



Human factors root causes of accidents in inland navigation: HMI and wheelhouse design

Annex



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Ergonomics & Human Factors

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Colophon

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Annex 1 – Overview vessel characteristics

Vessel visits (Random order)	What role do you have on your vessel at this moment?	How long have you been active in inland shipping in total?	Construction year of vessel	In what year did you last adjust the wheelhouse?	What was replaced?	What is your nationality?	What is the type of vessel you sail?	What is the size of your vessel?	What is your ship's tonnage?	What is the vessel's equipment standard?
1	Shipping company employee	10-20 yrs.	2019	2020	Radar	BE	Tanker	CEMT Va (110-135 x 11,4)	2051-4000 ton	S2
2	Self-employed	< 30 yrs.	2009	Not adjusted		NL	Container vessel	CEMT Va (110-135 x 11,4)	2051-4000 ton	S2
3	Captain/ boatmaster	10-20 yrs.	1949	2016	Pilot, radar, bow thruster alarms and control panel	NL	Dry cargo	CEMT III (55-85 x 8,2m)	651-1250 ton	S1
4	Self-employed	10-20 yrs.	1993	2018		NL	Dry cargo	CEMT Va (110-135 x 11,4)	2051-4000 ton	S2
5	Self-employed	20-30 yrs.	2000	Last couple of years	Tracking pilot, spud poles, ballast pump	DE	Tanker	CEMT IVa (80-105 x 9,5m)	1251-2050 ton	S2
6	Captain/ boatmaster	0-5 yrs.	1956	2019	New pilot complete with instrumentation	FR	Container vessel	CEMT IVa (80-105 x 9,5m)	1251-2050 ton	S1
7	Captain/ boatmaster	20-30 yrs.	2008	Not adjusted		NL	Container vessel	CEMT VIa (110-135 x 13,5-17,0m)	4001-5601 ton	S2
8	Self-employed	10-20 yrs.	1954 (middle section 1982)	2019	Bow thruster control	NL	Dry cargo	CEMT IVa (80-105 x 9,5m)	1251-2050 ton	S2
9	Captain/ boatmaster	20-30 yrs.	2004	2020	The shuttles and the display of the main engines	DE	Passenger vessel	CEMT IVa (80-105 x 9,5m)	1251-2050 ton	S1
10	Captain/ boatmaster	20-30 yrs.	2020	Not adjusted		NL	Passenger vessel	CEMT Va (110-135 x 11,4)	4001-5601 ton	S2

Vessel visits (Random order)	How many crew members are on board?	What are did you regularly sail the last year?	What is the most common mode of operation of the vessel you usually sail on?	What is in practice your average consecutive duration per day for navigating?	What is in practice the minimum number of consecutively rest hours between two navigation periods?	What is the most common consecutive length of stay on board the ship you are sailing on?	Other	TV in wheelhouse?	Does wheelhouse comply with EN1864 layout? (L= large, M= medium, S = small wheelhouse according to EN 1864)
1	4	Lower Rhine, Netherlands	A1	8-10 hrs.	6-8 hrs.		3 weeks on/ off	Yes	L: Yes
2	5	Upper Rhine, Netherlands	B	6-8 hrs.	6-8 hrs.	Continuous (ship = house)		Yes	L: Yes
3	2	Netherlands, Flanders, Wallonia	A1	12-14 hrs.	6-8 hrs.		Weekend-off	Yes	M: No Seating is in the back but with a table in the middle. No cupboards
4	4	Lower Rhine, Middle Rhine, Netherlands, Flanders, Wallonia	A2	>14 hrs. per day	6-8 hrs.	Continuous (ship = house)		Yes	L: No , seating is in the back. Left front is desk with pc. Right front is just a desk
5	2	Lower Rhine, Middle Rhine		>14 hrs. per day	>14 hrs. per day			Yes	No pictures available
6	2	France	A2	12-14 hrs.	2-4 hrs.	2 weeks on/ off		No	M/S: ? No pictures that can establish this
7	3	ARA-area	A2	4-6 hrs.	6-8 hrs.	2 weeks on/ off		Yes	L: No , Lessenaar and cupboards changed. Desk and seating is according to EN1864
8	2	Lower Rhine, Netherlands, Flanders, Wallonia, West Germany	A1	8-10 hrs.			Weekend-off	No	M: No Different seating area
9	7	Lower Rhine	A1	10-12 hrs.	0-2 hrs.		Depending on the situation	No	L: No Seating in back, two desks: left front & right front
10	>8	Lower Rhine, Upper Rhine, Middle Rhine	A2	8-10 hrs.	>14 hrs. per day	2 weeks on/ off		No	M: No , Complete rear is desk, no individual seating area

Annex 2 – Summary of positions of controls and displays from respondents

In the questionnaire respondents marked the position of relevant controls and displays in the helmsman stand. Also, they reported whether they were (very) (dis)satisfied about the position of each device.

The reported position distributed in 18 zones is marked in dots. A large sized dot indicates more respondents reporting the location of this device in that specific segment.

In the visual of the helmsman stand the dissatisfaction is marked in a red dot and satisfaction in a green dot.

Rudder control

Positions	No answer	1	10	11	12	13	14	3	7	Not present	Total
No answer	3		1								4
Not present											-
(very) Dissatisfied			3	1		1					5
(very) Satisfied	2	2	36	1	6	22	1	1	1	4	76
Total	5	2	40	2	6	23	1	1	1	4	85



Emergency rudder control

Positions	No answer	1	10	11	12	13	15	3	Not present	Total
No answer	3									3
Not present									1	1
(very) Dissatisfied				1	2	1	2			6
(very) Satisfied	4	1	12	29	16	9	1	1	2	75
Total	7	1	13	31	17	11	1	1	3	85



Control of propulsion engines

Positions	No answer	1	10	11	12	13	4	8	Not present	Total
No answer	3				1					4
Not present								1	1	2
(very) Dissatisfied				1	1	1				3
(very) Satisfied	5	2	15	12	21	17	1	2	1	76
Total	8	2	16	12	23	19	1	2	2	85



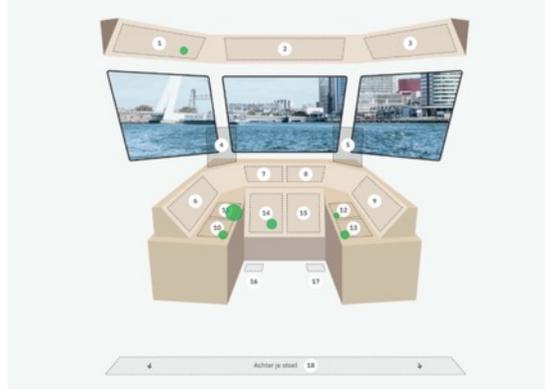
Control of bow thruster

Positions	No answer	1	10	11	12	13	15	2	Not present	Total
No answer	4								1	5
Not present									3	3
(very) Dissatisfied			1	1	4	2				8
(very) Satisfied	3	1	8	12	18	24	1	1	1	69
Total	7	1	9	13	22	26	1	1	5	85



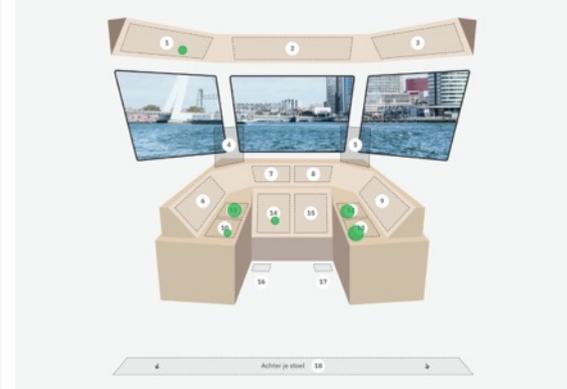
Rudder propeller left

Positions	No answer	1	10	11	12	13	14	Not present	Total
No answer	19	1						2	22
Not present	11					2	1	29	43
(very) Dissatisfied								2	2
(very) Satisfied	3	2	2	8	1	1		1	18
Total	33	3	2	8	1	3	1	34	85



Rudder propeller right

Positions	No answer	1	10	11	12	13	14	Not present	Total
No answer	19							2	21
Not present	11					3	1	29	44
(very) Dissatisfied								2	2
(very) Satisfied	4	2	1	3	4	4			18
Total	34	2	1	3	4	7	1	33	85



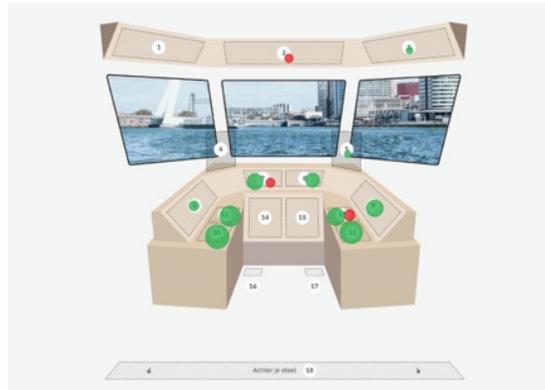
Control autopilot

Positions	No answer	1	10	11	12	13	3	5	7	8	Not present	Total
No answer	3		2								1	7
Not present											4	4
(very) Dissatisfied			2		1							3
(very) Satisfied	3	1	23	6	3	19	1	1	6	5	3	71
Total	6	1	27	6	4	19	1	1	7	5	8	85



Optical alarm operation autopilot

Positions	No answer	10	11	12	13	2	3	5	6	7	8	9	Not present	Total
No answer	3	1											3	8
Not present													5	5
(very) Dissatisfied	1			2		1				1			1	6
(very) Satisfied	3	15	12	6	11		1	1	1	5	4	4	3	66
Total	7	16	12	8	11	1	1	1	1	9	4	4	10	85



Anchor control

Positions	No answer	10	11	12	14	16	3	5	6	9	Not present	Total
No answer	9		1								3	13
Not present	4				1						10	15
(very) Dissatisfied	1	1								1	1	4
(very) Satisfied	8	2	5	2		1	2	1	15	16	1	53
Total	22	3	6	2	1	1	2	1	16	17	14	85



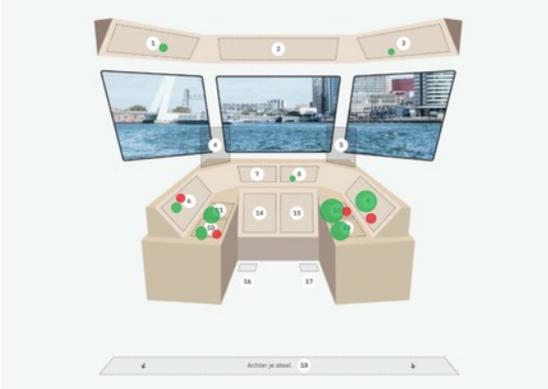
Wheelhouse up/down

Positions	No ans.	1	10	11	12	13	16	2	3	4	5	6	9	Not present	Total
No answer	6		1			1						1	1	1	11
Not present	2														6
(very) Dissatisfied	1	1	1	1					1	2	2				9
(very) Satisfied	4	1	8	4	7	6	1	1	1		1	16	6	1	57
Total	13	1	10	5	7	8	1	1	1	1	1	19	9	8	85



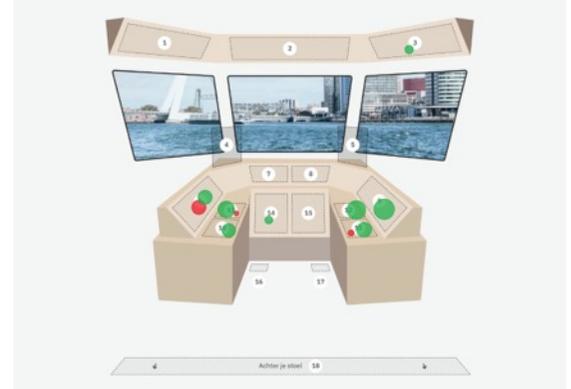
Blue board control

Positions	No answer	1	10	11	12	13	3	6	8	9	Not present	Total
No answer	4		1					1			1	7
Not present											2	2
(very) Dissatisfied	1	1	1	1			1	2				6
(very) Satisfied	3	1	4	6	20	16	2	4	1	12	1	70
Total	8	1	6	6	21	16	2	6	1	14	4	85



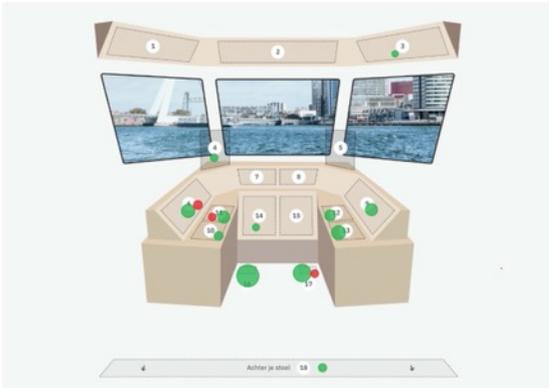
Windshield wiper

Positions	No answer	10	11	12	13	14	3	6	9	Not present	Total
No answer	3				1			1	1		6
Not present											-
(very) Dissatisfied	1		1	1			3	2			8
(very) Satisfied	6	6	14	13	9	1	2	6	13	1	71
Total	10	6	15	13	11	1	2	10	16	1	85



Ship's horn

Positions	No ans.	10	11	12	13	14	16	17	18	3	4	6	9	Not present	Total
No answer	3	1											1	1	6
Not present															-
(very) Dissatisfied	2	1				1				3					7
(very) Satisfied	6	2	4	5	7	2	17	12	1	2	1	6	6	1	72
Total	11	3	5	5	7	2	17	13	1	2	1	10	7	1	85



Automatic sailing systems / autopilot

Positions	No answer	1	10	11	12	13	14	15	3	5	7	8	Not present	Total
No answer	6											1	2	9
Not present	2					2	1						11	16
(very) Dissatisfied	1			1	1				1					4
(very) Satisfied	7	1	20	4	3	7	2	1	2	4	3	2	2	56
Total	16	1	20	4	4	10	1	2	1	2	5	4	15	85



Ground speed indicator

Positions	No ans.	12	13	14	15	2	3	4	5	6	7	8	9	Not present	Total
No answer	3													1	4
Not present	1			1										1	3
(very) Dissatisfied	1											2			3
(very) Satisfied	9	2	1	14	15	4	2	4	2	4	11	3	2	2	75
Total	14	2	1	14	16	4	2	4	2	4	12	5	2	3	85



Heading indicator

Positions	No answer	12	13	14	15	2	3	5	6	7	8	Not present	Total
No answer	5				1						1		7
Not present	2											3	5
(very) Dissatisfied										1	2		3
(very) Satisfied	12	1	2	5	7	2	1	1	1	1	16	19	70
Total	19	1	2	5	8	2	1	1	1	18	21	6	85



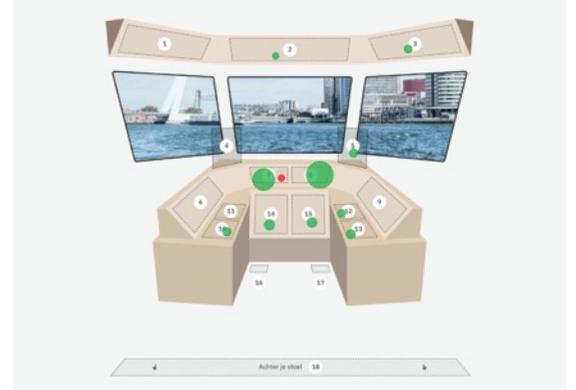
Rudder position

Positions	No ans.	10	12	13	14	15	2	3	5	6	7	8	Not present	Total
No answer	3											1		4
Not present	1												1	1
(very) Dissatisfied											1	1		2
(very) Satisfied	8	1	2	2	3	4	2	1	2	1	21	30	1	78
Total	12	1	2	2	3	4	2	1	2	1	23	31	1	85



Rotation speed

Positions	No answer	10	12	13	14	15	2	3	5	7	8	Not present	Total
No answer	3											1	4
Not present	1											1	3
(very) Dissatisfied											1	1	2
(very) Satisfied	8	1	1	2	5	2	2	1	2	17	31	2	74
Total	12	1	1	2	5	2	2	1	2	19	33	5	85



Draught

Positions	No ans.	11	13	14	15	2	3	4	5	7	8	9	Not present	Total
No answer	6				1						1	1	1	10
Not present	6	1											10	17
(very) Dissatisfied											1	1		2
(very) Satisfied	7	1		7	4	3	3	1	1	13	16			56
Total	19	1	1	7	5	3	3	1	1	14	17	2	11	85



Wind speed to ship

Positions	No answer	13	14	15	2	3	5	7	8	9	Not present	Total
No answer	8										3	11
Not present	7								1		11	19
(very) Dissatisfied						2	1	1			1	5
(very) Satisfied	8	1	4	6	3	5	2	9	10	1	1	50
Total	23	1	4	6	3	7	3	10	11	1	16	85



Turn indicator

Positions	No answer	1	14	2	3	5	7	8	Not present	Total
No answer	3							2		5
Not present	2								2	4
(very) Dissatisfied	2									2
(very) Satisfied	11	1	6	1	1	1	19	31	3	74
Total	18	1	6	1	1	1	21	31	5	85



Inland ECDIS screen

Positions	No ans.	1	11	12	13	14	15	16	2	3	4	5	6	7	8	Not prst.	Total
No answer	2												1				3
Not present	2																3
(very) Dissatisfied	2	1			1	2					1	1					8
(very) Satisfied	10	1	1	1	17	14	1	1	2	7	7	1	4	1	1	1	69
Total	16	1	1	1	18	16	1	1	2	8	9	1	4	1	1	4	85



Inland ECDIS control

Positions	No ans.	1	11	12	13	14	15	2	3	4	5	6	7	8	Not prst.	Total
No answer	3			1									1		1	6
Not present	2															3
(very) Dissatisfied	2	1	1	2							1					7
(very) Satisfied	10	1	3	7	6	10	11	1	1	5	3	3	3	2	1	67
Total	17	1	4	9	6	12	11	1	1	5	5	3	3	3	4	85



Radar screen

Positions	No ans.	1	12	14	15	16	3	4	6	7	8	9	Not present	Total
No answer	2													2
Not present														2
(very) Dissatisfied	1		2	1										4
(very) Satisfied	9	1	1	25	28	1	1	1	2	3	3	1	1	77
Total	12	1	1	27	29	1	1	1	2	3	3	1	3	85



Radar control

Positions	No ans.	10	11	12	14	15	16	3	4	7	8	9	Not present	Total
No answer	2										1			3
Not present												1	1	2
(very) Dissatisfied	1			1	1									3
(very) Satisfied	11	2	14	10	14	14	2	2	1	4	1	1	1	77
Total	14	2	14	10	15	15	2	2	1	5	2	1	2	85



Navigation lights control

Positions	No ans.	10	11	12	13	14	3	4	5	6	7	9	Not present	Total
No answer	2													2
Not present														-
(very) Dissatisfied	1									2				3
(very) Satisfied	13	2	3	2	2	1	1	1	3	23	2	25	2	80
Total	16	2	3	2	2	1	1	1	3	25	2	25	2	85



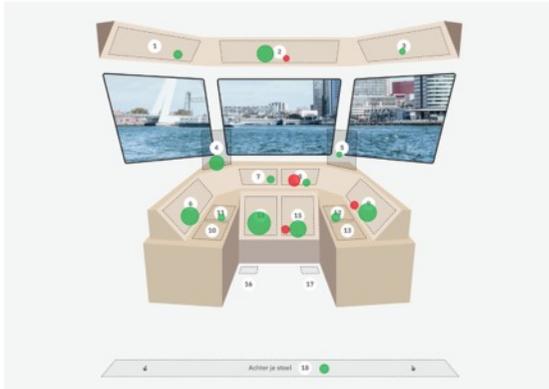
Search light control

Positions	No ans.	1	10	11	12	13	14	2	3	5	6	7	8	9	Not prst.	Total
No answer	2														1	3
Not present																-
(very) Dissatisfied	2											1		2		5
(very) Satisfied	11	2	7	12	13	11	1	2	1	2	6	1	1	5	2	77
Total	15	2	7	12	13	11	1	2	1	2	7	2	1	7	2	85



AIS Installation Information

Positions	No ans.	1	11	12	14	15	18	2	3	4	5	6	7	8	9	Not prst.	Total
No answer	3												1				4
Not present	1																1
(very) Dissatisfied	5				1		1							3	1	1	12
(very) Satisfied	15	1	2	2	9	4	1	5	1	4	1	8	3	2	8	2	68
Total	24	1	2	2	9	5	1	6	1	4	1	9	3	5	9	3	85



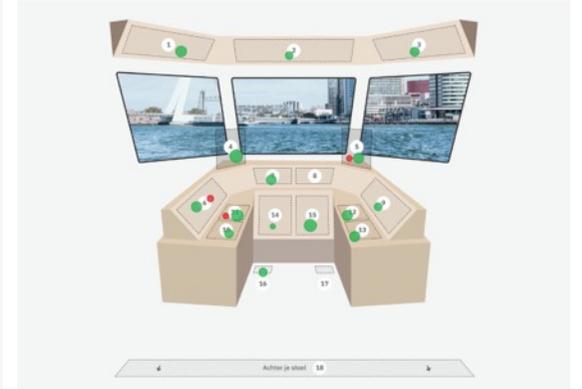
CCTV-camera displays

Positions	No a.	1	11	13	14	15	16	17	18	2	3	4	5	6	7	8	9	Not p.	Total	
No answer	2																			6
Not present	2									2	1	2								4
(very) Dissatisfied	3	1			1	1										1				8
(very) Satisfied	20	3	1	1	9	2	2	2	1	1	1	2	3	1	2		2	6		59
Total	27	4	1	1	11	3	2	2	2	3	1	3	6	1	4	1	2	11		85



CCTV camera control

Positions	No a.	1	10	11	12	13	14	15	16	2	3	4	5	6	7	9	Not p.	Total		
No answer	5																		7	
Not present	3																			9
(very) Dissatisfied	2			1												1	1			7
(very) Satisfied	16	2	1	3	4	4	2	4	2	2	2	4	3	2	3	4	1			59
Total	26	2	1	4	4	4	2	4	2	2	2	5	4	3	3	6	11			85



Additional radar screen

Positions	No answer	14	15	2	3	4	5	6	7	8	Not present	Total
No answer	8										1	9
Not present	5		1	1							14	21
(very) Dissatisfied	1	1	2									4
(very) Satisfied	13	10	14	1	2	3	2	3	1		2	51
Total	27	11	17	1	1	2	3	2	3	1	17	85



Controls of additional radar screen

Positions	No answer	1	11	12	14	15	4	5	6	7	8	Not present	Total
No answer	7		1									1	9
Not present	6		1									14	21
(very) Dissatisfied	1					1							2
(very) Satisfied	15	1	7	5	4	10	2	2	2	2	1	2	53
Total	29	1	9	5	4	11	2	2	2	2	1	17	85



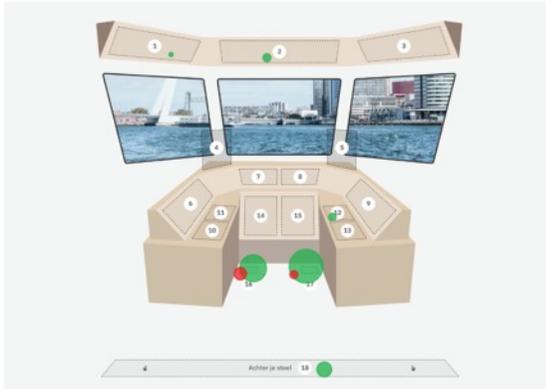
VHF device

Positions	No answer	1	10	11	13	16	2	3	6	8	9	Not present	Total
No answer	2												2
Not present													-
(very) Dissatisfied	1		1						1	1			4
(very) Satisfied	17	7	2	1	4	1	3	2	19	1	21	1	79
Total	20	7	3	1	4	1	3	2	20	1	22	1	85



VHF foot pedal

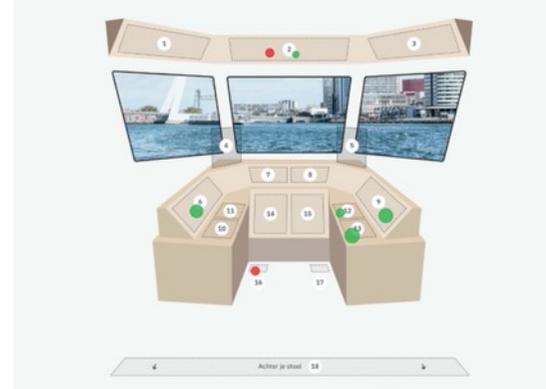
Positions	No answer	1	12	15	16	17	18	2	Not present	Total
No answer	2				1	3			2	8
Not present	3			1		3				7
(very) Dissatisfied	2			5	2					9
(very) Satisfied	15	1	1	14	20	4	1		5	61
Total	22	1	1	1	20	28	4	1	7	85



Intercom control

(*questionnaire error)

Positions	No a.	1	10	11	12	13	14	15	16	17	18	2	3	5	6	7	8	9	Not p.	Total
No answer *	18	1	2	2	2	1	1	12	3					1	7	2	1	4	1	58
Not present	1	2								1	1									6
(v.) Dissatisfied								1		1										2
(v.) Satisfied	7			1	4					1				3			3			19
Total	26	1	2	2	3	6	1	1	13	3	1	2	1	1	10	2	7	1		85



Controls of the alarm unit

Positions	No ans.	1	11	12	13	14	15	17	2	3	4	6	7	9	Not prst.	Total
No answer	3															3
Not present																-
(very) Dissatisfied									1	1			1			4
(very) Satisfied	26	1	1	3	4	2	1	1	1	4	1	14	1	17	1	78
Total	29	1	1	3	4	2	1	1	2	5	1	15	1	17	2	85



Television

Positions	No answer	1	13	15	18	3	4	5	6	Not present	Total
No answer	6									2	8
Not present	13				1					18	32
(very) Dissatisfied	1									1	2
(very) Satisfied	15	2	1	1	2	8	12	1		1	43
Total	35	2	1	1	1	2	8	12	1	22	85



Radio

Positions	No a.	1	10	11	12	13	14	18	2	3	4	5	6	7	8	9	Not p.	Total	
No answer	2																	2	
Not present	2																1	4	7
(v.) Dissatisfied				1												1			2
(v.) Satisfied	18	3	1	2	3	3	1	1	3	6	5	4	11		1	10	2		74
Total	22	3	2	2	3	3	1	1	3	6	5	5	11	1	1	10	6		85



Television

Positions	No answer	1	13	15	18	3	4	5	6	Not present	Total
No answer	6									2	8
Not present	13				1					18	32
(very) Dissatisfied	1									1	2
(very) Satisfied	15	2	1	1	2	8	12	1		1	43
Total	35	2	1	1	1	2	8	12	1	22	85



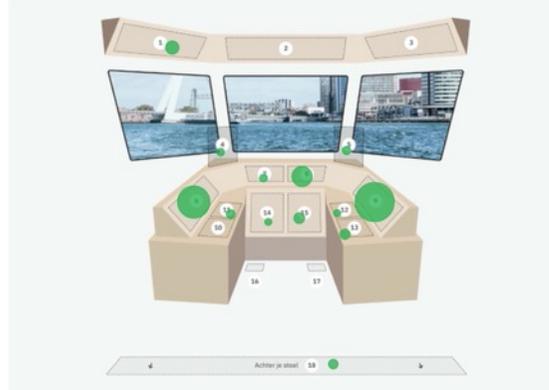
Engine status (fuel, oil, etc.)

Positions	No a.	11	12	13	14	15	18	2	3	4	5	6	7	8	9	Not p.	Total	
No answer	2		1														3	
Not present																1	1	2
(v.) Dissatisfied	1													1			2	
(v.) Satisfied	16	4	2	1	1	3	1	2	1	5	5	12	10	7	6	2	78	
Total	19	4	2	2	1	3	1	2	1	5	5	12	11	7	7	3	85	



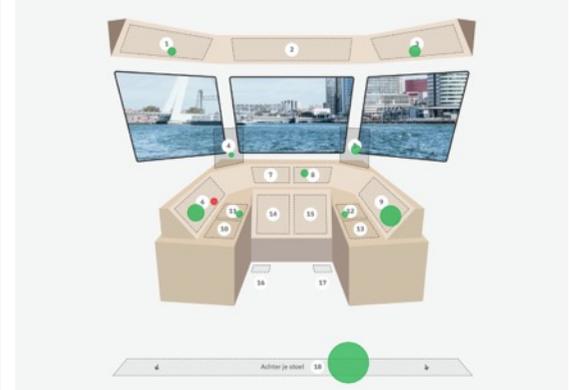
Status electrical installation

Positions	No a.	1	11	12	13	14	15	18	4	5	6	7	8	9	Not p.	Total	
No answer	2															2	
Not present															1	1	2
(v.) Dissatisfied	1															1	
(v.) Satisfied	18	3	1	1	1	1	2	2	1	2	14	1	5	25	3	80	
Total	21	3	1	1	1	1	2	2	1	2	15	1	5	25	4	85	



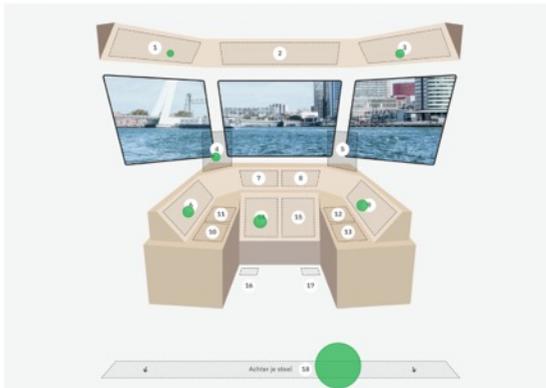
Fire alarm system

Positions	No ans.	1	11	12	18	3	4	5	6	8	9	Not present	Total
No answer	7												7
Not present	3		1		1								8
(very) Dissatisfied										1			1
(very) Satisfied	15	1	1	1	16	3	1	2	8	1	13	2	64
Total	25	1	2	1	17	3	1	2	9	1	13	10	85



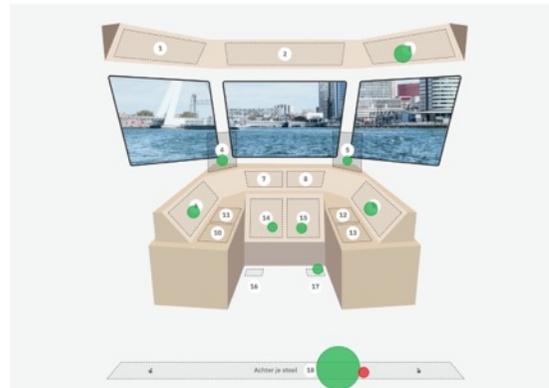
Information about cargo (temperature, pressure, flow)

Positions	No answer	1	14	18	3	4	6	7	9	Not present	Total
No answer	7							1		1	9
Not present	7	1		1						23	32
(very) Dissatisfied										1	1
(very) Satisfied	15	1	3	11	1	2	4		3	3	43
Total	29	2	3	12	1	2	4	1	3	28	85



Ship stability

Positions	No answer	14	15	17	18	3	4	5	6	9	Not present	Total
No answer	8									1	1	10
Not present	6				1	1					20	28
(very) Dissatisfied					1						1	2
(very) Satisfied	16	1	1	1	9	4	2	3	3	2	3	45
Total	30	1	1	1	11	4	3	3	3	3	25	85



Lifting mechanism wheelhouse

Positions	No answer	1	10	11	12	13	18	2	3	6	8	9	Not present	Total
No answer	6												1	7
Not present	4												6	10
(very) Dissatisfied	1					1				2	1	1		6
(very) Satisfied	11	1	4	8	3	7	1	1	2	13		9	2	62
Total	22	1	4	8	3	8	1	1	2	15	1	10	9	85



Emergency control wheelhouse

Positions	No answer	10	11	12	13	16	17	2	3	6	8	9	Not present	Total
No answer	7										1		1	9
Not present	2												8	10
(very) Dissatisfied							1						1	2
(very) Satisfied	12	4	6	3	5	1	2	1	2	8	1	18	1	64
Total	21	4	6	3	5	2	2	1	2	9	1	19	10	85



Coupling winches

Positions	No answer	11	12	18	2	3	4	8	9	Not present	Total
No answer	10									3	13
Not present	12			1	1					41	55
(very) Dissatisfied											-
(very) Satisfied	10	1	1		1	1	1	1	1	1	17
Total	32	1	1	1	1	1	1	1	1	45	85



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