CONSIDERTIONS ON THE ROLE OF EXPERIENCE OF SOME SHIP ACTIVITIES RISK ASSESSMENT EXPERTS

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Risk assessment plays a fundamental role in safety-related rules in shipping activity. Therefore, the main reson is to find a method to identify hazards and rank them for control. The aim of this paper is to determine the degree of agreement between experts concordance matrix in risk assessment of ten tasks of some activities on a container vessel. Were calculated the intrinsec risks and residual risks. To determine the concordance matrix, the ten tasks were risk assessed by three groups of experts each composed by six experts with similar grad of experience. The concordance coefficients were calculated for each group.

Keywords: risk assessment, hazard, residual risk, concordance matrix, concordance coefficient.

1. Intoduction

The safety-related rules in shipping were derived as a reaction to major incidents at sea in order to prevent similar accidents [1]. For this purpose, in 1995 the Interational Maritime Organisation Safety Committee (IMO-MSC) adopt the concept of Formal Safety Assessment (FSA) to improve marine safety [2], [3]. FSA method comprising five consecutive steps [4], it was discussed later [5] from point of view of roles of the experts in providing qualitative and quantitative information with respect to the quality of the Safety Assessment, and to developements of risk models.

Risk assessment and control have their origins in EN 1050 [6] adopted by ISO and renumered as ISO 14121-1 [7], and a Technical Report, ISO/TR 14121-2 [8], was produced that provided suporting information on risk assessment methods and scoring tools, finally includes as part of ISO 12100 [9].

In the risk assessment to find a method to identify hazards and rank them for control is fundamental reson.

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Some time ago, ranking was done based only on the severity of injury. This method, called Hazard Analysis, is now recognised as the second step in risk assessment, folowing Hazard Identification. Hazard Analysis is actually considered to encompass Characterisation of the hazard and estimation of the likely severity of injury. Using risk as the basis for ranking hazards provides a consistent and effective way to bin hazards, making prioritization of risk control efforts more straightforward.

2. Methodology

The basic methodology in ISO 12100 requires that risk skoring tools adress four risk parameters, as folow [10]: (a) Severity of injury related to a particular hazard; (b) Frequency and/or duration of exposure to the hazard; (c) Probability of the hazardous event; (d) Possibility to avoid or limit harm.

(a) Severity (S) can be estimated taking into account reversible and irreversible injuries and death. Based on the most probable consequences of hazards the appropriate values of severity can be chosen as you can see in Table 1 [11].

Table. 1

Severity weights [11]

Consequences of exposure to the hazard		Severity (S)
Reversible	Requiring first aid	1
	Requiring support medical practitioner	2
Irreversible	Broken limb or limbs, losing a finger or fingers	3
	Death, losing an eye or arm	4

(b) Frequency and duration of exposure (F) can be appreciated considering the need for access to the danger zone, the nature of the access and the average interval between exposures and the duration of exposure (greater than 10 minutes), (Table 2) [11].

Table 2

Frequency and duration of exposure [11].

Frequency of exposure	Duration (>10 min)
≤ 1h	**5**
1h to ≤ 1 day	**5**
> 1 day ≤ 2 weeks	**4**
>2 weeks ≤ 1 year	**3**
> 1 year	**2**

(c) Probability of the hazardous event (P) can be estimated considering whether ship equipment have propensity to act in an unexpected manner. As well, must be take into accont human behavior when interacting with ship equipment relevant to the hazard. In Table 3 [11] is contined the probability of occurance of the hazardous event weighting.

Table 3

Probability of occurance of hazardous event weighting [11]

Probability of occurance	Probability (P)
Negkigible	**1**
Rarely	**2**
Possible	**3**
Likely	**4**
Very high	**5**

(d) Possibility to avoid or limit harm (A) can be estimated considerating aspects of the equipment design and its intended application which may favor this possibility. Probability of avoidance or limiting harm (A) can be selected from Table 4 [11].

Table 4

Possibility to avoid or limit harm weighting [11]

Probability of occurance	Weight
Probable (probability approaches 100%**)**	**1**
Rarely (<50%**)**	**3**
Impossible (0%)	**5**

2.1. Risk scoring

To determine the risk level, the algoritm resulting in Table 5 and Table 6 is used.

Table 5

Risc scoring matrix

	Probability of injury class (P_{ic})				**P_{ic} = P*(F+A)**
Severity	3-10	11-20	21-30	31-40	41-50
4	12-40	44-80	84-120	124-160	164-200
3	9-30	33-60	63-90	93-120	123-150
2	6-20	22-40	42-60	62-80	82-100
1	3-10	11-20	21-30	31-40	41-50

Table 6

Approximate risk ranges

Approximate risk ranges				
1-10	11-20	21-100	101-150	164-200
Very low (VL)	Low (L)	Moderate (M)	High (H)	Very high (VH)

The basic algorithm to calculate the risk R is expressed by equation,

$$R = S*[P*(F+A)] \quad (1)$$

were **S** is severity of injury, **P** probability of hazardous event, **F** the frequency and duration of exposure and **A** possibility to avoid or limit harm, respectively.

3. Risk assessment in case of some activities on a container vessel

They were risk assessed ten tasks (Table 7 ÷ Table 16). In order to calculate the intrinsec risk and residual risc we used the relation (1) and Table 6.

3.1. Degree of agreement between experts concordance matrix

The role of the risk assessment expert experience in risk assessment of ship activities is shown in our study.

The ten tasks (see Table 7 ÷ Table 16) were risk assessed by three groups of experts, each comprised of six experts i.e. high expert experience (group 1), intermediate (group 2) and low (group 3), respectively.

If the number of expets (L experts in total) rank a number of hazards (K hazards in total), using the natural numbers (1, 2, 3, ... K), then expert l (l= 1, 2, 3, ... L; L=6) has thereby assigned rank x_{kl} to hazard k (k = 1, 2, 3, ...K; K=10). We can calculate the concordance coefficient w by formula [10],

$$W = \frac{12\ \sum_{k=1}^{K}\left[\sum_{l=1}^{L} x_{kl} - \frac{1}{2}L(K+1)\right]^2}{L^2K(K^2-1)} \quad (2)$$

The degree of agreement between experts concordance matrices for the three experts groups are presented in Tables 17, 18 and 19 respectively. Also are shown the calculated values of concordance coefficients. From Tables 17, 18 and 19 is quite evident how various degree of concordance have been formed. The level of agreement is characterized in Table 20. We propose to use an affected risk R_{aff}, taking into account the degree experience of experts,

$$R_{aff} = S * P_{ic} * w \quad (3)$$

The relation (3) shows the fact that $\mathbf{R_{aff}}$ is optimum when w = 1, i.e. the level of agreement between experts is perfect.

Table 7

Risk Assessment F01

M.V. CONTAINER		**Risk Assessment F01**		**MVC-SSO-RA-01**
Type of vessel: Container				**Record No: 1/01.08.2015**
Working area/ Department: Deck/Deck		**Job description: Blowing residues out of bulk tanks**		
Prepared by: N.V.	**Date: 01.08.2015**	**Revision No: 0**	**Approved by: N.V.**	**Date: 01.08.2015**

S=Severity of hazard (1-4); **F**=Frequency of exposure (2-5); **P**= Probability of occurance (2-5); **A**= Possibility to avoid (1,3,5); **R**=Risk level (1-10 very low; 11-20 low; 21-100 moderate; 101-150 high;151-200 (very high); **R=S*[P*(F+A)]**; Residual risk higher than 164(VH), is not acceptable.

No.	Task / Activity	Possible hazard/Risk (because of: people at risk, other than involve persons, etc)	Inherent Risk					Preventive / Control measures / Instructions	Residual Risk					Obs.
			S	P	F	A	R		S	P	F	A	R	
1	Connecting hose	Muscle strain/ back injury. Trapped fingers. Slips, trips and falls. Pressure on system. Hit by cap due to pressure.	3	5	4	3	H (105)	Apply PTW procedure. Wear proper PPE as gloves, goggles, boiler suits and safety shoes. Raise attention to lifting and carrying techniques. Enough men for the job, if required ask for support. /Ensure that the system is shut-down before connecting. Open drain cock to take pressure off the system./ Keep head out of Line of fire when removing. Adequate lighting round hose area. Aware of ship's movements. Foot wear in good order.	2	3	4	3	M (42)	-

Table 8

Risk Assessment F02

M.V. CONTAINER	Risk Assessment F02			MVC-SSO-RA-02
Type of vessel: Container				Record No: 2/01.08.2015
Working area/ Department: Main deck	Job description: Discharge of abnormal (heavy) lifts			
Prepared by: N.V.	Date: 01.08.2015	Revision No: 0	Approved by: N.V.	Date: 01.08.2015

S=Severity of hazard (1-4); **F**=Frequency of exposure (2-5); **P**= Probability of occurance (2-5); **A**= Possibility to avoid (1,3,5); **R**=Risk level (1-10 very low; 11-20 low; 21-100 moderate; 101-150 high;151-200 (very high); **R=S*[P*(F+A)]**; Residual risk higher than 164(VH), is not acceptable.

No.	Task / Activity	Possible hazard/Risk (because of: people at risk, other than involve persons, etc)	Inherent Risk					Preventive / Control measures / Instructions	Residual Risk					Obs.
			S	P	F	A	R		S	P	F	A	R	
1	Preparing lift for discharge	Securing arrangements. Unusual shape/design (trips/knocks). Heavy lifting slings (muscle strain). Trapped finger or hands.	3	4	5	4	H (108)	Always wear proper PPE as helmets, safety shoes and high visibility clothes. At least one man with VHF. / Ensure sea fastenings can be released from deck. Assess possible trip/knock hazards. Ensure lifting bridle is easily accessible with minimum of unnecessary movement.	2	2	4	3	M (28)	-

Table 9

Risk Assessment F03

M.V. CONTAINER		**Risk Assessment F03**		**MVC-SSO-RA-03**
Type of vessel: Container				**Record No: 3/01.08.2015**
Working area/ Department: Deck		**Job description: Back-loading cargo**		
Prepared by: N.V.	**Date: 01.08.2015**	**Revision No: 0**	**Approved by: N.V.**	**Date: 01.08.2015**

S=Severity of hazard (1-4); **F**=Frequency of exposure (2-5); **P**= Probability of occurance (2-5); **A**= Possibility to avoid (1,3,5); **R**=Risk level (1-10 very low; 11-20 low; 21-100 moderate; 101-150 high;151-200 (very high); **R=S*[P*(F+A)]**; Residual risk higher than 164(VH), is not acceptable.

No.	**Task / Activity**	**Possible hazard/Risk** (because of: people at risk, other than in-volve persons, etc)	**Inherent Risk**					**Preventive / Control measures / Instructions**	**Residual Risk**					**Obs.**
			S	**P**	**F**	**A**	**R**		**S**	**P**	**F**	**A**	**R**	
1	Lower or place lift on deck	Injuries through car-go. Striking, trapping or crushing people. Wire break or falling-off cargo/dropped objects	**4**	**4**	**4**	**3**	**H (112)**	All personal should keep clear of landing area and unit presently lift or landed. Always at least 2 men deck crew. At least one man equipped with VHF./ Waiting till the crane wire loose its tension and weight is off. / Any person should be able stop lifting operation, wherever there is a potential safety issue.	**3**	**2**	**4**	**3**	**M (42)**	**-**

Table 10

Risk Assessment F04

M.V. CONTAINER		**Risk Assessment F04**		**MVC-SSO-RA-04**
Type of vessel: Container				**Record No: 4/01.08.2015**
Working area/ Department: Vessel /Deck		**Job description: Changing lights bubs**		
Prepared by: N.V.	**Date: 01.08.2015**	**Revision No: 0**	**Approved by: N.V.**	**Date: 01.08.2015**

S=Severity of hazard (1-4); **F**=Frequency of exposure (2-5); **P**= Probability of occurance (2-5); **A**= Possibility to avoid (1,3,5); **R**=Risk level (1-10 very low; 11-20 low; 21-100 moderate; 101-150 high;151-200 (very high); **R=S*[P*(F+A)]**; Residual risk higher than 164(VH), is not acceptable.

No.	Task / Activity	Possible hazard/Risk (because of: people at risk, other than involve persons, etc)	Inherent Risk					Preventive / Control measures / Instructions	Residual Risk					Obs.
			S	P	F	A	R		S	P	F	A	R	
1	Removing or replacing bulb	Electric shock from open wires. Glass breaking when handling. Falling down when working in the loft.	4	3	5	5	H (120)	PTW procedure applies in case of working aloft. During night and bad weather working aloft is not permitted. /Turn off power, both at switch and remove switch/ circuit breaker. / Warning sign on switches. Always wear proper PPE as gloves, safety belts and harness. Ensure adequate lighting.	3	2	4	3	M (42)	-

Table 11

Risk Assessment F05

M.V. CONTAINER		Risk Assessment F05		MVC-SSO-RA-05
Type of vessel: Container				Record No: 5/01.08.2015
Working area/ Department: Main deck /Deck		Job description: Discharging tubes/ pipes		
Prepared by: N.V.	Date: 01.08.2015	Revision No: 0	Approved by: N.V.	Date: 01.08.2015

S=Severity of hazard (1-4); **F**=Frequency of exposure (2-5); **P**= Probability of occurance (2-5); **A**= Possibility to avoid (1,3,5); **R**=Risk level (1-10 very low; 11-20 low; 21-100 moderate; 101-150 high;151-200 (very high); **R=S*[P*(F+A)]**; Residual risk higher than 164(VH), is not acceptable.

No.	Task / Activity	Possible hazard/Risk (because of: people at risk, other than involve persons, etc)	Inherent Risk					Preventive / Control measures / Instructions	Residual Risk					Obs.
			S	P	F	A	R		S	P	F	A	R	
1	Before/during the work	Slips, trips and fall	3	5	5	3	H (120)	Always wear proper PPE as helmet, safety goggles, long sleeved boiler suit with closed cuffs, safety shoes/boots, working gloves, remove jewelry./ Check PPE for its condition before use. Make sure that safety shoes/boots are free of any contamination. / ensure proper illumination of the work area. Be aware of ship movements, in particular bad weather. Do not start the work without permission of OOW. Stay always in a safe position.	3	2	5	3	M (48)	-

Table 12

Risk Assessment F06

M.V. CONTAINER		**Risk Assessment F06**		**MVC-SSO-RA-06**
Type of vessel: Container				**Record No: 6/01.08.2015**
Working area/ Department: Galley/ Catering		**Job description: Cutting**		
Prepared by: N.V.	**Date: 01.08.2015**	**Revision No: 0**	**Approved by: N.V.**	**Date: 01.08.2015**

S=Severity of hazard (1-4); **F**=Frequency of exposure (2-5); **P**= Probability of occurance (2-5); **A**= Possibility to avoid (1,3,5); **R**=Risk level (1-10 very low; 11-20 low; 21-100 moderate; 101-150 high;151-200 (very high); **R=S*[P*(F+A)]**; Residual risk higher than 164(VH), is not acceptable.

No.	**Task / Activity**	**Possible hazard/Risk** (because of: people at risk, other than involve persons, etc)	**Inherent Risk**					**Preventive / Control measures / Instructions**	**Residual Risk**					**Obs.**
			S	**P**	**F**	**A**	**R**		**S**	**P**	**F**	**A**	**R**	
1	Using knives	Cuts	**3**	**4**	**5**	**5**	**H (120)**	Always wear proper PPE as cook dress, safety shoes and gloves. Adequate use for knives./ Replace defective knives. /Use correct PPE (butcher gloves). Minimize distraction, raise attention.	**2**	**2**	**2**	**3**	**L (20)**	**-**

Table 13

Risk Assessment F07

M.V. CONTAINER		**Risk Assessment F07**		**MVC-SSO-RA-07**
Type of vessel: Container				**Record No: 7/01.08.2015**
Working area/ Department: Engine		**Job description: Fault finding at main switchboard**		
Prepared by: N.V.	**Date: 01.08.2015**	**Revision No: 0**	**Approved by: N.V.**	**Date: 01.08.2015**

S=Severity of hazard (1-4); **F**=Frequency of exposure (2-5); **P**= Probability of occurance (2-5); **A**= Possibility to avoid (1,3,5); **R**=Risk level (1-10 very low; 11-20 low; 21-100 moderate; 101-150 high;151-200 (very high); **R=S*[P*(F+A)]**; Residual risk higher than 164(VH), is not acceptable.

No.	**Task / Activity**	**Possible hazard/Risk** (because of: people at risk, other than involve persons, etc)	**Inherent Risk**					**Preventive / Control measures / Instructions**	**Residual Risk**					**Obs.**
			S	**P**	**F**	**A**	**R**		**S**	**P**	**F**	**A**	**R**	

1	Fault at main switchboard	Electrocution	**3**	**4**	**5**	**5**	**H (120)**	Ensure electrician/subcontractor is following safe practices and use good isolated tools. At least one other person to be in attendance at all times that person able to disconnect power supply person to made aware of electric shock emergency resuscitation before work commencing./ Post rubber blanket in front of switchboards.	**3**	**1**	**4**	**1**	**L (15)**	-

Table 14

Risk Assessment F08

M.V. CONTAINER		**Risk Assessment F08**		**MVC-SSO-RA-08**
Type of vessel: Container				**Record No: 8/01.08.2015**
Working area/ Department: Mast /Deck		**Job description: Changing out a navigation light**		
Prepared by: N.V.	**Date: 01.08.2015**	**Revision No: 0**	**Approved by: N.V.**	**Date: 01.08.2015**

S=Severity of hazard (1-4); **F**=Frequency of exposure (2-5); **P**= Probability of occurance (2-5); **A**= Possibility to avoid (1,3,5); **R**=Risk level (1-10 very low; 11-20 low; 21-100 moderate; 101-150 high;151-200 (very high); **R=S*[P*(F+A)]**; Residual risk higher than 164(VH), is not acceptable.

No.	**Task / Activity**	**Possible hazard/Risk** (because of: people at risk, other than in-volve persons, etc)	**Inherent Risk**					**Preventive / Control measures / Instructions**	**Residual Risk**					**Obs.**
			S	**P**	**F**	**A**	**R**		**S**	**P**	**F**	**A**	**R**	
1	Ascend mast to access the navigation light unit	Access ladder may be damaged/ inadequate, falling down. Ladder may be wet. A radiation hazard may exist if the radars are switched on. A shock hazard may exist if work is close to the main radio aerials.	**4**	**4**	**5**	**5**	**VH (160)**	PTW procedure applies in case of working aloft. During night and in bad weather working aloft is not permitted./ Inspect the ladder visually. Inform OOW that you enter the mast. Ensure radar and radio installation have been switched off and warning signs placed on equipment. Have an assistant supporting and spotting for you. No change of light during night and severe weather condition.	**3**	**2**	**4**	**3**	**M (42)**	-

Table 15

Risk Assessment F09

M.V. CONTAINER		**Risk Assessment F09**		**MVC-SSO-RA-09**
Type of vessel: Container				**Record No: 9/01.08.2015**
Working area/ Department: Galley / Catering		**Job description: Cooking in heavy weather**		
Prepared by: N.V.	**Date: 01.08.2015**	**Revision No: 0**	**Approved by: N.V.**	**Date: 01.08.2015**

S=Severity of hazard (1-4); **F**=Frequency of exposure (2-5); **P**= Probability of occurance (2-5); **A**= Possibility to avoid (1,3,5); **R**=Risk level (1-10 very low; 11-20 low; 21-100 moderate; 101-150 high;151-200 (very high); **R=S*[P*(F+A)]**; Residual risk higher than 164(VH), is not acceptable.

No.	**Task / Activity**	**Possible hazard/Risk** (because of: people at risk, other than involve persons, etc)	**Inherent Risk**					**Preventive / Control measures / Instructions**	**Residual Risk**					**Obs.**
			S	**P**	**F**	**A**	**R**		**S**	**P**	**F**	**A**	**R**	
1	Working with oil (deep fat frver)	Hot oil may cause severe burns (2nd and 3rd degree)	**4**	**4**	**5**	**5**	**VH (160)**	Always wear proper PPE as cook dress, safety shoes and gloves. Use of apron. / Filling acc. to the manual./ use a blocking gear. Raise attention. In doubt do not use. Setting of the menu.	**3**	**1**	**2**	**1**	**VL (9)**	-

Table 16

Risk Assessment F10

M.V. CONTAINER		**Risk Assessment F10**		**MVC-SSO-RA-10**
Type of vessel: Container				**Record No: 10/01.08.2015**
Working area/ Department: Engine		**Job description: Internal cleaning and maintenance of switchboards**		
Prepared by: N.V.	**Date: 01.08.2015**	**Revision No: 0**	**Approved by: N.V.**	**Date: 01.08.2015**

S=Severity of hazard (1-4); **F**=Frequency of exposure (2-5); **P**= Probability of occurance (2-5); **A**= Possibility to avoid (1,3,5); **R**=Risk level (1-10 very low; 11-20 low; 21-100 moderate; 101-150 high;151-200 (very high); **R=S*[P*(F+A)]**; Residual risk higher than 164(VH), is not acceptable.

No.	**Task / Activity**	**Possible hazard/Risk** (because of: people at risk, other than involve persons, etc)	**Inherent Risk**					**Preventive / Control measures / Instructions**	**Residual Risk**					**Obs.**
			S	**P**	**F**	**A**	**R**		**S**	**P**	**F**	**A**	**R**	

1	Shut down, open and cleaning switchboards	Electrocution , fire	**4**	**4**	**5**	**5**	**VH (160)**	Consult the PTW procedure! Always wear proper PPE as dry boiler suits, gloves and safety shoes. Humidity, sweating and wetness increase the risk of electric shocks and reduce the contact resistance of the body. It should be borne that cuts and abrasions significantly reduce skin resistance. Fuses should be removed or circuit breaker opened to ensure that all related circuits are dead. Power should always be cut off at the mains. Flammable materials should never be left near switchboards. A second person should continually in attendance. Wrist watches, rings and jewelry should be removed. Metal fitting on clothing or footwear are also dangerous.	**3**	**1**	**2**	**3**	**L (15)**	-

Table 17

Group of experts with high degree of agreement (group 1)

HAZARD / **EXPERT**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	1	3	2	4	5	6	7	8	9	10
2	1	3	4	2	5	6	8	10	7	9
3	1	2	3	4	5	7	6	8	9	10
4	2	3	1	4	5	6	8	10	9	7
5	2	1	4	3	6	5	7	8	10	9
6	1	2	4	3	5	7	6	8	9	10
$\sum_{l=1}^{L} x_{kl}$	8	14	18	20	31	37	42	52	53	55

w = 0.918

Table 18

Group of experts with poor degree of agreement (group 2)

HAZARD / **EXPERT**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	2	3	1	5	6	4	7	8	10	9
2	1	6	8	4	2	3	7	5	9	10
3	3	4	1	2	5	8	9	10	6	7
4	3	4	1	9	2	5	7	10	6	8
5	4	5	6	1	8	2	3	10	7	9
6	5	1	7	4	3	8	9	2	10	6
$\sum_{l=1}^{L} x_{kl}$	18	23	24	25	26	30	42	45	48	49

w = 0.415

Table 19

Group of experts with poor degree of agreement (group 3)

HAZARD / EXPERT	1	2	3	4	5	6	7	8	9	10
1	1	5	7	4	8	9	3	6	2	10
2	4	9	3	8	2	1	7	10	6	5
3	6	2	8	3	9	10	4	1	5	7
4	6	1	3	5	2	8	4	9	7	10
5	1	4	3	2	7	5	9	6	10	8
6	2	4	5	8	7	3	10	6	9	1
$\sum_{l=1}^{L} x_{kl}$	20	25	29	30	35	36	37	38	39	41

w = 0.140

Table 20

Level of agreement

Concordance coeficient		
w	>0,7	Good agreement
w	0,5÷0,7	Medium agreement
w	<0,5	Poor agreement

4. Conclusions

According to ISO 12100 the basic methodology requires that risc scoring tools adress four parameters: severity of injury related to a particular hazard (S); frequency and/or duration of exposure to the hazard (F); probability of the hazardous event (P); possibility to avoid or limit harm (A). Severity was estimated taking into account reversibile and irreversibile injures and death correspunding to the severity parameter weights from 1 to 4. Frequency and duration of exposure was appreciated considering the need and the nature for access to the danger area, the average interval between exposures and the duration of exposure with frequency and duration of exposure weights of 2, 3, 4 and 5. Probability of the hazardous event was estimated taking into account whether ship equipment have propensity to act in an unexpected manner, as well the human behavior when interacting with ship equipment relevant to the hazard; probability of occurence of hazardous event weighting of 1-5. Possibility to avoid or limit harm was estimated taking into account aspects of the equipment design and its intended application which may favor this possibility; possibility to avoid or limit harm weights 1, 3, 5.

The basic algoritm to calculate the risc was expresed by R = S*[P*(F+A)], accepting approximate risk ranges: very low (1-10), low (11-20), moderate (21-100), high (101-150), very high (151-200).

In order to calculate the inherent risk and residual risk were risk assessed ten tasks in the case of some activities on a container vessel, i.e. bowling residues out of bulk tanks (connecting hose), discharge of abnormal lifts (preparing lift for discharge), back-loading cargo (lower or place lift on deck), changing light bulbs (removing or replacing bulb), discharging tubes/pipes (before/during the work), cutting (using knives), fault finding at main switchboard and at generator (fault at main switchboard), changing out a navigation light (ascend must to access the navigation light unit), cooking in heavy weather (working with oil), internal cleaning and maintenance of switchboards (shut down, open and cleaning switchboards).

To determine the degree of agreement between experts concordance matrix, the ten tasks were risk assessed by three groups of experts each composed by six experts, i.e. experts with experience high, intermediate and low. By calculating the concordance coefficient we obtain for the three experts groups the values 0.918, 0.415 and 0.140 respectively.

In order to take into account the experience degree of experts we propose to use an affected risk R_{aff} which is optimum for the concordance coefficient equal by unity.

R E F E R E N C E S

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