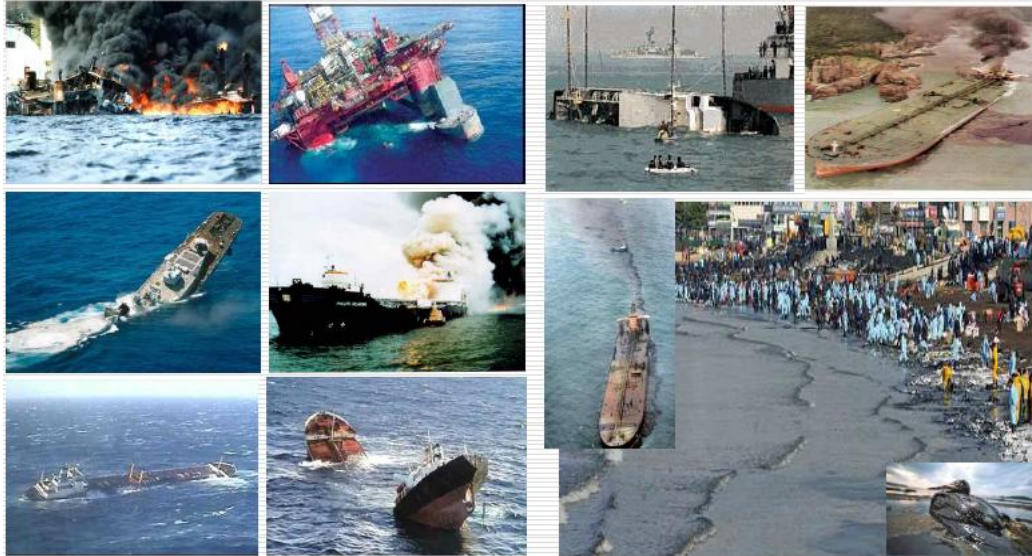


Risk-Based Design for Ship Safety

(Suggestions for Development of Industry Standards)



Dec. 1, 2011

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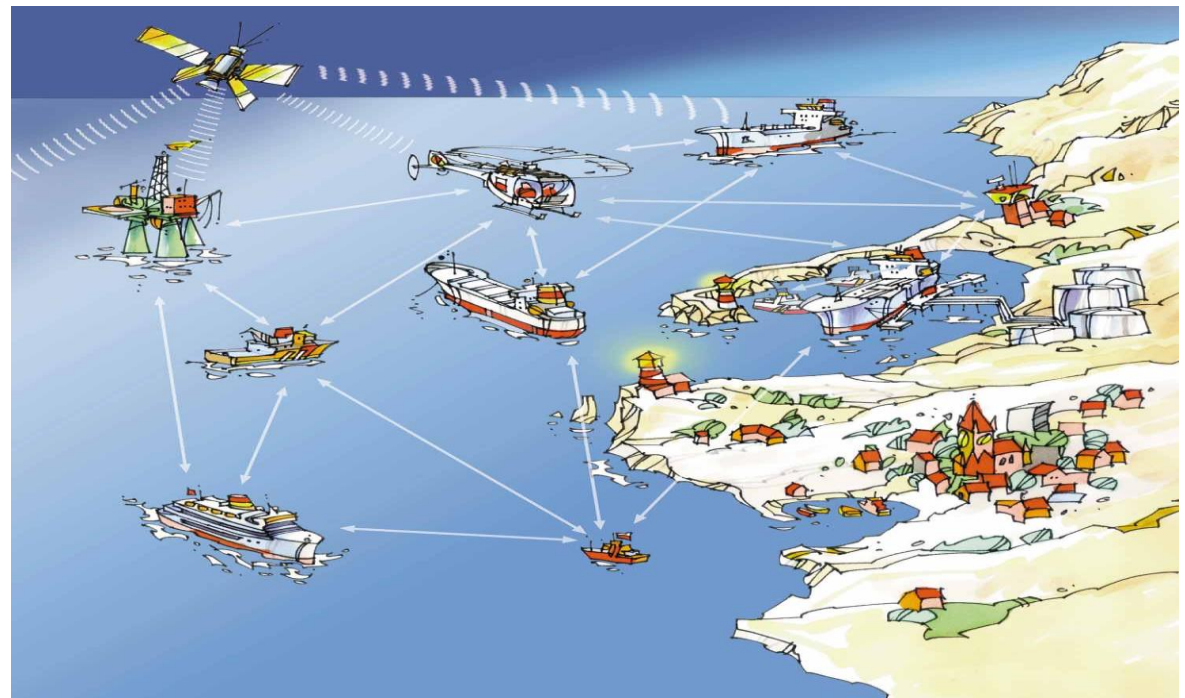
III. Standardization for RBD

IV. Summary

Safety is ...

- “freedom from danger” – *Oxford Dictionary*
- “a perceived quality that determines to what extent the management, engineering and operation of a system is free of danger to life, property and environment” – *C. Kuo*

*Environment of
Maritime Safety*

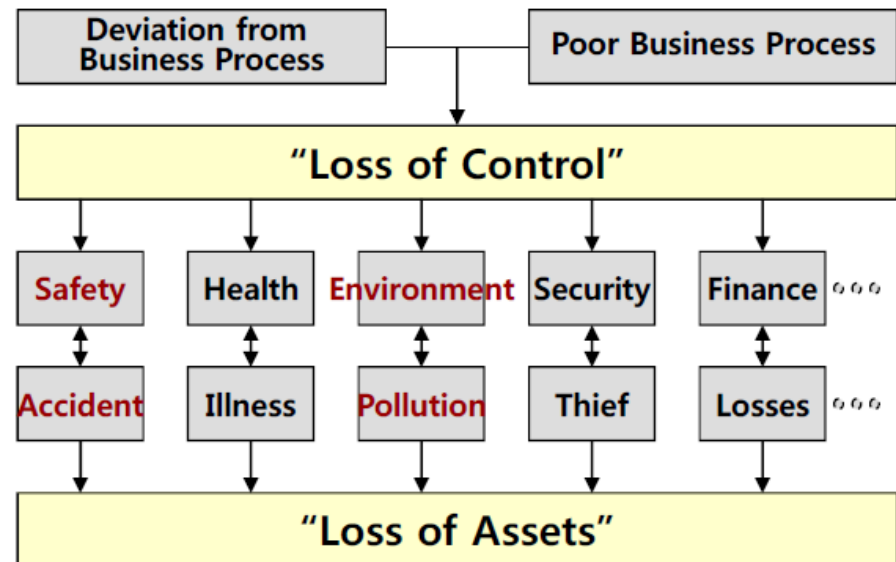


Risk is ...

- “effect of uncertainty on objectives”
- “the combination of the **frequency** and the severity of **consequence**” – *IMO FSA Guidelines*

✂ Domains of Risk

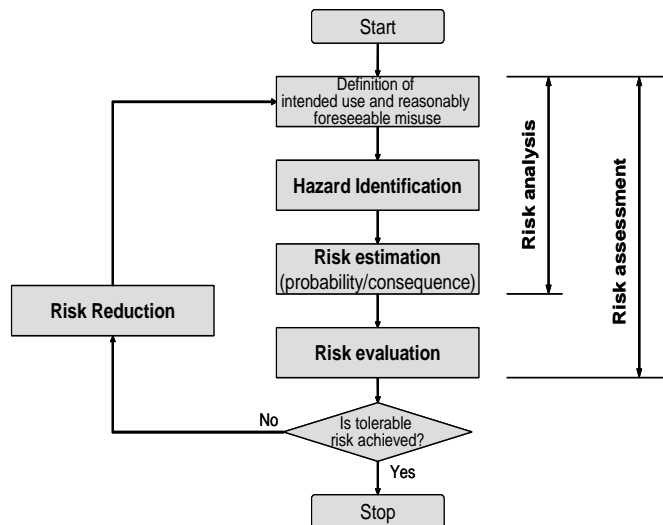
- Cost
- Schedule
- Technical Performance
- **Safety**
- Environmental
- Legal
- Political
- ...



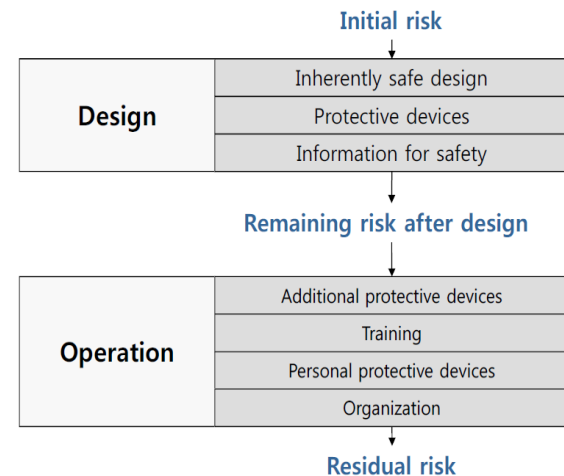
Basics of Risks

Safety and Risk (ISO/IEC Guide 51)

- ❑ No absolute safety, relatively safe with residual risk
- ❑ Safety is defined as “**freedom from unacceptable risk**”
- ❑ Safety is achieved by reducing risk to a ‘tolerable level’ (**tolerable risk**)
- ❑ ‘**Tolerable risk**’ is achieved by the iterative process of risk assessment (risk analysis and risk evaluation) and risk reduction .



Iterative process of risk assessment and risk reduction



Priority of Risk reduction

Risk-Based Approach(RBA) is

- a systematic, logical, and comprehensive tool to assess risks for the purpose of increasing safety in the life-cycle of a system(s)

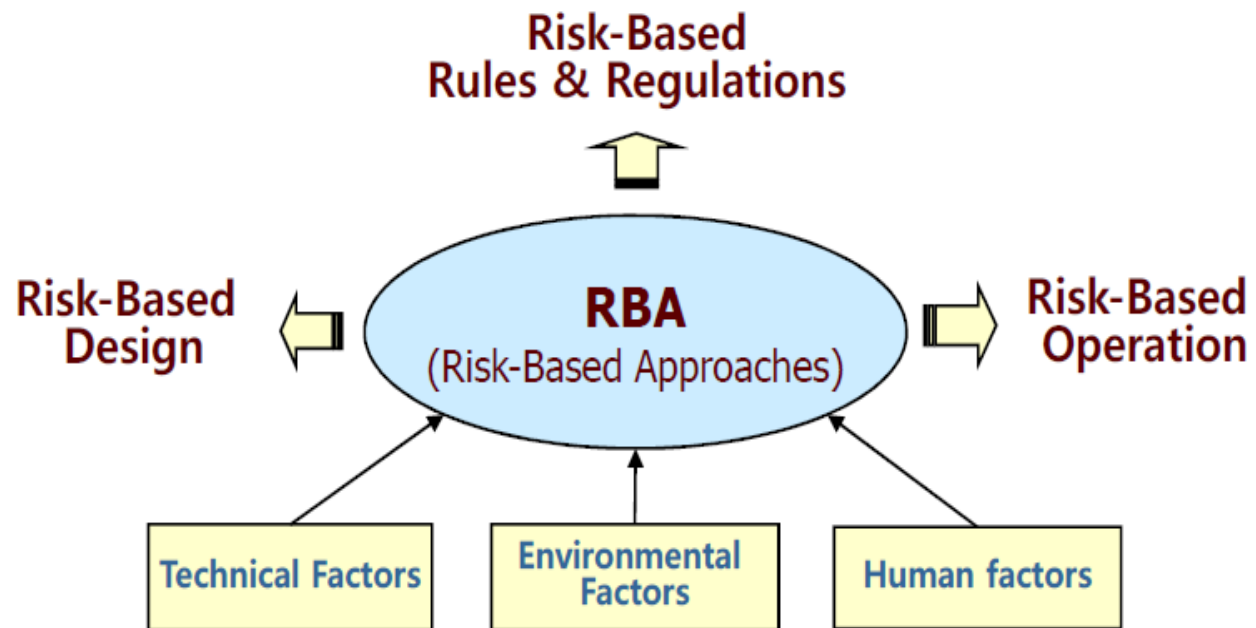


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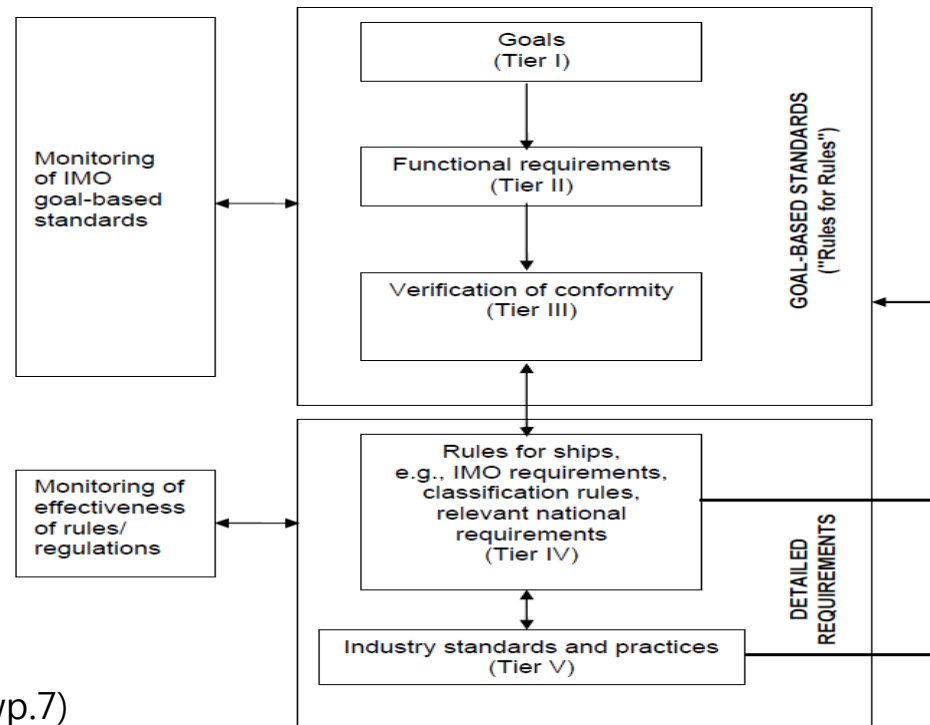
IV. Summary

RBA in the Maritime Industry

- ❑ **Safety Cases** (*UK Health and Safety Executive, 1992*)
- ❑ **Risk-Based Decision-Making System** (*USCG, 2000*)
- ❑ **Interim Guidelines for WIG craft** (*IMO MSC/Circ.1054*)
- ❑ **Alternative Design and Arrangements**
(*IMO MSC/Circ.1002, MSC.1/Circ.1212*)
- ❑ **IMO FSA** (*IMO MSC/Circ.1023-MEPC/Circ.392, 2001*)
- ❑ **GBS/SLA-based**
- ❑ **Goal-based regulations (being developed)**
 - Revision of the Polar Code
 - Revision of LSA
 - Revision of damage stability code, SOLAS 2009
 - New generation of intact stability
 - ...

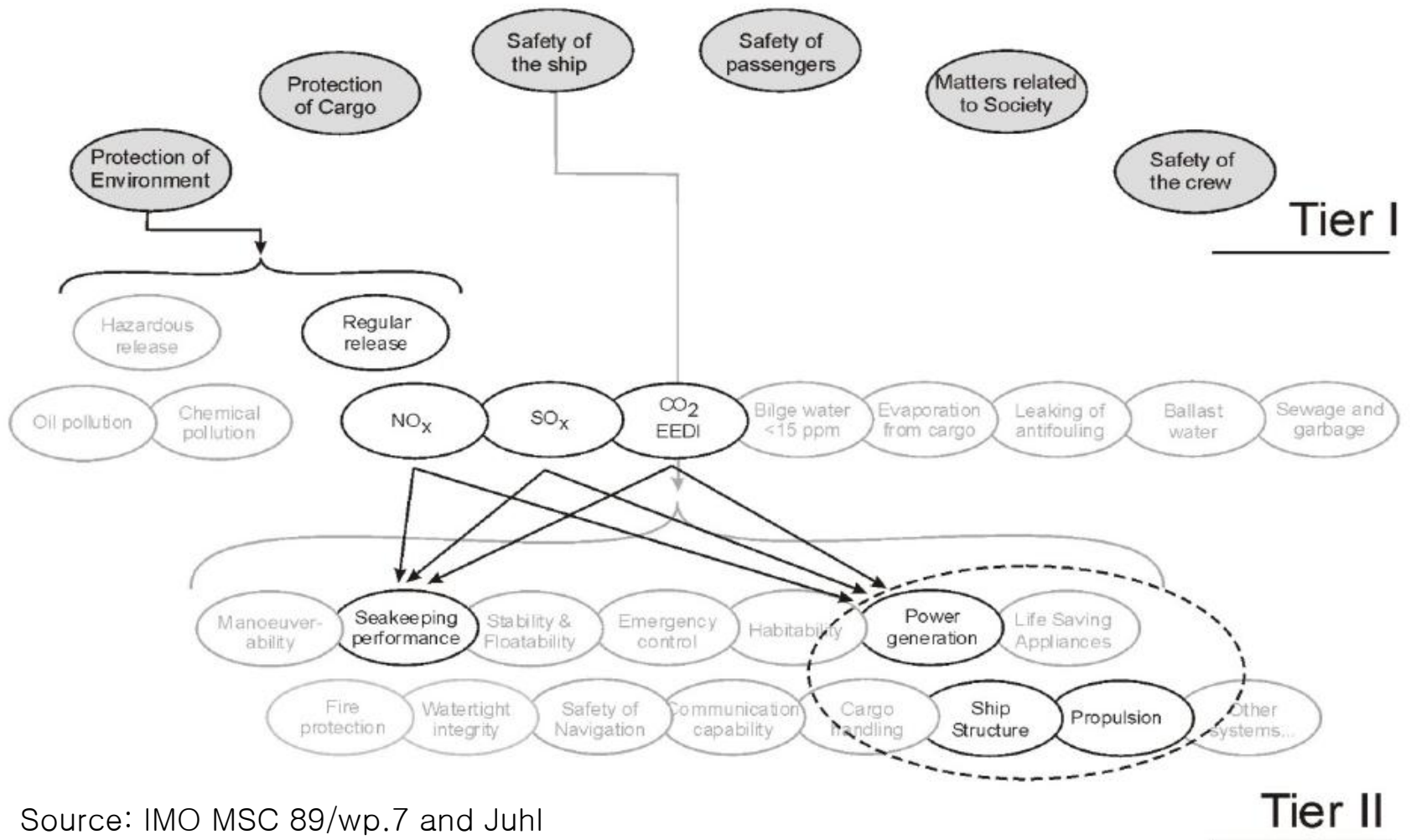
※ IMO GBS (Goal-Based Standards)

- ❑ A new regulatory framework for the design and construction of new ships “for safe, secure, efficient and environmentally sound shipping”
- ❑ IMO Resolution A.944(23), The Strategic Plan of the Organization



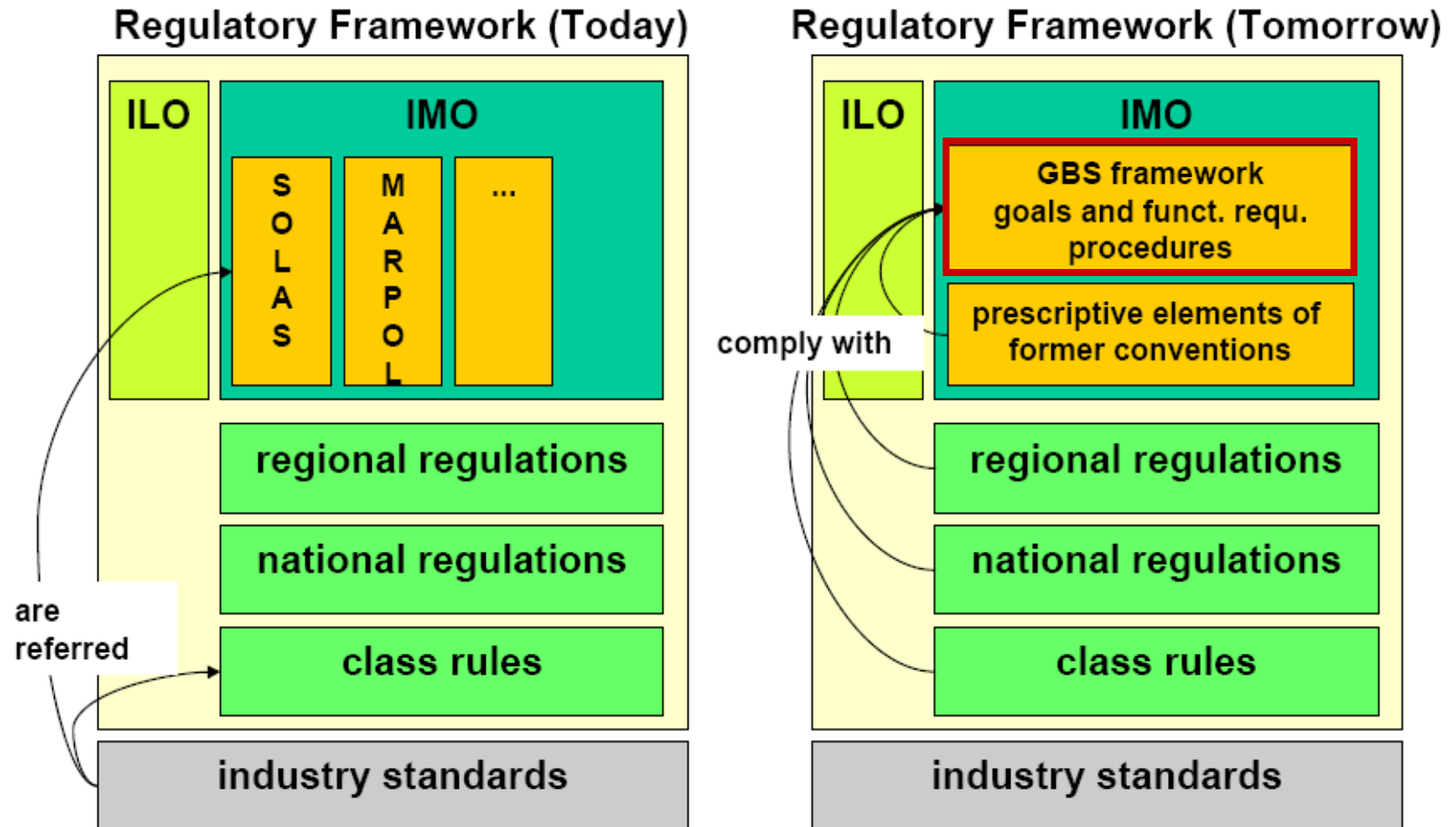
GBS framework (MSC 89/wp.7)

※ Holistic GBS framework



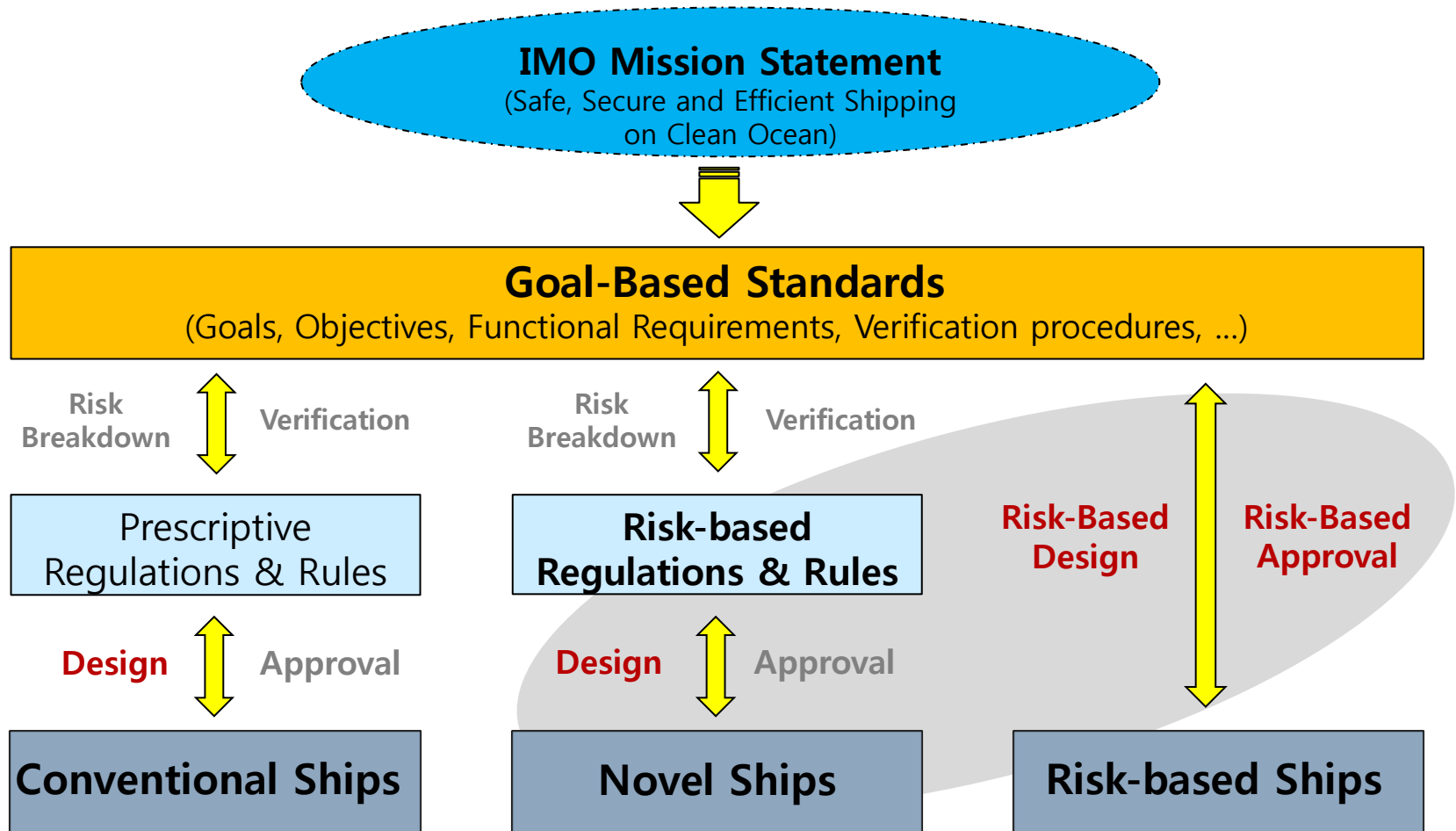
Source: IMO MSC 89/wp.7 and Juhl

※ Long-term Vision of IMO GBS



Source: Sames, 2009

Approaches to Fulfilling GBS

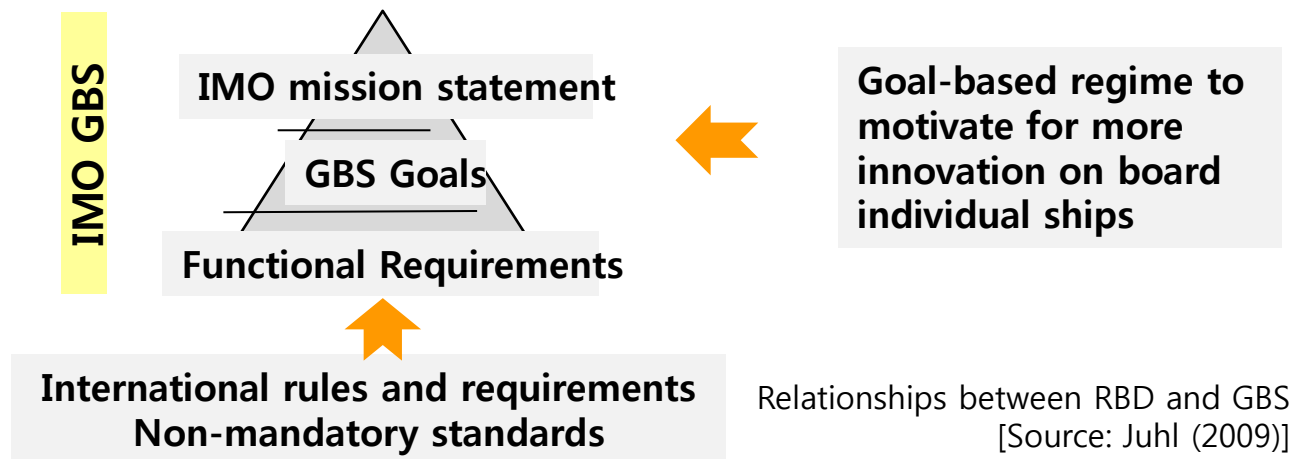


Source: SAFEDOR, 2008

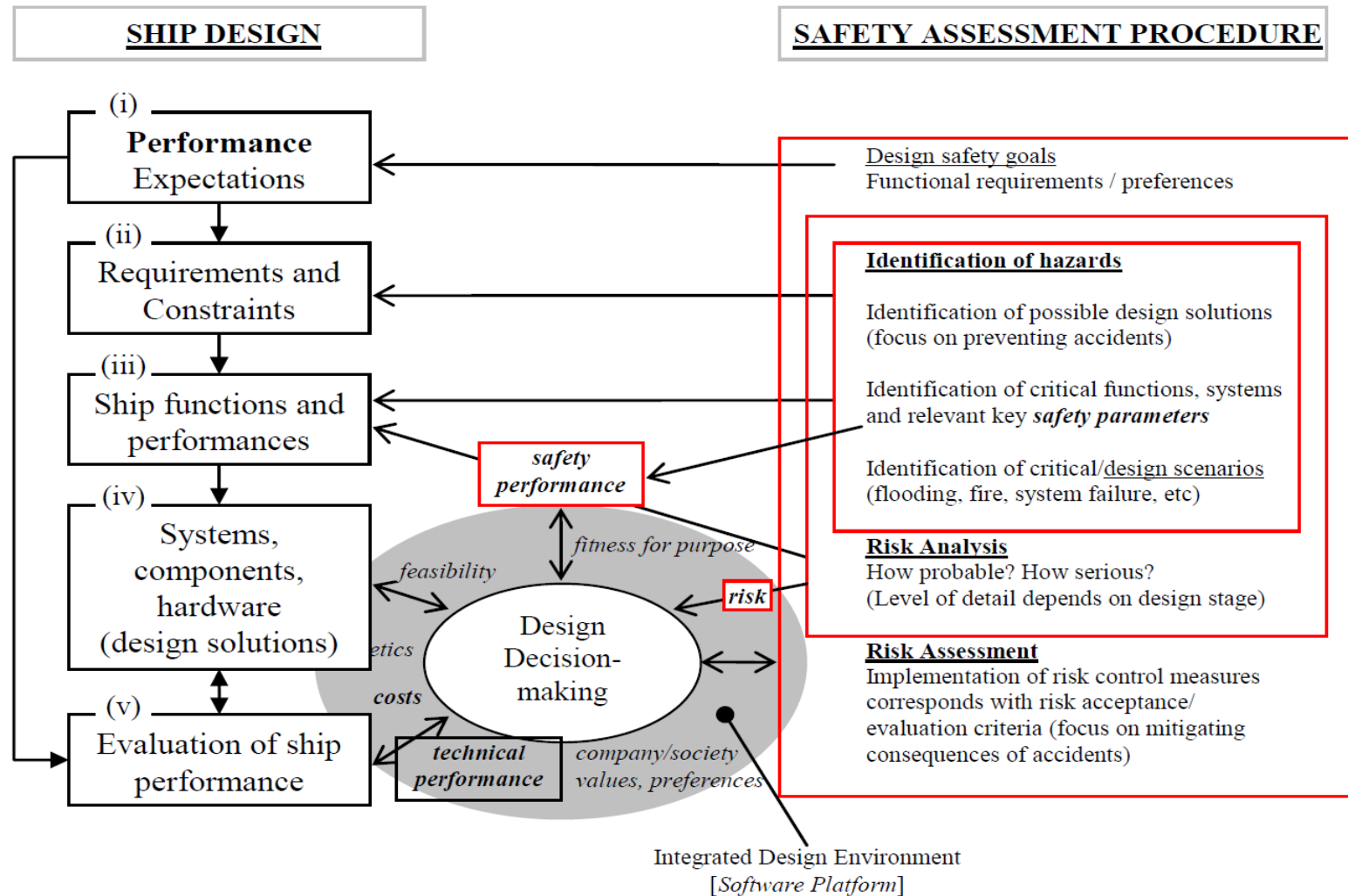
RBD(Risk-based Design) is

□ a new methodology integrating probabilistic / risk-based approaches in the design and approval processes (for beyond regulations)

- ☞ **Safety** is one additional quantified design objective along traditional objectives such as speed and cargo capacity
- ☞ **Risk** is used as measure to evaluate effectiveness of design alternatives with respect to safety and environmental protection



※ High-level RBD Framework ("SAFEDOR")



※ Approval Process for RBD (MSC 86/5/3)

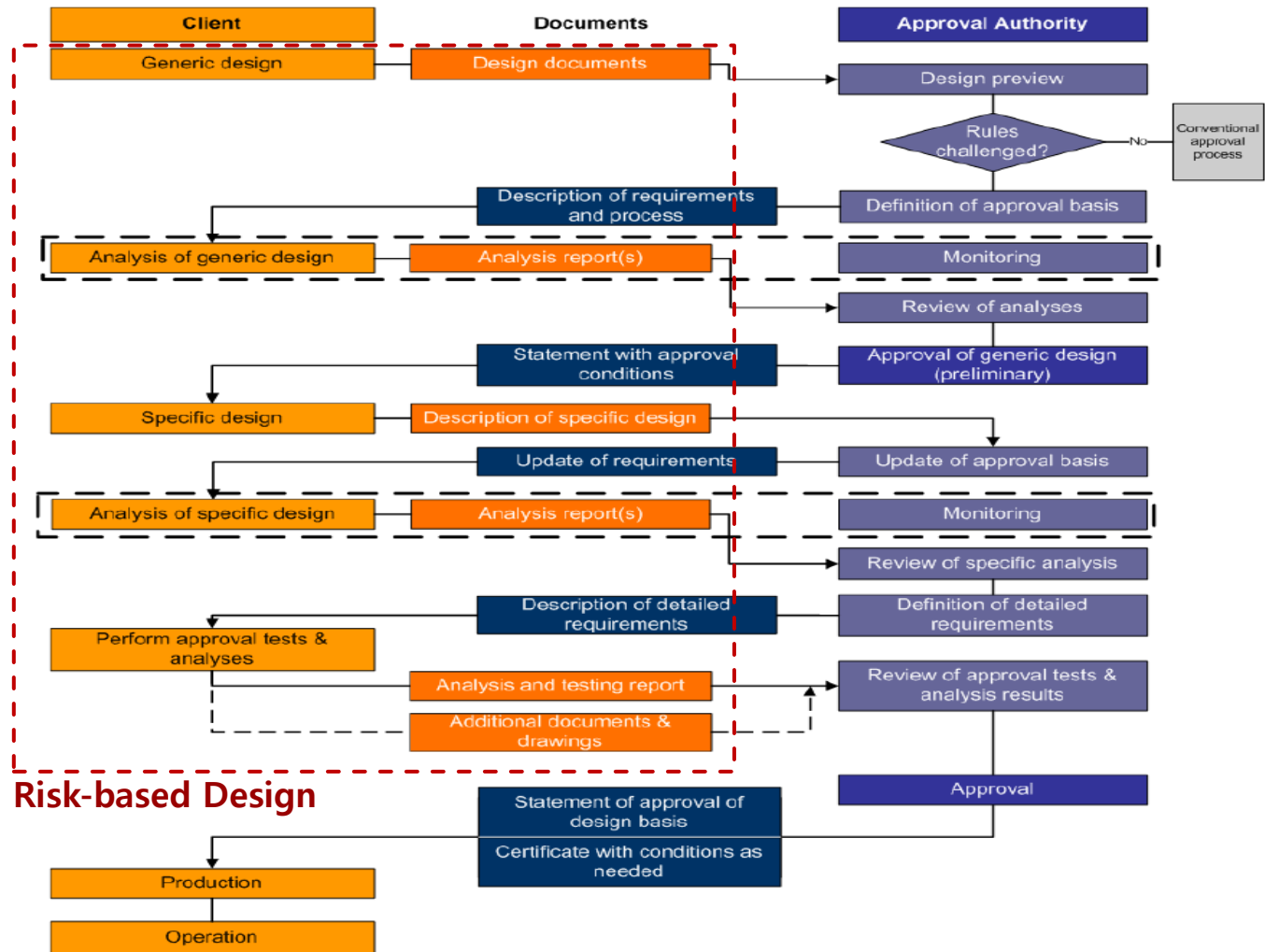


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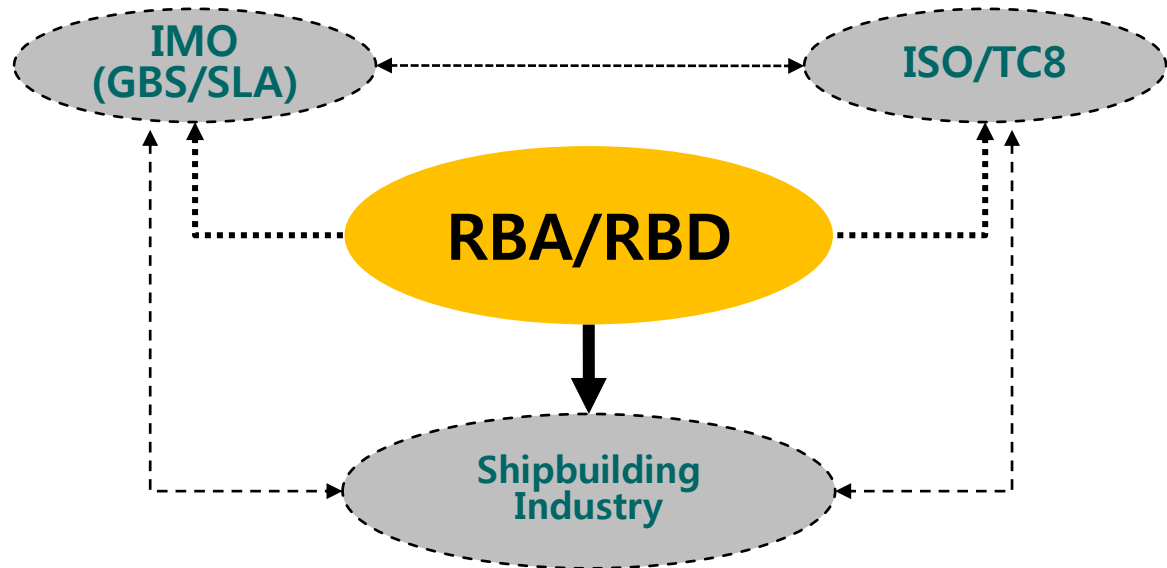
Challenges in Shipbuilding

- ❑ **Very time consuming**
- ❑ **Difficulties at pre-contractual stage**
(new contractual relationships needed)
- ❑ **Huge amount of information to be shared quickly and effectively**
- ❑ **Lacks of supporting tools**
(Some tools are still expensive, inaccurate, difficult to use, not fully validated)
- ❑ **Familiarity with the new methodology and approval process among stakeholders**
(including suppliers and sub-contractors)
- ❑ **Acceptance of the results by other Flags, Classes**
- ❑ ...

➔ *More systematic / standardized approach is necessary.*

Standardization for RBD

- ❑ Establishment of systematic / structured processes (from the shipbuilder's perspective)
- ❑ Development of methodologies and tools for verification of safety requirements
- ❑ Development of recommended practices for applications



Objectives of Standards

- ❑ To provide practicable design tools
- ❑ To clearly define requirements for relevant tasks
- ❑ To reduce the need for company / project specifications
- ❑ To improve the HSE continuously
- ❑ To maximize the reference to recognized codes and standards
- ❑ ...

➔ *Tools for ensuring 'quality' and 'efficiency' in design for safety*

Approaches to RBD Standards

Base Documents

(normative/ informative)

- IMO Conventions
- Rules/regulations
- Industry standards
 - International (ISO/IEC, ...)
 - National
 - De-facto
- Others

Standardization

Establishment of general requirement of RBA/RBD for ships/systems

Development of methods and tools for implementation

Application of RBA/RBD methodology and tools

Standards(possible)

General Guidelines incl.

- terminology
- process
- evaluation criteria
- documentations, etc.

Detail Guidance for:

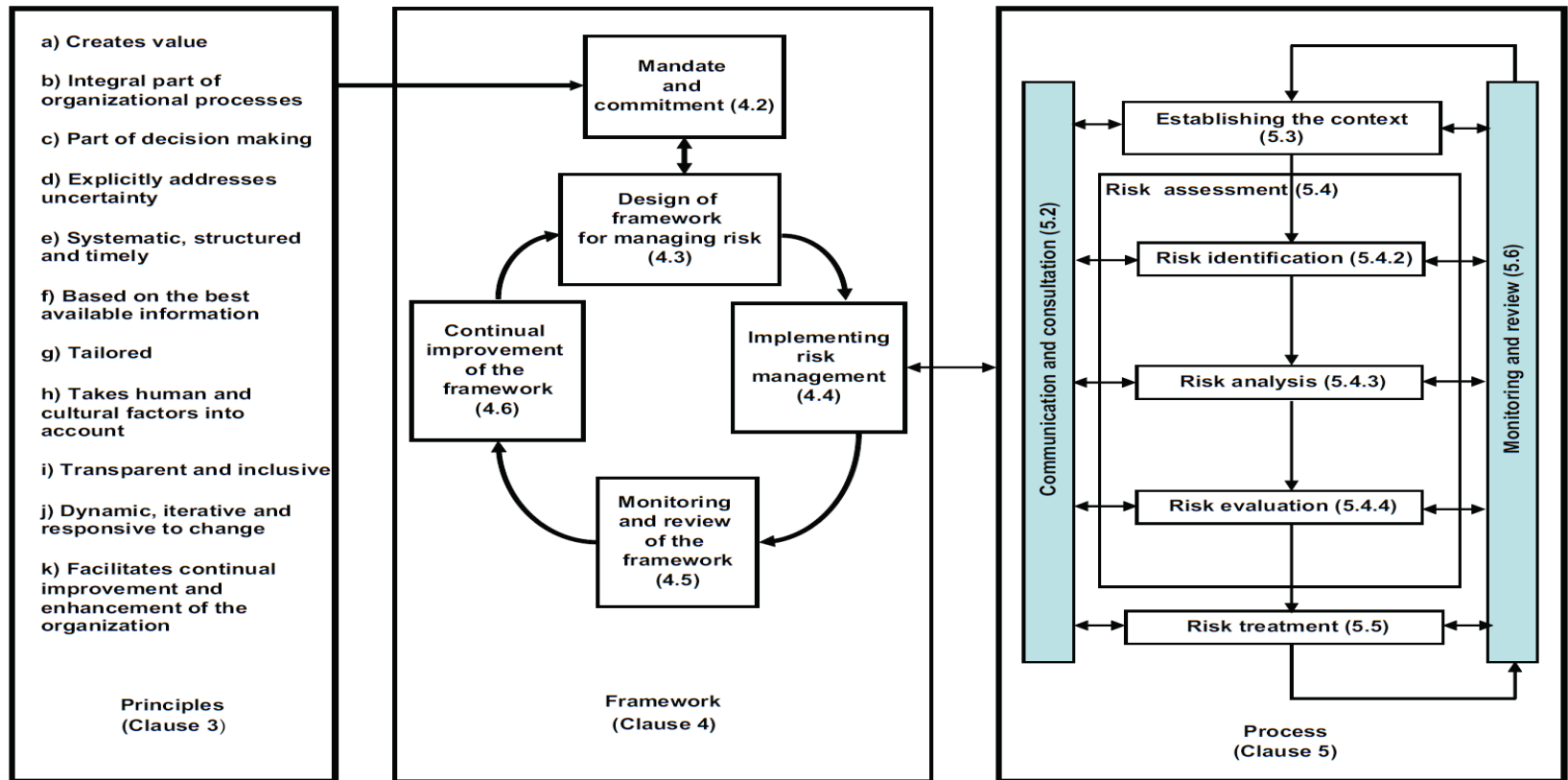
- risk models
- cost-benefit analysis
- other risk assessment techniques and tools

Recommended practices for RBA/RBD applications

Related Standards

- ❑ **IMO MSC/Circ.1023–MEPC/Circ.392**
(Guidelines for Formal Safety Assessment (FSA) for use in the IMO rule-making process)
- ❑ **IMO MSC/Circ.1002, MSC.1/Circ.1212**
(Guidelines on alternative design and arrangements)
- ❑ **ISO/IEC 31000:2009**
(Risk management - Principles and guidelines)
- ❑ **ISO/IEC 31010:2009**
(Risk management - Risk assessment techniques)
- ❑ **ISO/IEC Guide 51:2002**
(Safety aspects-Guidelines for their use in standards)
- ❑ **ISO 12100:2010**
(Safety of machinery –General principles for design - Risk assessment and risk reduction)
- ❑ **IEC 61508:2010**
(Functional safety of electrical/electronic/programmable electronic safety-related systems)
- ❑ ...

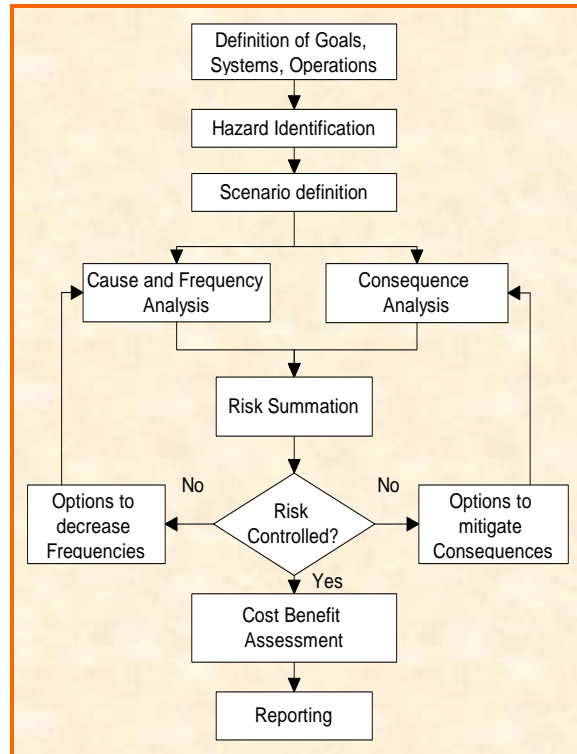
✳ ISO 31000 Risk management



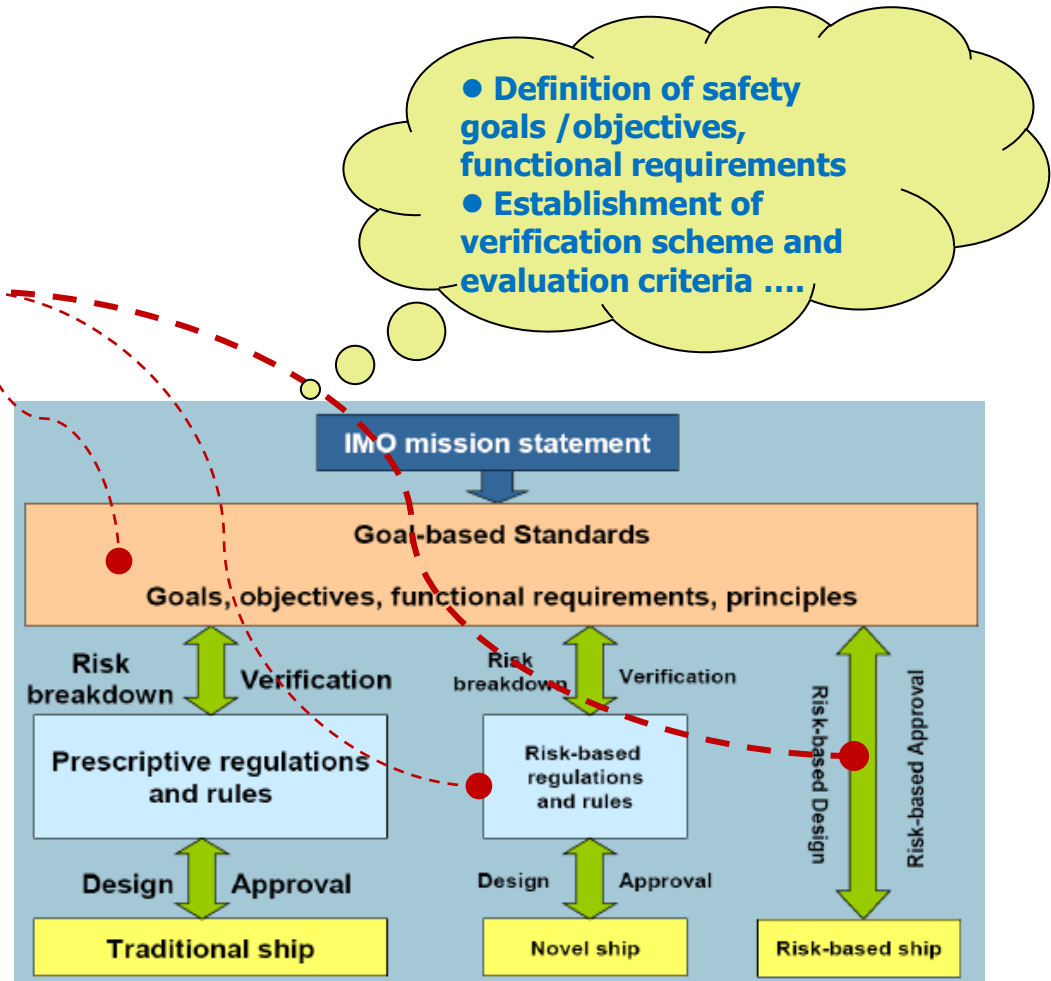
Risk management principles, framework and process

- ☞ IEC/ISO 31010:2009 Risk management - Risk assessment techniques
- ☞ ISO/IEC Guide 73 Risk management - Vocabulary - Guidelines for use in standards

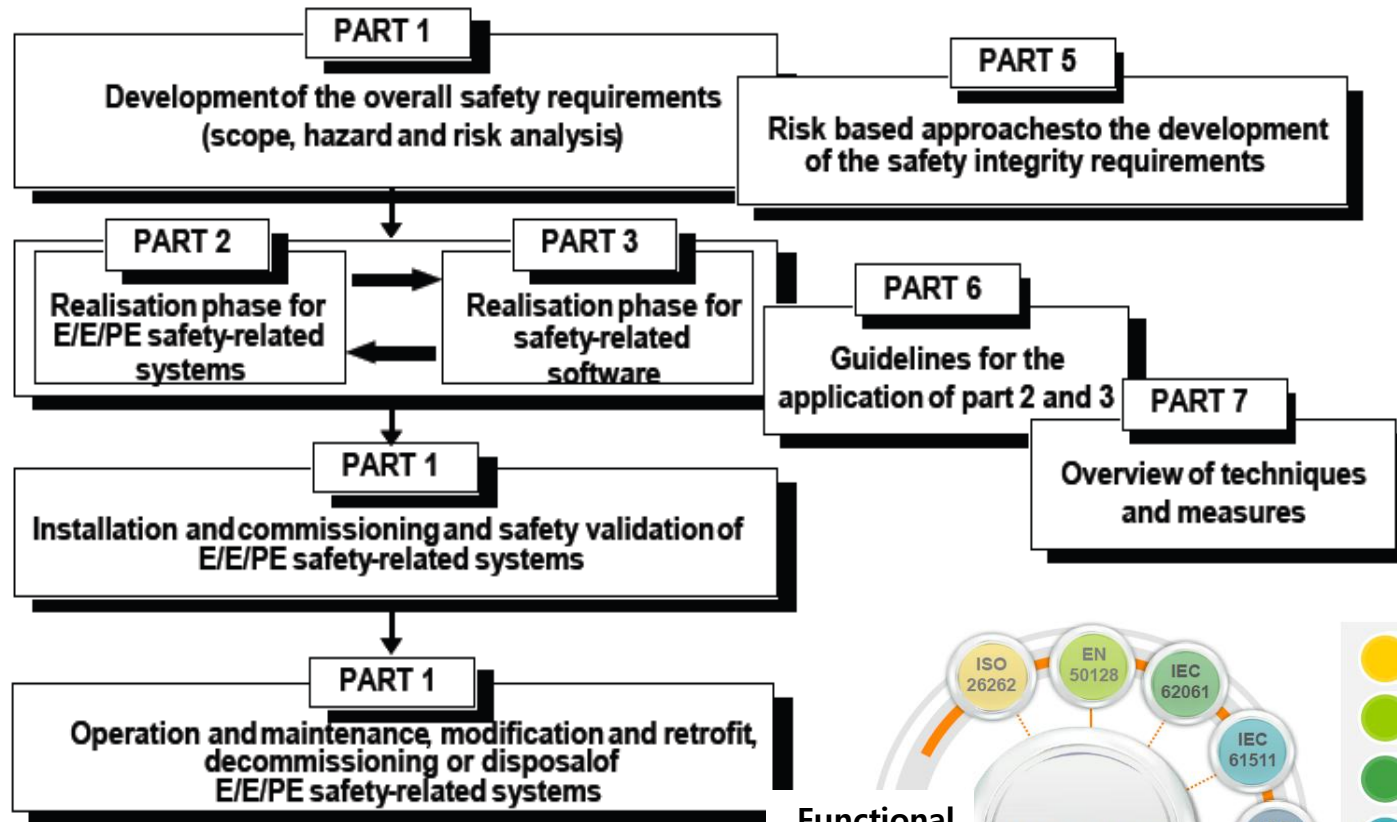
※ IMO FSA, as a tool for RBD



Process of IMO FSA (IACS)



✳ IEC 61508 Functional Safety



Technical Requirements of IEC 61508
(Experia, 2006)

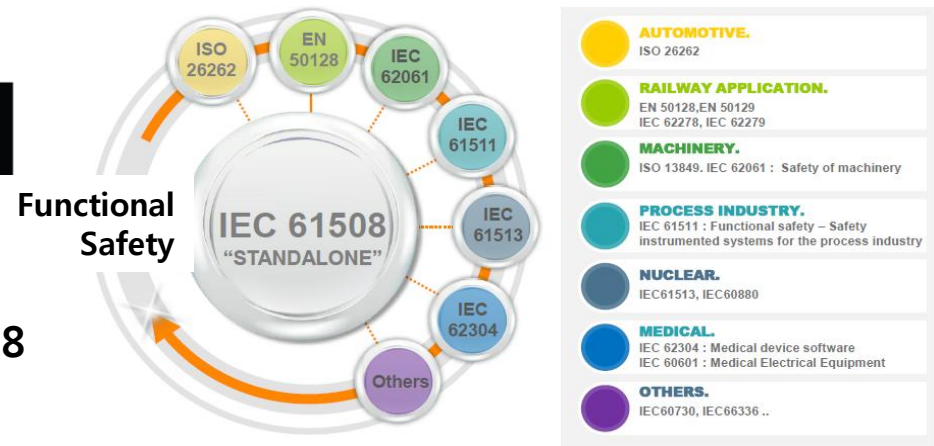


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Summary

- ❑ Safety is a key design factor of ships and must be assured in design phase.
- ❑ RBA/RBD is one of the most reasonable means to assure the life-cycle safety of ships
- ❑ More R&D are needed for Industry:
 - Processes
 - Technologies & tools
- ❑ Consideration for the development of industry standards for RBD:
 - At ISO/TC8
 - With collaborations amongst stakeholders (shipping / shipbuilding / classification societies, etc.)

Workshop on RBA/RBD

☐ **Purpose:**

- To share information about the RBA/RBD technologies in the maritime industry
- To develop the NP for ISO standards on RBD for ship safety

☐ **Date: March 8-9, 2012**

☐ **Place: Busan, Korea**

☐ **Agenda (tentative):**

- RBA applications in the maritime industry (focused on FSA/GBS)
- Reviews on RBD (principles, process and tools and examples)
- Industry standards for RBA/RBD
- Draft NP for RBA/RBD (for discussion)

Thank you.



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