years (n=547)
Recognition	1.56	1.53	1.66	1.69	1.85
Ability	1.52	1.28	1.40	1.33	1.54
Motivation	1.46	1.46	1.57	1.61	1.84
Courage	1.26	1.26	1.32	1.37	1.66
Action	1.31	1.19	1.28	1.35	1.49

BAR CHART 28 Risk Reduction Capacity by vocational experience

15.7.4.3 Safety by vocational experience

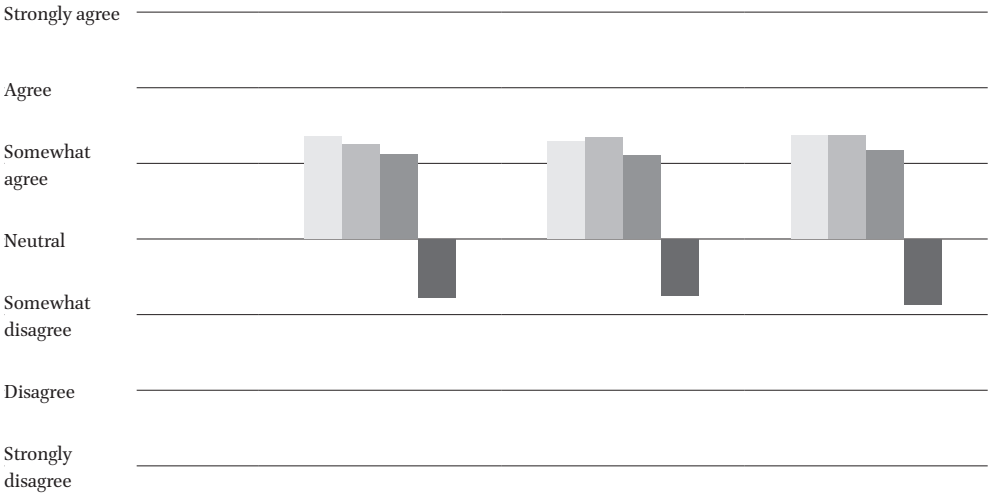


	0–5 years (n=324)	5–10 years (n=439)	11–20 years (n=492)	21–30 years (n=396)	31–50 years (n=348)
Event History	-1.11	-1.04	-1.11	-1.13	-1.39
Sense of Safety	2.02	1.88	1.92	1.87	1.90
Risk Potential	0.68	0.62	0.87	0.81	0.68

BAR CHART 29 Safety by vocational experience

15.7.5 *Mean scores by safety incident history*

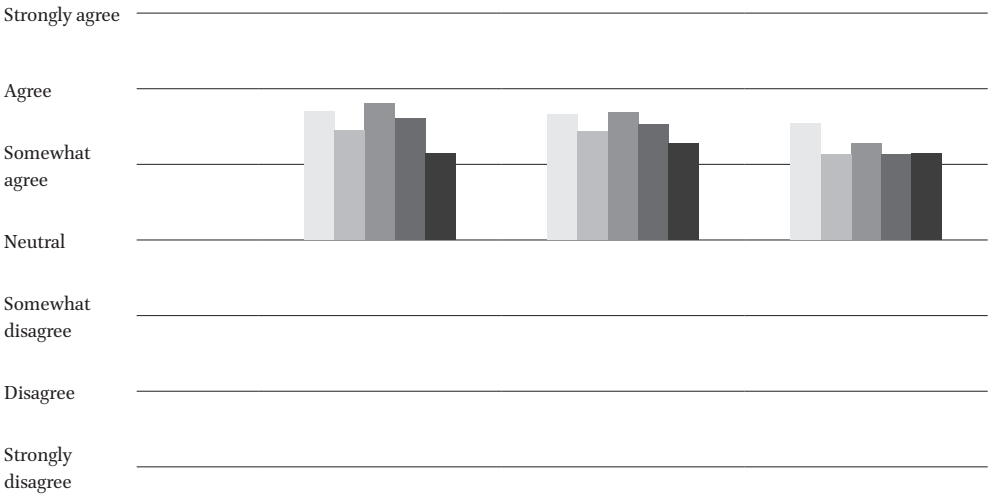
15.7.5.1 Safety Leadership by safety incident history



	Victim (n=233)	Witness (n=1293)	Neither (n=1772)
Relation	1.35	1.29	1.37
Process	1.25	1.34	1.37
Production	1.12	1.11	1.17
Dominance	-0.78	-0.75	-0.87

BAR CHART 30 Safety Leadership by safety incident history

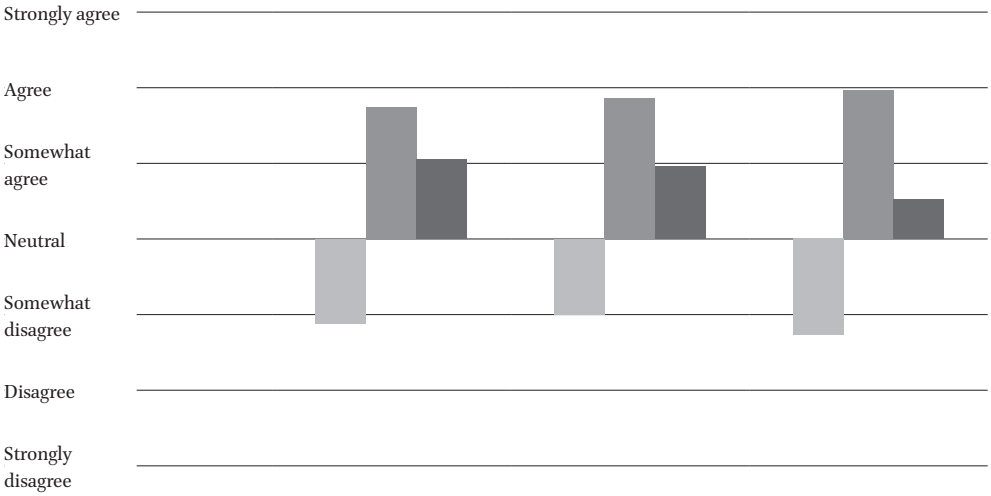
15.7.5.2 Risk Reduction Capacity by safety incident history



	Victim (n=232)	Witness (n=1292)	Neither (n=1767)
Recognition	1.70	1.66	1.54
Ability	1.45	1.43	1.13
Motivation	1.81	1.68	1.27
Courage	1.61	1.53	1.13
Action	1.14	1.28	1.14

BAR CHART 31 Risk Reduction Capacity by safety incident history

15.7.5.3 Safety by safety incident history



	Victim (n=140)	Witness (n=821)	Neither (n=1043)
Event History	-1.12	-1.00	-1.27
Sense of Safety	1.74	1.86	1.97
Risk Potential	1.05	0.96	0.52

BAR CHART 32 Safety by incident history

15.8 Conversation guide for reflection by senior leaders

Objective and method

Interviews with CEO/managing director, operational manager and safety manager.

To obtain the reflection by the interviewee about the results of questionnaire in terms of the Risk Reduction Cycle and Safety Leadership orientations as collected in his/her organisation.

Duration: Approx. 1 hour Location: Office of the interviewee

References

What is the response to the results of the survey with regard to the Risk Reduction Cycle and behavioural orientations of leaders?

Risk Reduction Cycle
- Understanding /Kennen
- Ability /Kunnen
- Motivation /Willen
- Courage /Durven
- Action /Doen

Safety Leadership orientations
- Task
- Relation
- Self

Results

Striking results?

What results are expected and what are unexpected?

Comments?

Follow up

What can/do you want with the results?

Own experience: Have you ever been directly/indirectly involved in a "calamity"?

Organisation code	**Date/time of interview:**					
Position of interviewee						
Number of years in sector						
Number of years in office						
Age	35–40	40–45	45–50	50–55	55–60	>60
M/F						

15.9 Effects of Safety Leadership on risk reduction phases

By application of Structural Equation Modelling (SEM), we identified the standardised regression coefficients of the effect of the four Safety Leadership orientations on risk reduction. The results of this analysis are shown in below Table 27.
The shaded cells indicate that there is no effect for these specific coordinates.

	Effects on Risk Reduction Phases				
	Recognition	**Ability**	**Motivation**	**Courage**	**Action**
Relation	-0.25				-0.26
Process	0.72	0.59	0.42	0.61	0.79
Production	-0.18	-0.17			-0.19
Dominance					

TABLE 27 Standardised regression coefficients of effects of Safety Leadership on Risk Reduction

15.10 Mediating effects of risk reduction phases on Safety.

By application of Structural Equation Modelling (SEM), we identified the standardised regression coefficients (or standardised loadings) of the effects of each individual risk reduction phase on the three characteristics of the Safety node of the Safety Leadership Model (Event History, Sense of Safety and Risk Potential). The referred results are presented in the table below (Table 28). All effects less than 0.10 are considered too weak to be considered and are ignored. The shaded cells contain the ignored effects.

	Event History	Sense of Safety	Risk Potential
Recognition	-0.16	0.14	-0.06
Ability	-0.16	0.14	-0.05
Motivation	-0.12	0.08	-0.05
Courage	-0.16	0.07	-0.07
Action	-0.18	0.16	-0.09

TABLE 28 Standardised regression coefficients of effects of risk reduction phases on Safety

15.11 Direct and indirect influences of Safety Leadership on Safety

	Indirect (mediated) effect															Direct effect		
	Recognition			Ability			Motivation			Courage			Action			Event History	Sense of Safety	Risk Potential
	E	S	R	E	S	R	E	S	R	E	S	R	E	S	R	E	S	R
Relation	.04	-.004											.05	-.04		.33 – .38		
Process	-.12	.10		-.09	.08		-.05	.03		-.09	.04	.04	-.14	.12	-.07	-.43 – -.52	.35 – .44	
Production	.03	-.03		.03	-.02								.03	-.03		.17 – .19		
Dominance																.37 – .38		.22 - .24

TABLE 29 Standardised regression coefficients of influences of Safety Leadership on Safety

LEGEND: E=Event History S=Sense of Safety R=Risk Potential
Green =noticeable effect
Grey =no significant effect
Blank =negligible effect

15.12 Sources versus Process-oriented Safety Leadership Principles

In this appendix we explain how the different sources (the behavioural characteristics of Process-oriented leaders, the Academic Safety Leadership Practices and the findings by Flin and Hale et al.) have been applied to develop the Process-oriented Safety Leadership Principles as presented in paragraph 11.2.2.3.

Below we show a numbered list of all Academic Safety Leadership Practices plus the findings by Flin and Hale et al. We used this list to develop a table showing which item served as source for each Process-oriented Safety Leadership Principle. This table is presented after the numbered list.

15.12.1 *List of source items* (*numbered*)

LEGEND OF CODES after text:

G=Growth Mindset
PS=Psychological Safety
HRO=High Reliable Organizing
TL=Transformational Leadership
Flin=Item mentioned by Flin
Hale=Item mentioned by Hale et al.

Numbers shown after source items refer to related Process-oriented Safety Leadership Principle.

1. In selection and hiring processes, looking for people who are filled with passion and a desire to get things done. **G2**
2. Welcoming change and new ideas regardless of their source. **G7**
3. Being understanding and supportive when things have gone different as envisaged and helping employees through, acting as a guide, not as a judge. **G6**
4. Shutting down elitism and getting rid of brutal 'bosses'; fostering productivity by mentoring. Talking journey, instead of royalty, limiting the use of the words 'I' and 'me'; using 'we' and 'us' instead. Rewarding teamwork rather than individual genius. **G6**
5. Managers visiting operational sites to chat with front-line employees frequently. **G6**
6. Opening up dialogue and channels for honest feedback; asking team members what they like and dislike about the company and what they think needing change, e.g., by setting up structures, processes and forums for input and providing guidelines for discussion. **G6** + **PS6**
7. Showing that the analyzed values and stimulates personal development and growth of employees. **PS2** + **PS3**
8. Emphasizing purpose by identifying what is at stake, why it matters and for whom. **PS1**

9. Clear framing of work by setting expectations about failure, uncertainty and interdependence to clarify the need for voice. **PS4** + **PS3**
10. Inclusion of all team members, through *direct invitation*, in discussions and decisions in which their voices and perspectives might otherwise be absent. **PS6**
11. Supporting collaboration across organisational boundaries by inviting input from relevant operational competence and experience in all meetings and consultations, ignoring hierarchy and departmental barriers. **PS6** + **PS3**
12. Demonstrating situational humility by acknowledging gaps in own performance. **PS4**
13. Fostering a just culture by focusing on system flaws, not on individuals, but sanction clear violations. **PS7**
14. Destigmatizing failure by looking forward, offering help, discussion, consideration and brainstorming next steps. **PS6** + **PS3**
15. Stimulating reporting of safety risks and operational disturbances and express appreciation by listening, acknowledging and thanking for communicating. **PS7**
16. Practicing inquiry by asking good questions and listening intensively. **PS6**
17. Considering that changes taking place at any hierarchical level, these must be supported by concomitant change at other levels. **TL8**
18. Intervention models must assume a multi-level perspective, because processes take place at any organisational level influence and are influenced by, adjacent levels, i.e., processes at different levels are interconnected. **TL8**
19. Deliver incentives as part of their daily routine. Weekly feedback to line-supervisors concerning the frequency of safety-oriented interactions with subordinates, accompanied by communication of (high) safety-priority from direct superiors (i.e., section managers). **TL6**
20. Feedback concerned randomly timed episodic interviews with subordinates. During interviews, workers described their most recent interaction with their supervisor. **TL6** + **TL3**
21. Emphasize that incentives delivered by superiors (e.g., personal attention and recognition) have consistently been shown to provide the strongest reinforcement value in the organisational context, surpassing material and social incentives. **TL6**
22. leaders dare to discuss identified normalized deviant behaviour with their followers. **HRO6**
23. leaders should not avoid debates about the (ignorance of) seemingly unimportant deviations from normal, also known as 'weak signals.' **HRO7**
24. Identify whether there are variances in operation procedures between departments, sites or time periods (e.g., days/nights, weekends, holidays). **HRO7** + **HRO3**
25. an open dialogue between all relevant operating and supervisory staff is easily facilitated in order to find the reasons why the identified differences exist. **HRO6**
26. leaders should be alert concerning team members who are often absent when it comes to evaluating, reflecting and learning. **HRO7**

27. Leaders be aware and respect that unknown risks (blind spots) may exist and also motivate their team members to take this into account during their operations. **HRO7 + HRO3**
28. Leaders should respond positively, should verify the message and be prepared to take timely all remedial actions needed to prevent escalation. **HRO8**
29. "Expect the unexpected and always assume that during operations something can go wrong!" **HRO7**
30. As in any other facet of management, what is critical is the behaviours that are demonstrated in relation to safety. **Flin7**
31. Especially time is a crucial factor as it is the strongest signal of commitment by busy managers with little time to spare. **Flin6**
32. Show the importance of the safety professional and top management support as **'motor'** for the successful implementation of safety interventions. **Flin5**
33. The importance of dialogue between the workforce and line-management as the most essential factor in ensuring that analyzed learn and change. Central to this dialogue was the reporting of dangerous situations (Recognition!). **Hale6 + Hale3**
34. most successful companies in the study, were the companies where the workforce and managers were more actively encouraged to look for safety risks; these companies showed spectacular increases in numbers. **Hale7 + Hale3**
35. Rewarding reporters of (perceived) safety risks by ensuring that all reports are analyzed and decisions on remedial actions taken on them and that the reporters would receive feedback on actions taken (even if that feedback was to explain the reasons for lack of action). **Hale8**
36. The workforce was empowered to refuse to work under unsafe conditions. **Hale4 + Hale3**
37. Top and line-managers were offered safety leadership training. **Hale5**

15.12.2 *Reference table: Sources of Process-oriented Safety Leadership Principles*

PROCESS-ORIENTED SAFETY LEADERSHIP PRINCIPLE	Process-oriented characteristic	Flin	Hale	HRO	Psychological safety	Growth mindset	Transformational leadership
1. Don't skimp on safety	A				8		
2. Assure a sufficient number of competent staffing	A				7	1, 4	
3. Enable all employees to perform their duties in a safe way	A		33, 34, 36	24, 27	7, 9, 11, 14		20
4. Empower employees to refuse to work under unsafe conditions	C, D		36		9, 12		
5. Arrange professional safety leadership training for all leaders at all levels	A	32	37				
6. Allocate sufficient time for dialogues with workforce at their workplaces	A, C	31	33	22, 25	6, 10, 11, 14, 16	3, 4, 5,6	19, 20, 21
7. Actively encourage identification and communication of safety hazards	C	30	34	23, 24, 26, 27, 29	13, 15	2	
8. Monitor implementation and achieved effects of risk reducing measures	B		35	28			17, 18

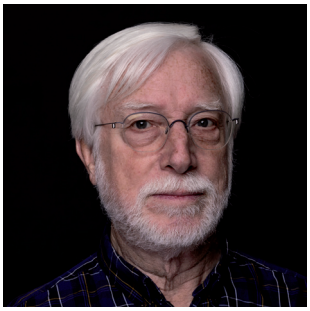
TABLE 30 Sources of Process-oriented Safety Leadership Principles

LEGEND: *Process-oriented characteristics*

A. Sincerely care for safety
B. Ensure that necessary improvements are implemented timely
C. Motivate team members to intervene to prevent safety incidents
D. Forgive people who intervene by mistake

Numbers refer to source items (listed under previous paragraph 15.12.1)

Curriculum vitae



Victor Roggeveen (Amsterdam, 1949) joined the Royal Netherlands Navy in 1965 and was trained as a ship's engineer. He resigned after 8 years of service to accept an offshore technical position in an oil company operating a gas exploration activity in the southern North Sea (1973). Two years later, after the company obtained a gas production license, he was assigned as the first company's 'safety man' offshore. After 9 years of experience in the safety profession, he resigned in order to found his own independent safety consultancy firm Advi-Safe Consultants (1984). This company rendered safety consultancy services to high-risk organisations in the oil and gas, tank storage, railways and other industries on a global scale. Under his supervision, the company developed safety management systems, safety incident investigations and conducted safety related training courses. In the year 2000 he retired from Advi-Safe Consultants. Since then, Victor operates as an independent risk management consultant, Tripod trainer and incident investigator, with a focus on the health care sector (hospitals) and other high-risk industries.

Since 1995 he holds a professional master degree in Occupational Health, Safety and Welfare from Amsterdam University (UvA). From 2006 until 2012 he chaired the Dutch Society of Safety Practitioners (NVVK). In 2013 he enrolled the Dual PhD Centre of Leiden University to do PhD research into the influence of leaders on the prevention of safety incidents.