

MARITIME

Goal-Based Standards SLA

Life Saving Appliances exercise

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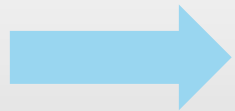
Contents

Speaker's

- **Motivation for LSA Exercise**
- **Background**
- **LSA Exercise**
- **Summary & Outlook**

Motivation₁

- **Generic Guidelines For Developing IMO Goal-Based Standards (MSC.1/Circ. 1394, 2011) one of the major results of GBS-SLA discussion**



Rarely addresses the elements needed for GBS-SLA!

- Main outstanding issues (more exist)
 - Goals
 - Granularity
 - Quantitative / qualitative
 - Functional requirements
 - Granularity
 - How to formulate (contents, style)
 - Quantitative elements
 - Tier III justification

Motivation₂

- The discussion on GBS-SLA so far
 - Produced a lot of valuable information on single aspect, e.g.:
 - Single aspect on reliability analysis (structure)
 - Relation between FSA and GBS-SLA
 - Basic set of functions for ship safety
 - But was hardly structured



No clear model/description for IMO

GBS-SLA exists!

- Remark: The following slides contain
 - Results of the current discussion
 - Proposals made
 - Further developments made (drafting GBS-SLA)

Developing GBS-SLA by means of LSA Exercise

GBS-SLA: LSA Exercise

- In order to have a more structured discussion Germany suggested to develop a practical example for functions and functional requirements (MSC 90/5/2)
- This example
 - Can be used to discuss and solve remaining issues of GBS-SLA
 - Will provide details of GBS-SLA
 - Subsequently provides a “blue print” for further development of a GBS-SLA framework

LSA Exercise (MSC 90/28)

- LSA Exercise uses existing DE agenda item(s)

DEVELOPMENT OF A NEW FRAMEWORK OF REQUIREMENTS FOR LIFE-SAVING APPLIANCES

DEVELOPMENT OF SAFETY OBJECTIVES AND FUNCTIONAL REQUIREMENTS OF THE GUIDELINES ON ALTERNATIVE DESIGN AND ARRANGEMENTS FOR SOLAS CHAPTERS II-1 AND III

GBS-SLA: LSA Exercise

- **Why LSA activities?**
- **DEVELOPMENT OF A NEW FRAMEWORK OF REQUIREMENTS FOR LIFE-SAVING APPLIANCES**
 - Complete review of SOLAS chapter III including new provisions (DE 51)
 - To cope with future technological development: goals & functional requirements (DE 52)
- **DEVELOPMENT OF SAFETY OBJECTIVES AND FUNCTIONAL REQUIREMENTS OF THE GUIDELINES ON ALTERNATIVE DESIGN AND ARRANGEMENTS FOR SOLAS CHAPTERS II-1 AND III**
 - Safety objectives (goals) and functional requirements will support alternative design analysis and approval (MSC.1/Circ.1455 Definition of approval basis)



Close relation to GBS discussion at MSC

GBS-SLA: LSA Exercise

**First focus: Development of a functional model
towards existing regulations**



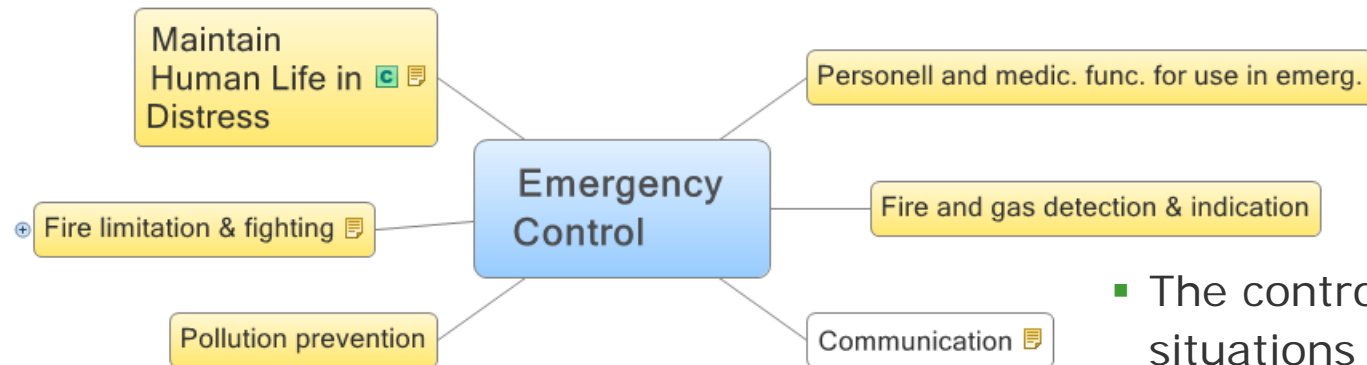
LSA Exercise: *Function Map₁*

- The goal related to safety of persons on board and environmental protection relate to safety of ship

- One of the functions assigned to ship safety is the control of emergency situation (functions specified by CG)

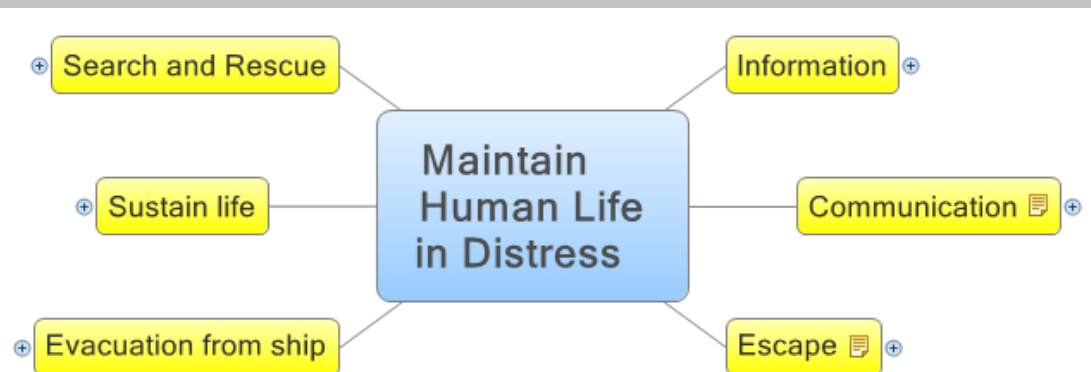


LSA Exercise: *Function Map₂*



- The control of emergency situations (incidents) should consider detection and mitigation

- High-level functional map considering six subsystems as specified by DE correspondence group



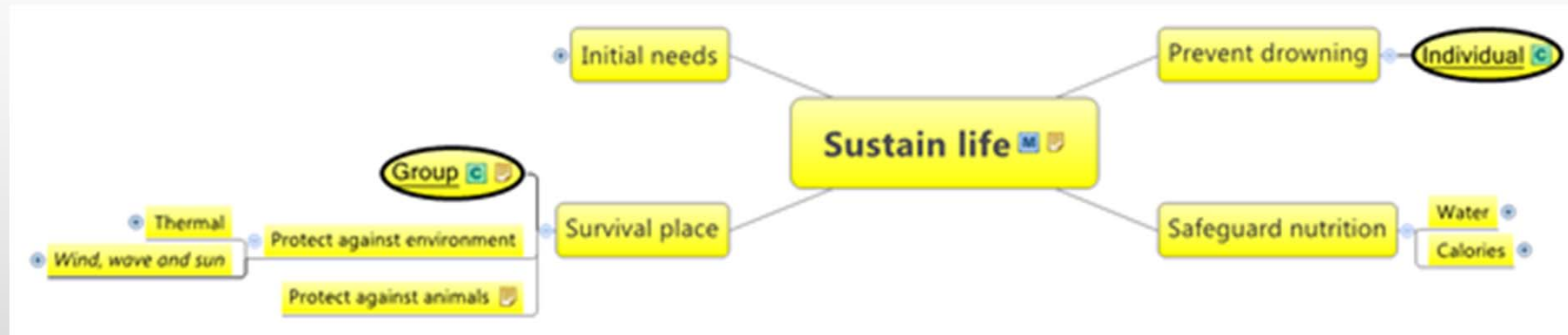
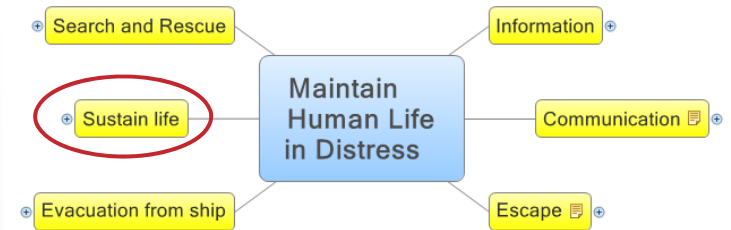
LSA Exercise: *Function Map*₃



- Further *Function map* iteratively developed considering
 - Definitions for six subsystems developed in CG¹, e.g.:
 - *Sustain life*: ensure safety of persons in water or in survival craft. Examples of present appliances of this functional requirements are immersion suits, lifejackets and thermal protective aids;
 - Search & Rescue, evacuation from ship, escape, communication and information
 - Specifications for functional categories¹ (*Accessibility, Usability, Reliability, ...*)
 - Regulations of SOLAS Chapter III and LSA Code
- Function map can help to
 - Develop the structure for FRs
 - Formulate FR
- Result presented on following slides

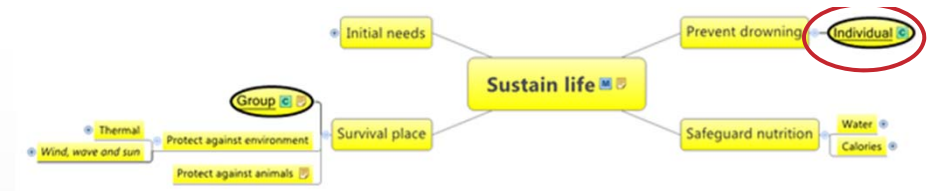
¹ DE 57/7

LSA Exercise: *Function Map*₄

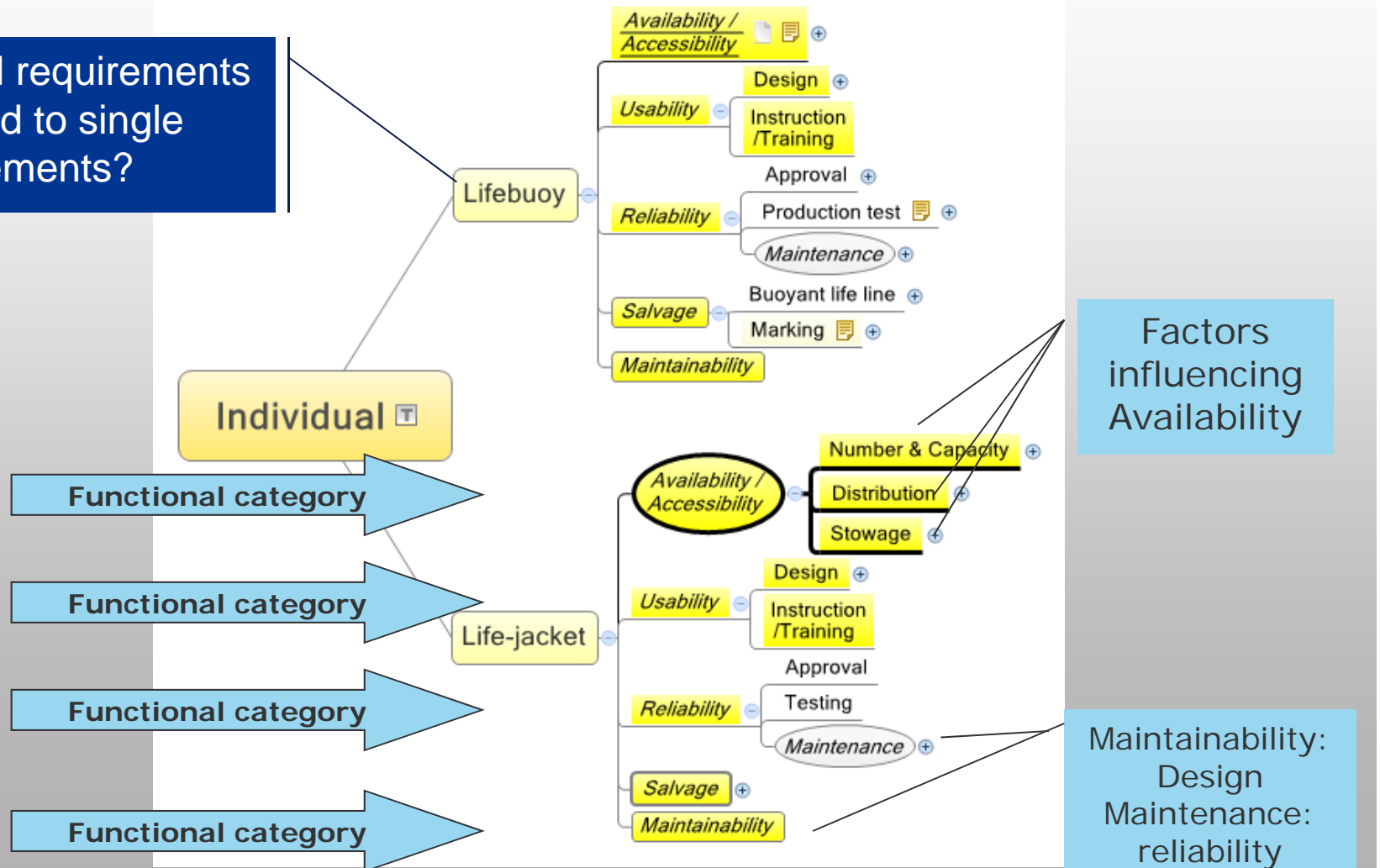


- These functional areas address the following hazards:
 - Prevent drowning: means to prevent drowning of individuals,
 - Safeguard nutrition: means to supply evacuated persons with water and calories,
 - Protect against animals: means to protect evacuated persons against animals (e.g. relevant for ships operating in Arctic waters); and.
 - Survival place: means provide a habitable place (until rescue)
 habitable means: protection against high/low temperature, sun (solar radiation), wind (e.g. combination with low temperature) and waves
as well as protect against drowning.

LSA Exercise: *Function Map*₅



functional requirements
related to single
elements?



LSA Exercise: *Function Map₆*

Life-jacket

Number & Capacity

One for every person o.B. SOLAS III/7, 2.1

Sufficient for persons on watch and remotely located survival stations SOLAS III/7, 2.1.4

+5% min add SOLAS III/22 (Pax)

Child One for each child but at least 10% of the pax SOLAS III/7, 2.14.3

Infant Voyages of ≥ 24 h One for each infant SOLAS III/7, 2.1.2

Voyages of < 24 h 2,5% of the pax SOLAS III/7, 2.1.1

One for every person o.B. SOLAS III/7, 2.1

Sufficient for persons on watch and remotely located survival stations SOLAS III/7, 2.1.4

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One for every person o.B. SOLAS III/7, 2.1

Sufficient for persons on watch and remotely located survival stations SOLAS III/7, 2.1.4

Availability / Accessibility

Distribution

Pax Distribution SOLAS III/22 (Pax)

cabins SOLAS III/7

over ship alternative spaces SOLAS III/7

work stations SOLAS III/7

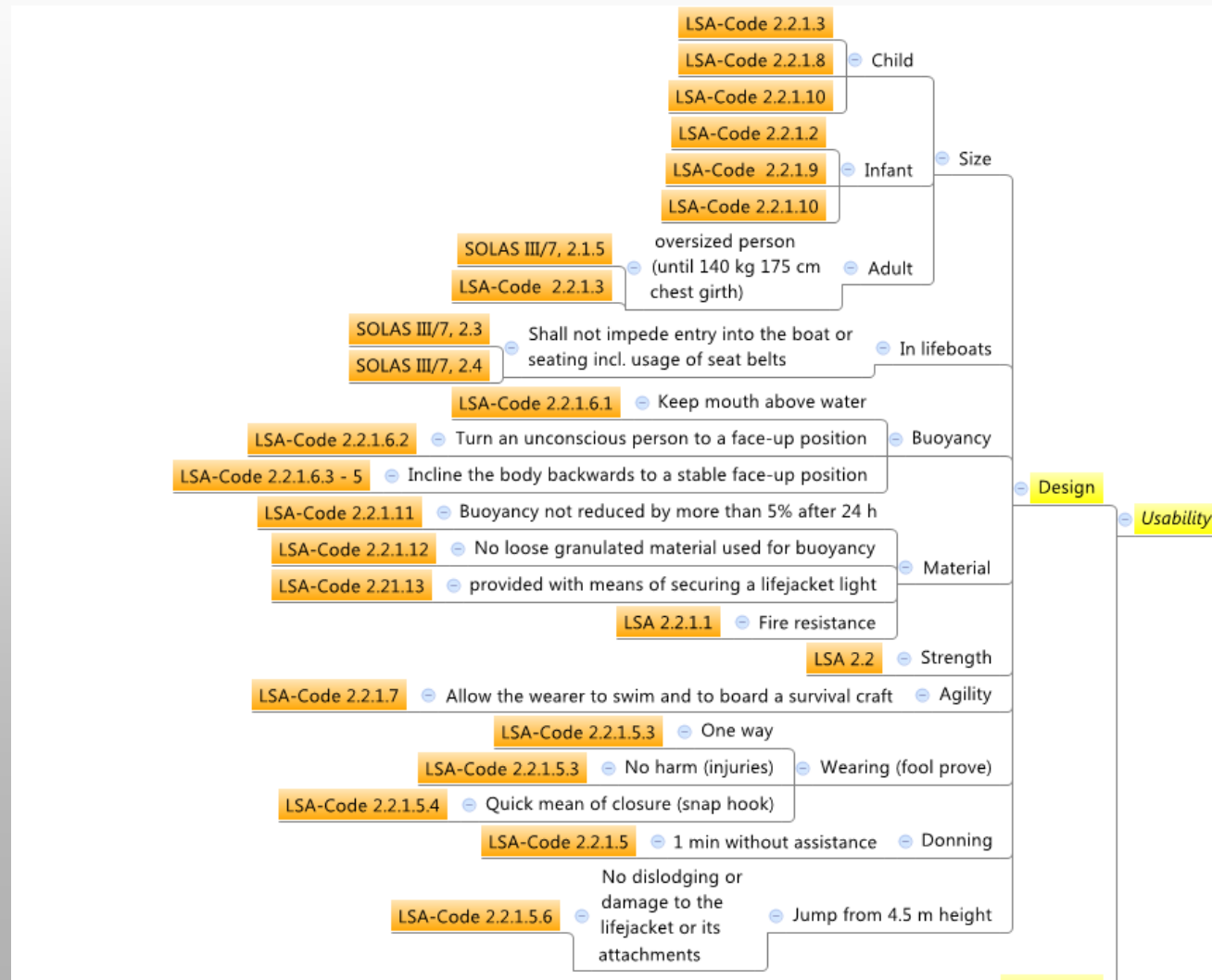
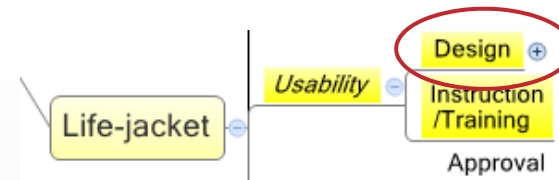
related to attachments SOLAS III/7

Stowage

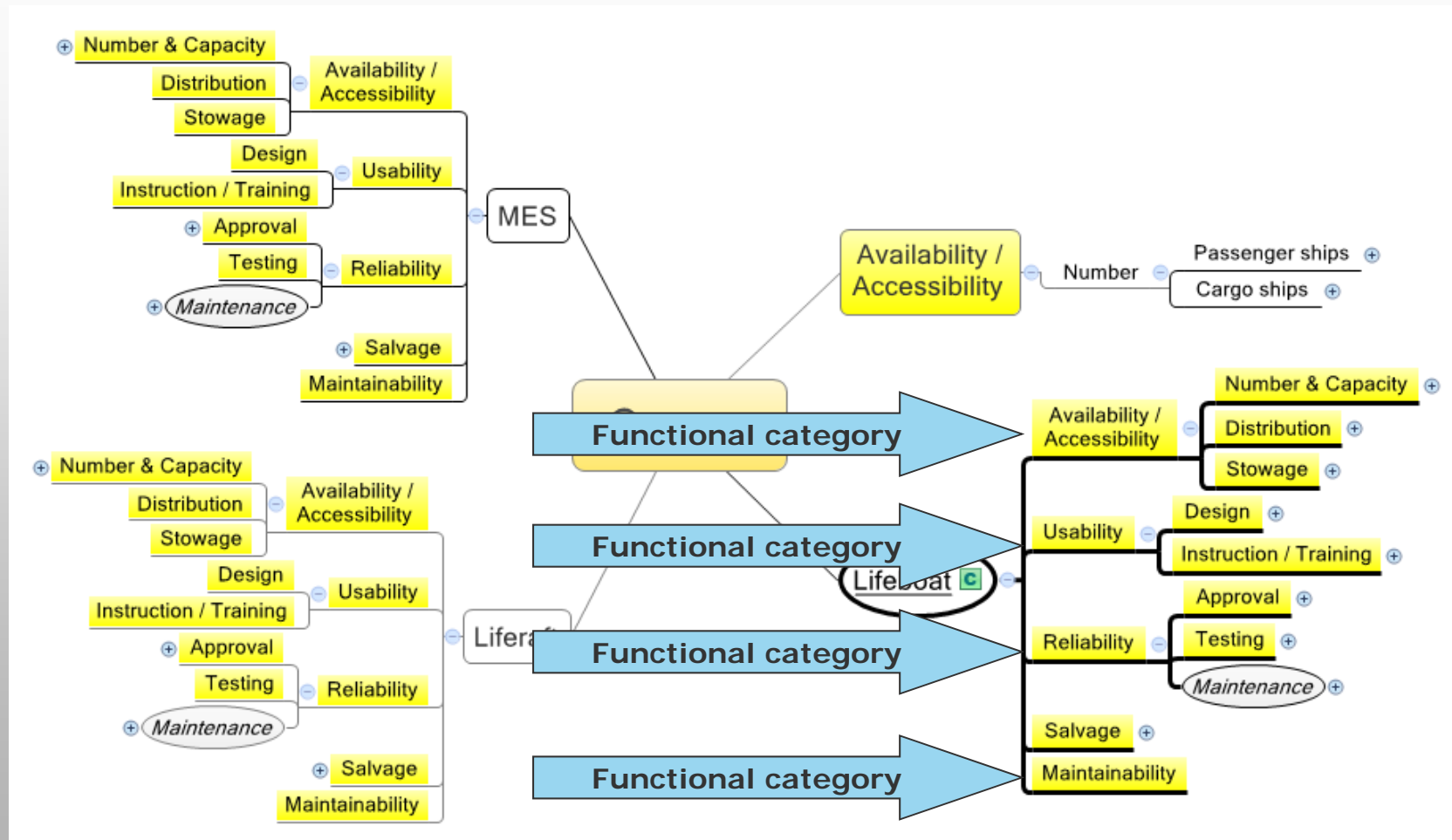
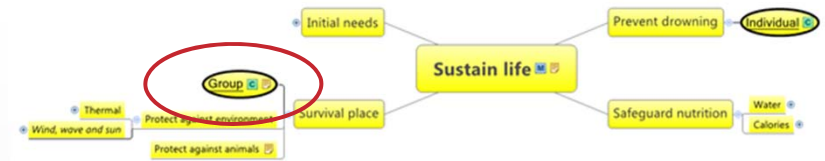
SOLAS III/22 (Pax) Public space Pax

SOLAS III/7, 2.2 If lifejackets may become inaccessible additional are necessary

LSA Exercise: *Function Map₇*



LSA Exercise: *Function Map₈*



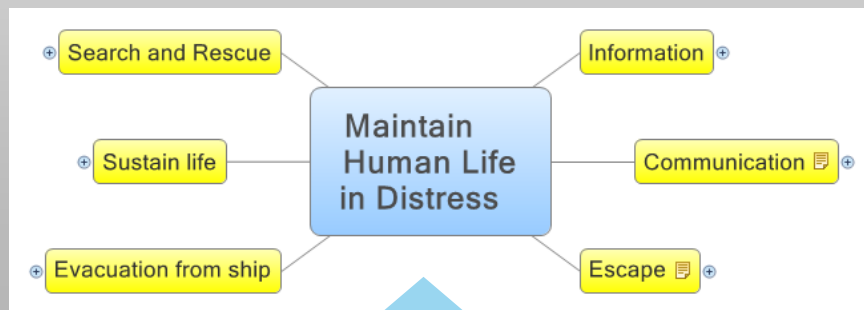
LSA Exercise

- Function map
 - Provides relation between high-level functional requirements (DE 57) and current regulations (SOLAS, LSA)
 - If further developed: relation to other SOLAS chapter
 - Structure relation using “functions” and “functional categories”
 - Parallel gap analysis delivered some inconsistencies

Next?

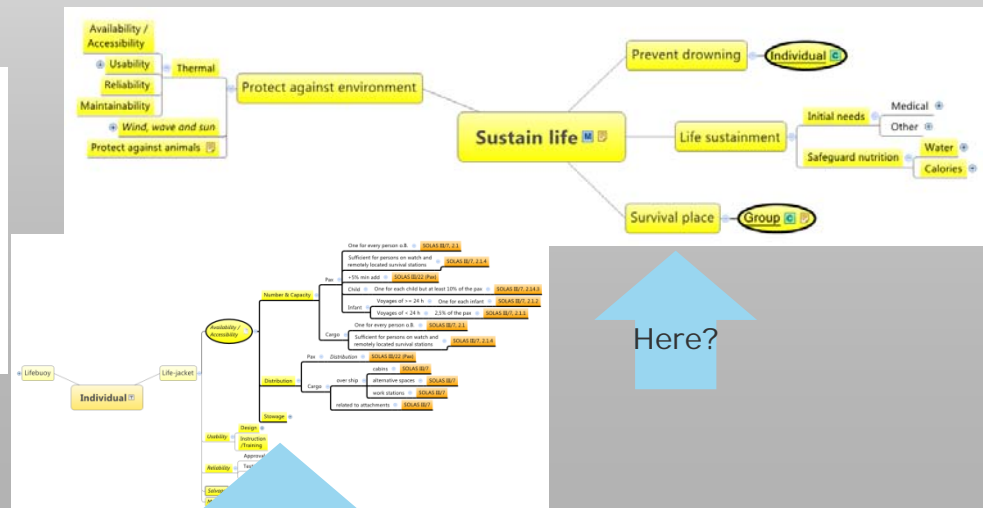
Functional Requirements

- “Requirements” for Functional Requirements
 - Criteria for compliance with goals
 - Should cover all areas necessary to meet goals
 - Consider all relevant hazards
 - +
 - Must fulfil requirements for GBS (“leave space for innovation”; “describe what to achieve”)
 - Provide basis for Alternative Design
- Open: style and granularity



Here?

Here?




Here?

Here?

Functional Requirements

Granularity

- Generic “high level” functional requirement (e.g. “sustain life”)
 - Easier to develop (requires no detailed structuring of functions) (+)
 - Less detailed relation to regulations (-)
 - Leave large space for interpretation (-)

 Suggestion: develop functional requirements on more detailed level

Style

Proposal: consider three elements

- A description explaining the requirement short and concise
- The rationale behind the function required
- Information on the expected performance.

Functional Requirements: LSA Example



Description	Rationale	Expected performance
Provide a safe place protecting all people (crew + passengers) on board a ship in distress until rescue	Fire & explosion and loss of floatability of vessel endanger persons on board and require a place for survival until rescue	<ul style="list-style-type: none"> - Safe even if vessel sinks - Safe in case of fire on vessel - Protection for anticipated time of rescue (set by regulator?)
Provide means to protect people in distress against (extreme) environmental conditions	High/low temperature, strong wind, animals etc. can endanger people by the hazards hypothermia, heat stroke etc.	<ul style="list-style-type: none"> - A habitable environment is provided protecting people against anticipated temperatures, wind, sun radiation, ...
Provide means to enable survival in water until rescue	Persons in water are endangered by drowning and hypothermia.	Means are provided to <ul style="list-style-type: none"> - prevent drowning of persons (unconscious, awake) in water - enable/support rescue from water?
Provide means for life-sustainment	Persons in distress are endangered by starvation, die of thirst or injuries. Persons on board are endangered by consequences of injuries.	Means are provided to <ul style="list-style-type: none"> - sufficiently supply people with water - sufficiently supply people with calories - allow first medical aid for injuries - all provided for anticipated time of rescue

Functional Requirements: LSA Example



Description	Rationale	Expected performance
Provide a safe place protecting all people (crew + passengers) on board a ship in distress until rescue	Fire & explosion and loss of floatability of vessel endanger persons on board and require a place for survival until rescue	<p>Expected performance wrt.</p> <p>Accessibility/Availability</p> <p>Usability</p> <p>Reliability</p> <p>Maintainability</p> <p>...</p>
Provide means to protect people in distress against (extreme) environmental conditions	High/low temperature, strong wind, animals etc. can endanger people by the hazards hypothermia, heat stroke etc.	
Provide means to enable survival in water until rescue	Persons in water are endangered by drowning and hypothermia.	
Provide means for life-sustainment	Persons in distress are endangered by starvation, die of thirst or injuries. Persons on board are endangered by consequences of injuries.	

Functional Requirements: LSA Example



Description	Rationale	Expected performance
Provide a safe place protecting all people (crew + passengers) on board a ship in distress until rescue	Fire & explosion and loss of floatability of vessel endanger persons on board and require a place for survival until rescue	<p>GBS-SLA</p> <p>stepwise replacement by quantitative requirements for safety or related dimensions</p>
Provide means to protect people in distress against (extreme) environmental conditions	High/low temperature, strong wind, animals etc. can endanger people by the hazards hypothermia, heat stroke etc.	
Provide means to enable survival in water until rescue	Persons in water are endangered by drowning and hypothermia.	
Provide means for life-sustainment	Persons in distress are endangered by starvation, die of thirst or injuries. Persons on board are endangered by consequences of injuries.	

Functional Requirement



Description			Rationale	Expected performance
Provide strength	sufficient	ultimate	Local or global structural failure by tearing, instable crack growth or instability can lead to flooding of compartment and subsequent loss of stability endanger persons on board and/or release of environmental harmful substances	<ul style="list-style-type: none"> - Structure ultimate load bearing capacity is higher than stresses by operational loads (cargo, environmental) throughout the lifetime / service period of ship <ul style="list-style-type: none"> o Maintenance o Corrosion protection - Welds and base material provide sufficient ductility to prevent brittle fracture - ...
Provide strength	sufficient	service	Local or global plastic deformation can lead to loss of serviceability endanger persons on board and/or release of environmental harmful substances	<ul style="list-style-type: none"> - Structure load bearing capacity before yielding is higher than stresses by operational loads (cargo, environmental) throughout the lifetime/service period of ship - Consideration of uncertainty in anticipated loads - ...
Provide strength	sufficient	fatigue	Local or global structural failure by stable crack growth can lead to flooding of compartment and subsequent loss of stability endanger persons on board and/or release of environmental harmful substances .	<ul style="list-style-type: none"> - Fatigue life is higher than anticipated lifetime/service period of ship - Consideration of uncertainty in anticipated loads - Consideration of uncertainty in material properties - Consideration of tolerances

Functional Requirement



Description			Rationale	Expected performance
Provide strength	sufficient	ultimate	Local or global structural failure by tearing, instable crack growth or instability can lead to flooding of compartment and subsequent loss of stability endanger persons on board and/or release of environmental harmful substances	<p>GBS-SLA</p> <p>stepwise replacement by quantitative requirements for safety or related dimensions</p>
Provide strength	sufficient	service	Local or global plastic deformation can lead to loss of serviceability endanger persons on board and/or release of environmental harmful substances	
Provide strength	sufficient	fatigue	Local or global structural failure by stable crack growth can lead to flooding of compartment and subsequent loss of stability endanger persons on board and/or release of environmental harmful substances .	

LSA Exercise

- Function map
 - Provides relation between high-level functional requirements (DE 57) and current regulations
 - Structure relation using “functions” and “functional categories”
 - Parallel gap analysis delivered some inconsistencies
- Functional requirements
 - Consider “function”, “rationale” & “performance”
 - Examples provided for further discussion

Next?

LSA Exercise: Risk Model

- GBS-SLA will use risk-based verification/justification for regulations and rules (Tier III):
- Risk-based verification/justification is understood as quantitative risk analysis
- Effort increases with degree of detail for risk analysis
- “Uncertainty” in risk analysis needs to be acceptable for regulator



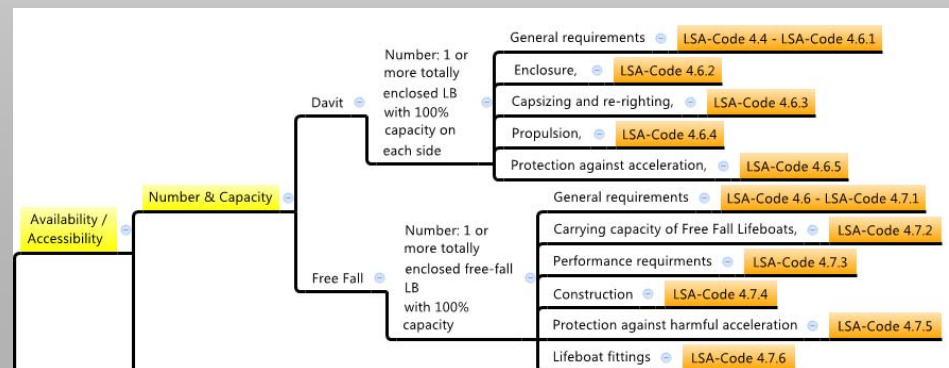
- What shall be considered?
- Granularity of risk calculation: for each regulation / global model?
- Relation between “functional requirements”, “function map” and “risk model”
- Quantification of risk model?

LSA Exercise: Risk Model

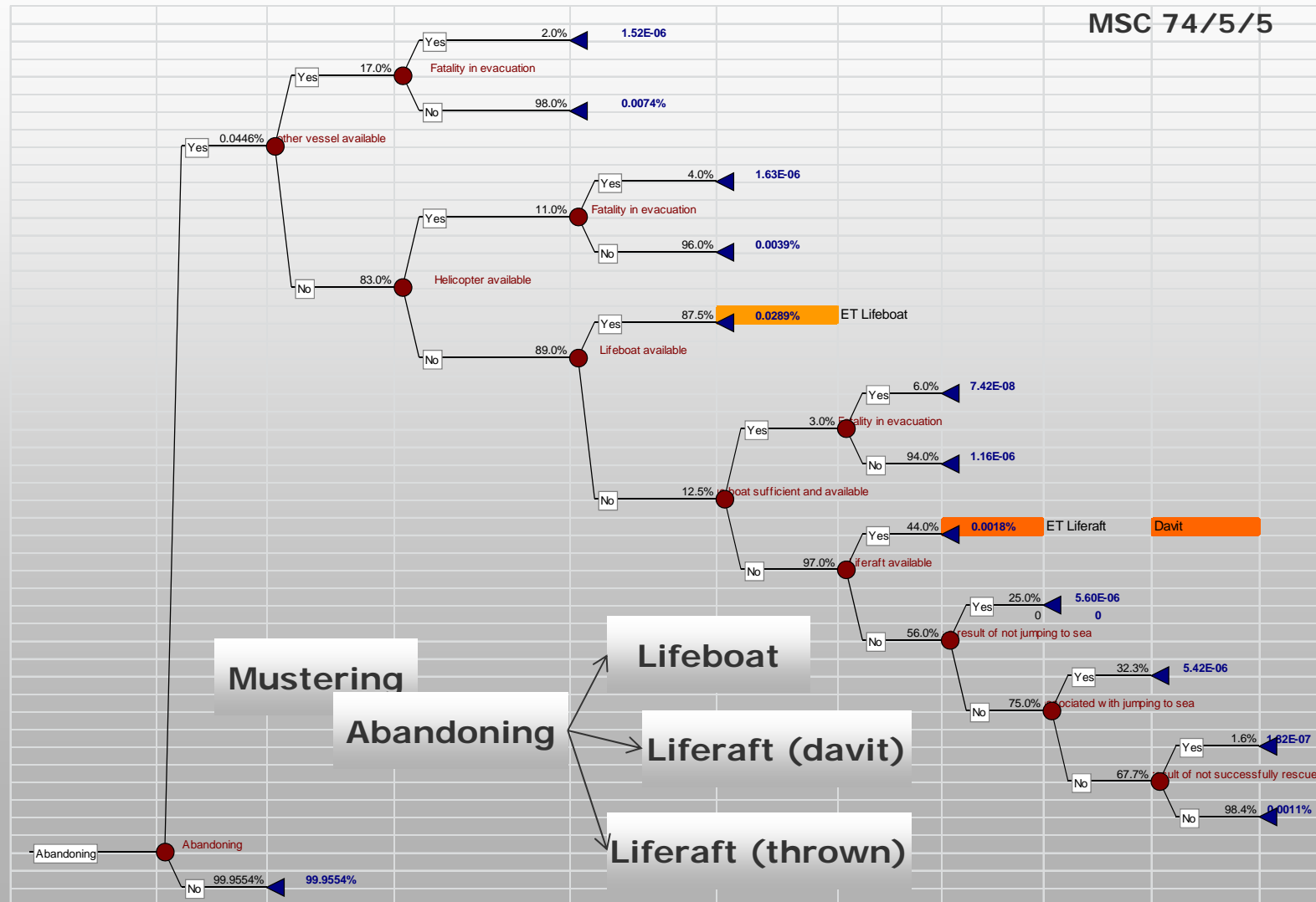
- What shall be considered?
 - Some elements in regulations should not be considered, e.g.:
 - Colour: LSA 1.2.2.6 "...be of international or vivid reddish orange, or a comparably highly visible colour on all parts where this will assist detection at sea..."
 - Radio frequency: SOLAS IV/7.2 "... a radio installation capable of maintaining a continuous DSC watch on VHF channel 70..."

➡ Should not be considered but agreed

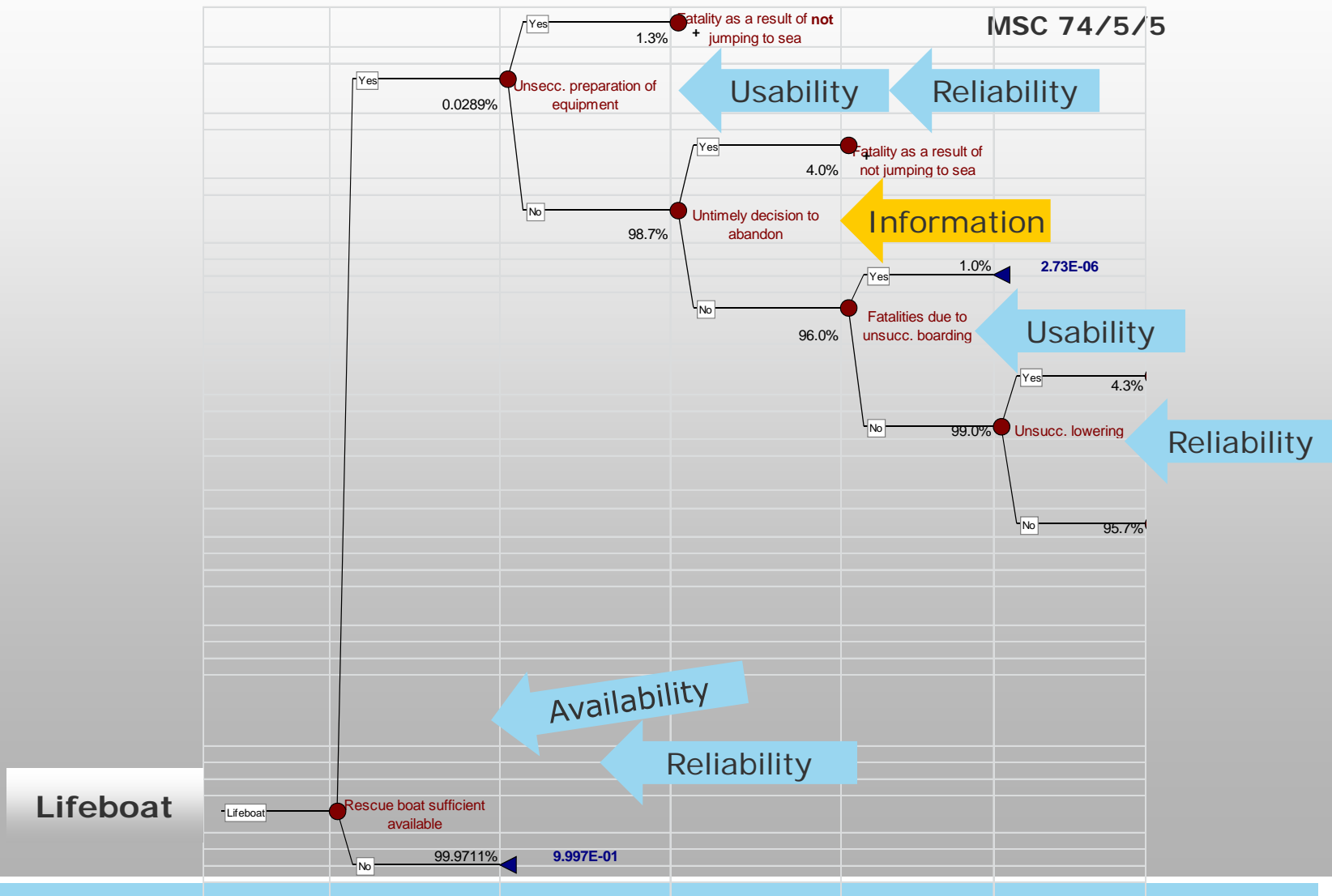
- Granularity of risk calculation: for each regulation?



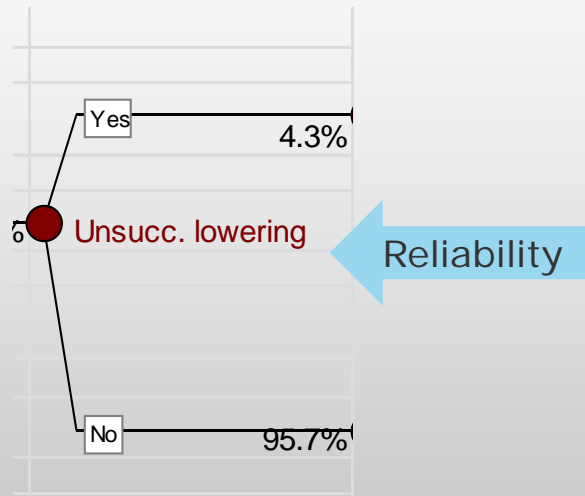
First Approach: FSA Bulk Carrier



First Approach: FSA Bulk Carrier



LSA Exercise: Risk Model



- Risk model can be further developed considering the elements of the system, e.g.
 - Technical:
 - Davit (brake, sleeves, wire)
 - Hook
 - Lifeboat
 - Requires reliability data
 - +
 - Human element
- Important: balance effort and result

LSA Exercise

- So far work on LSA Exercise provides
 - Function map: relation between high-level functional requirements (DE 57) and current regulations
 - Proposal for developing functional requirements
 - Consider “function”, “rationale” & “performance”
- Next steps should be:
 - Agree on style guide for functional requirements
 - Develop and agree on example for Tier III risk-based verification/justification



Summary & Outlook

- Goal-Based Standards are an alternative to current regulation:
 - specifying what shall be achieved rather than how
- GBS-SLA requires the application of risk-based methods for justification of regulations and rules
- Results of discussion so far provide
 - no clear model of GBS-SLA
 - demonstrate the need for applying a step-by-step approach limiting discussion to single aspects

Summary & Outlook

- Due to the fact that no “unique” solution exists favourably examples should be developed:
 - identification of issues and their solution
 - agreeing the structure “step-by-step” (next step: agree on formulation and placing of functional requirements)
 - participation of all stakeholders and not only “experts”
 - produce a “blueprint” for the further development
- LSA Exercise will provide basis for detailed discussion on GBS elements and verification of functionality and therefore support development of GBS SLA
- LSA Exercise suggested to address remaining issues by an example

Summary & Outlook

- Results of work on LSA Exercise
 - Example for function map provides a clearer structure of regulations (avoidance of *unwanted side effects*)
 - Suggested structure for formulation of functional requirements addresses some of the concerns raised in discussions
- Next steps should be:
 - Agree on style guide for functional requirements (MSC 94?)
 - Develop and agree on example for Tier III risk-based verification/justification

Thank You For Your Kind Attention!

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