



The Sixteenth International Conference on Systems
ICONS 2021

April 18, 2021 to April 22, 2021 - Porto, Portugal

Track **WiSEB 2021:**
Widening Systems
Engineering Borders

FINCANTIERI
The sea ahead



A Capability Based Approach for Warship Design

Paola Gualeni
DITEN – University of Genoa
Genoa, Italy

Lucio Tirone, Maria Giovanna Scognamiglio, Paola Bonofiglio
Fincantieri S.p.A.
Genoa, Italy

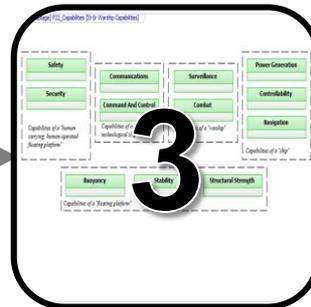
Summary



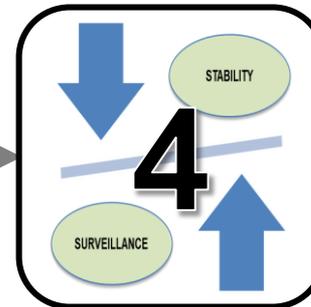
Naval Ships
Need for an
Innovative
Design



The Capability
approach



Taxonomy of
Capabilities

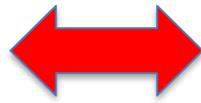


Capability
Interdependencies



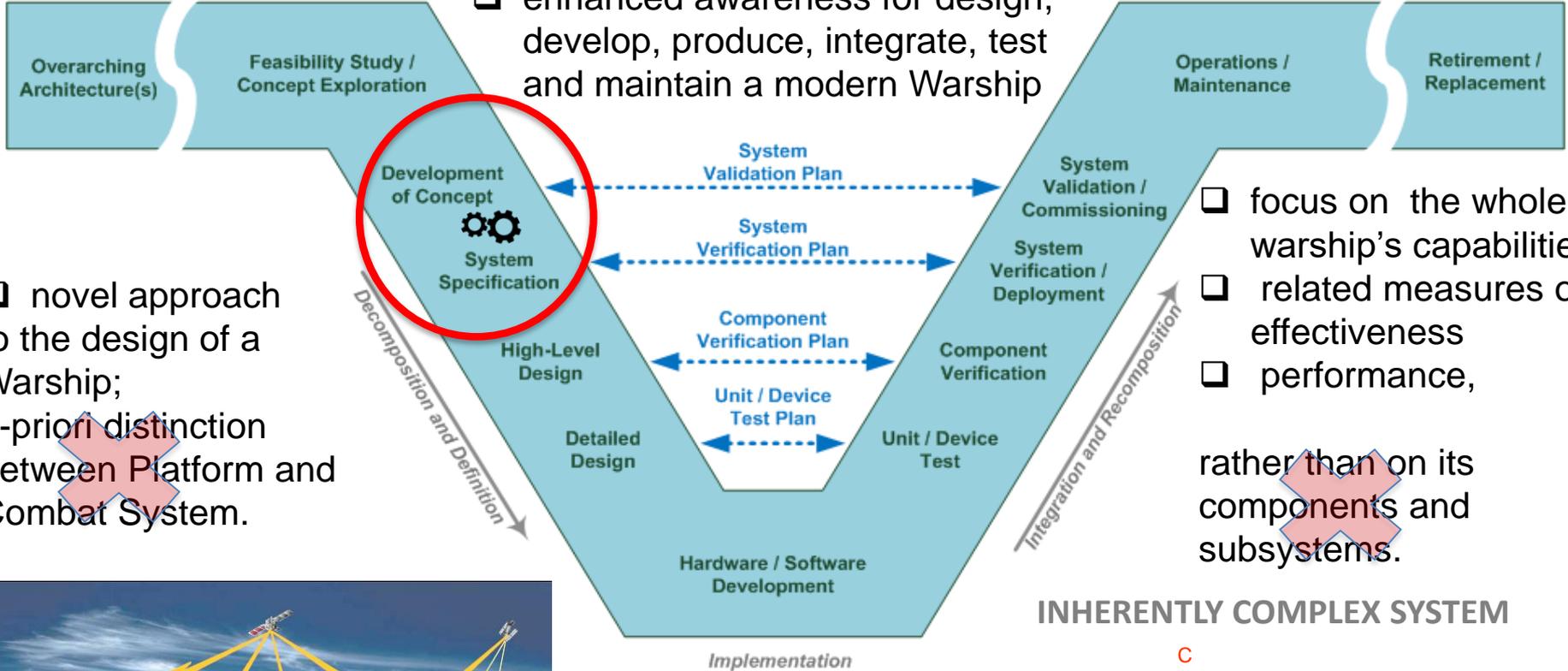
Conclusions

Naval Ships



Innovative Design

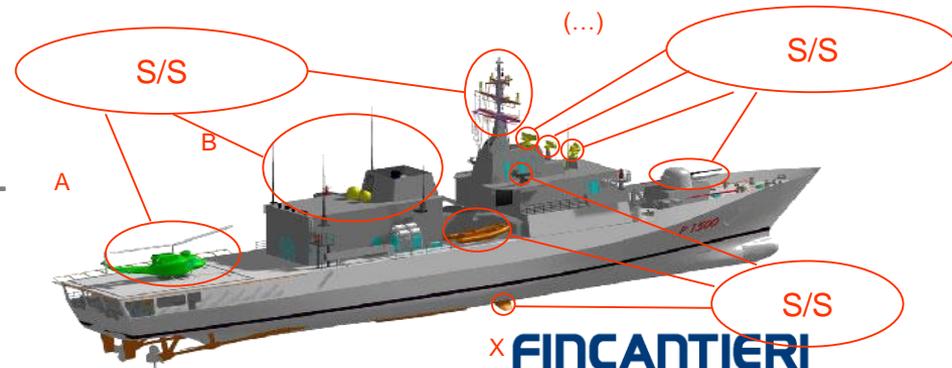
- enhanced awareness for design, develop, produce, integrate, test and maintain a modern Warship



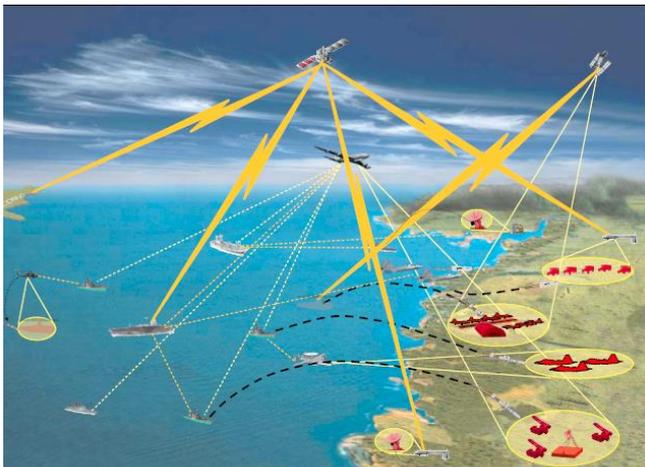
- focus on the whole warship's capabilities
 - related measures of effectiveness
 - performance,
- rather than on its components and subsystems.

INHERENTLY COMPLEX SYSTEM

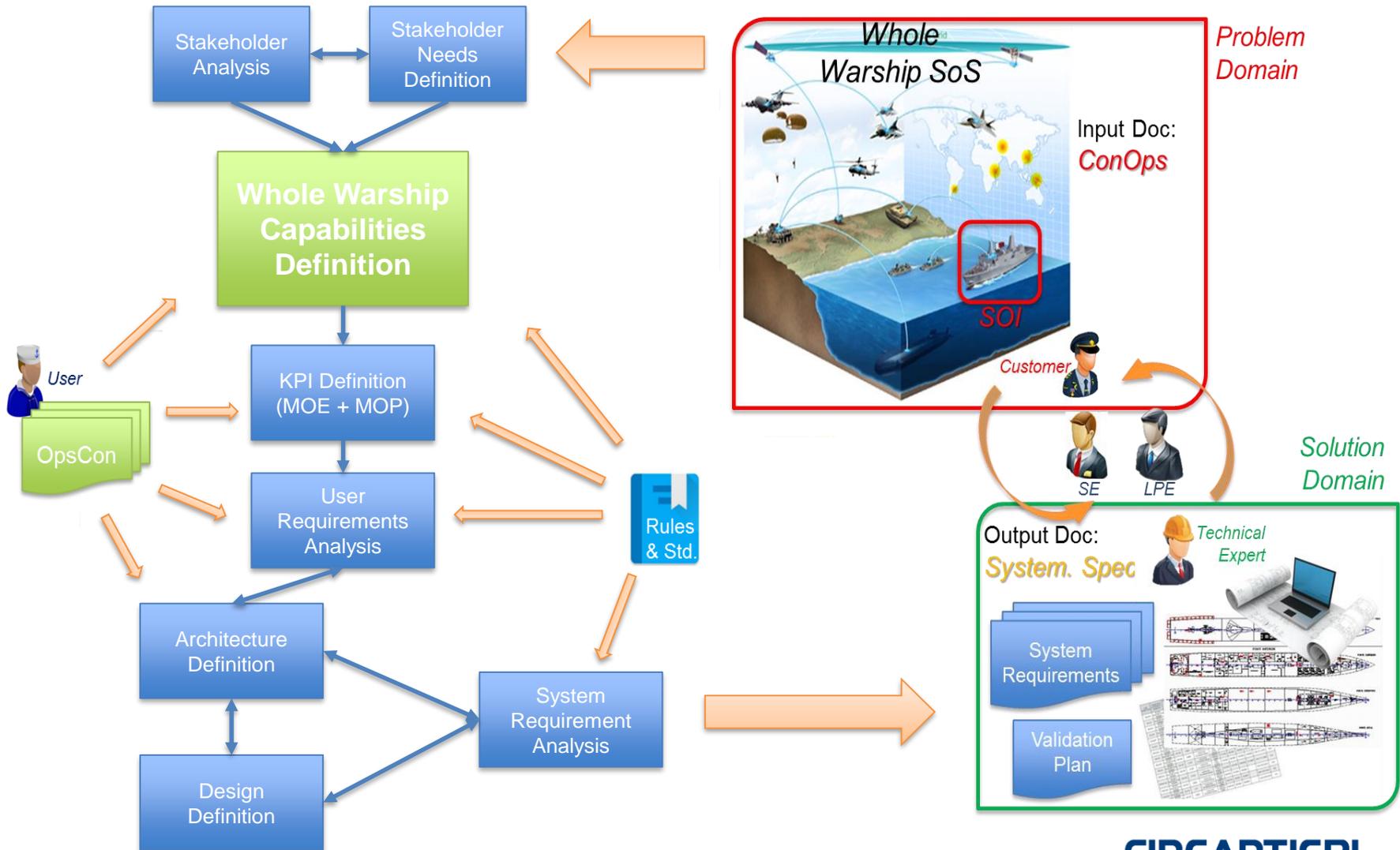
C



OPERATIONAL SCENARIO

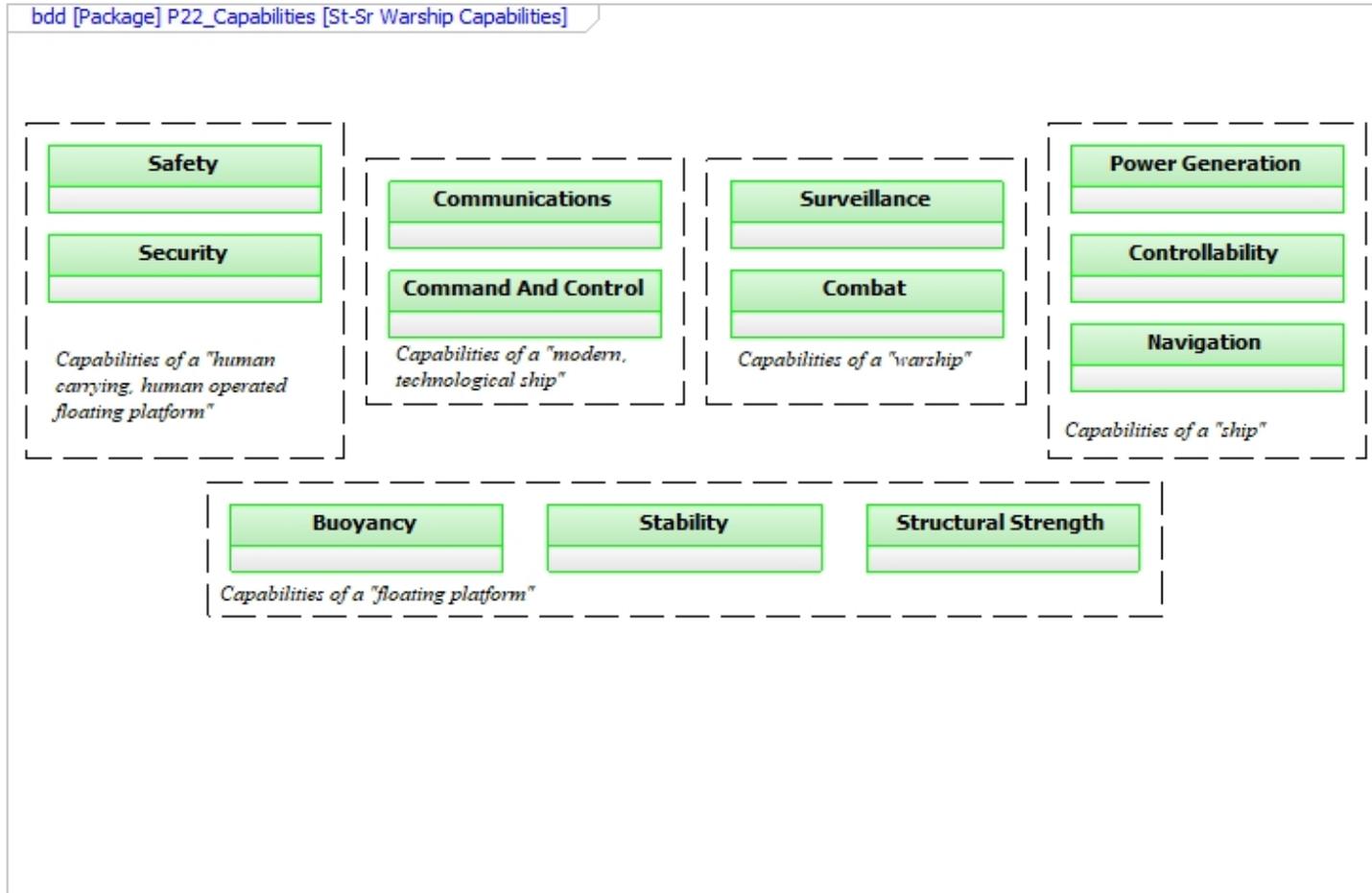


The Capability approach



Taxonomy of Capabilities (1/6)

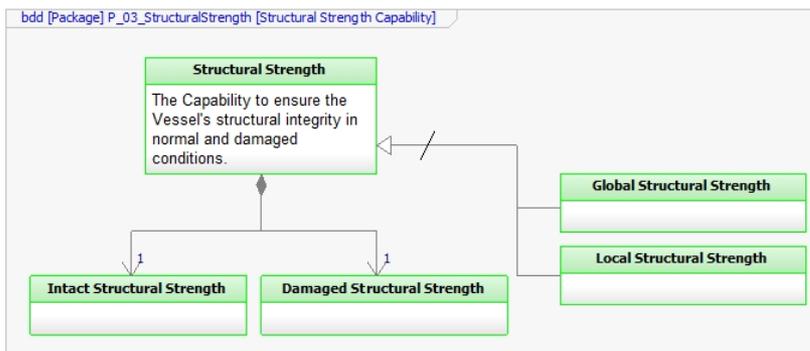
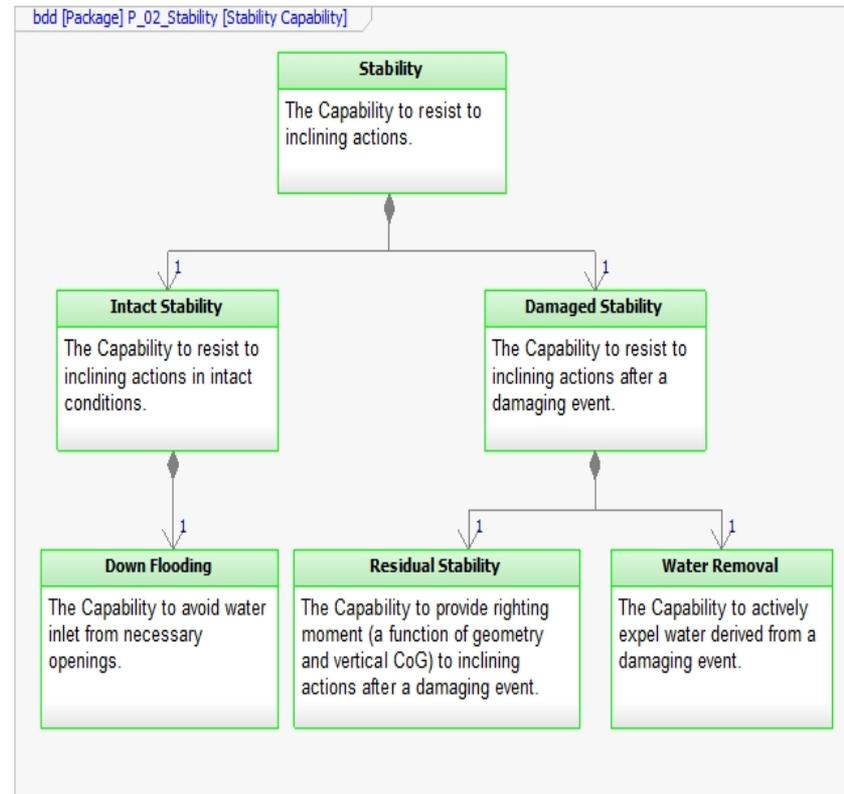
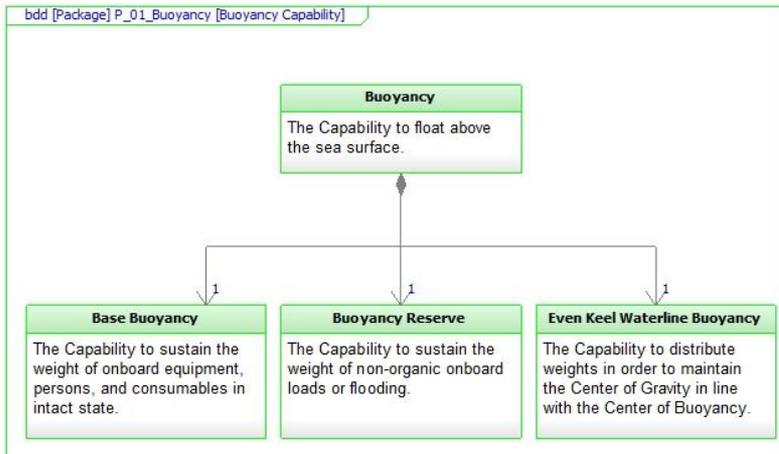
- ❑ proposed categorization of the Capabilities related to a Warship
- ❑ the Warship itself is seen as a ship in its own right, and even before, as a platform floating on the sea, used by and interacting with human operators:



Taxonomy of Capabilities (2/6)

The basic Capabilities for any sea faring “platform”:

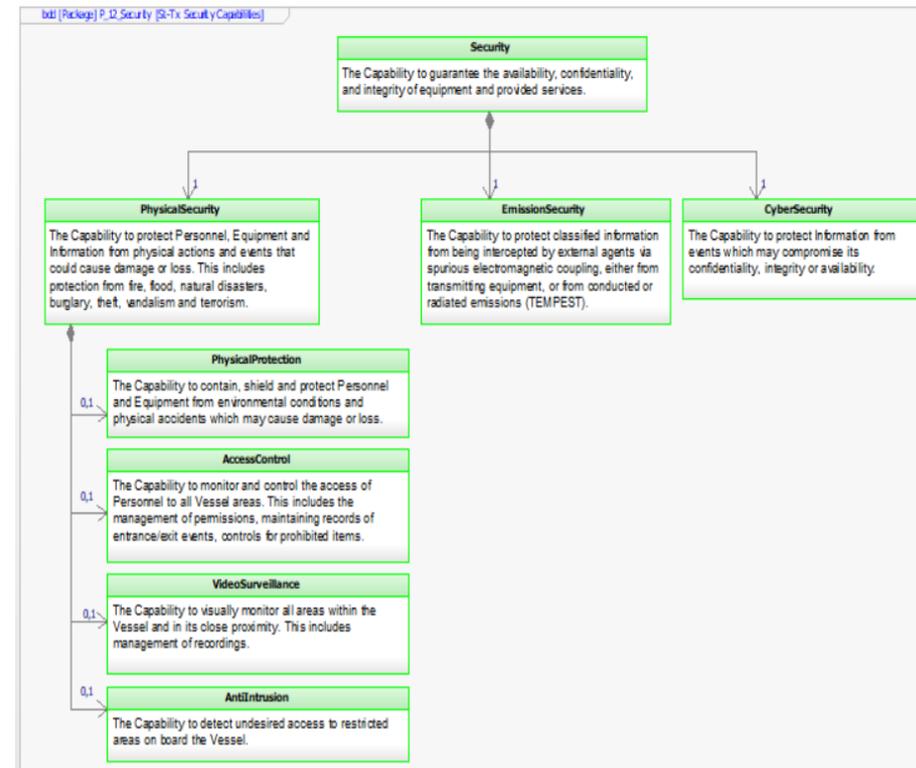
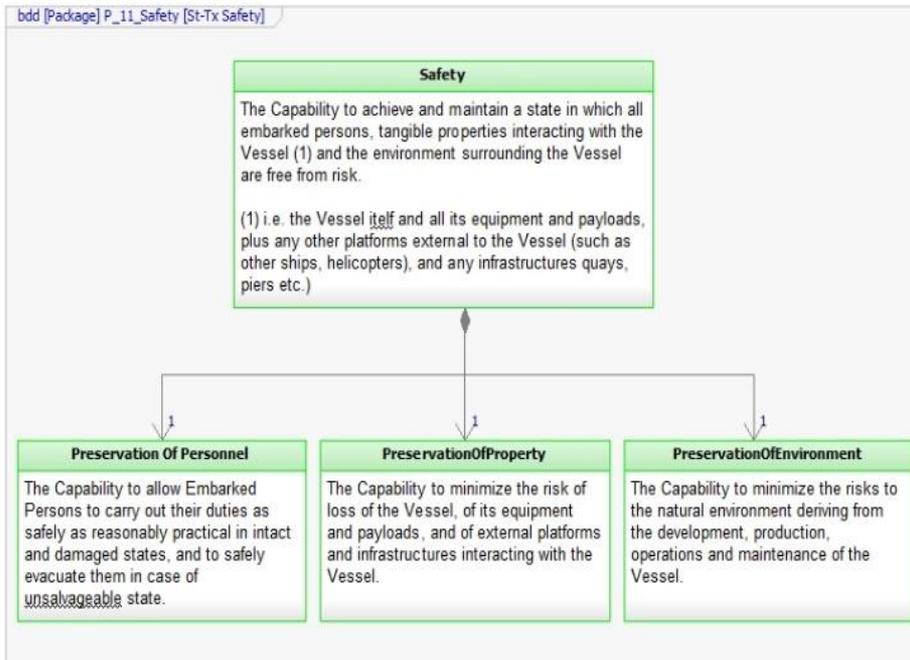
- ❑ **Buoyancy:** the platform has to float on the waters, carrying its load
- ❑ **Stability:** it has to avoid capsizing
- ❑ **Structural Strength:** it has to avoid falling apart



Taxonomy of Capabilities (3/6)

Any such platform needs to be operated by humans, and will interact with them, with man made infrastructures, and with the environment, and so needs the following Capabilities:

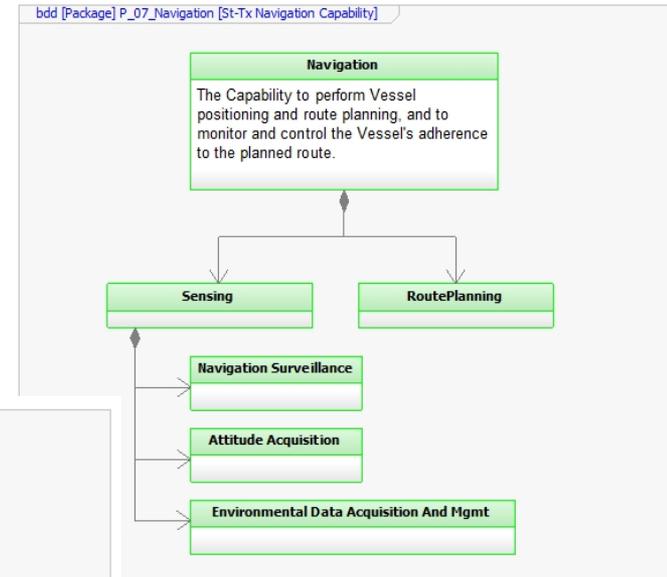
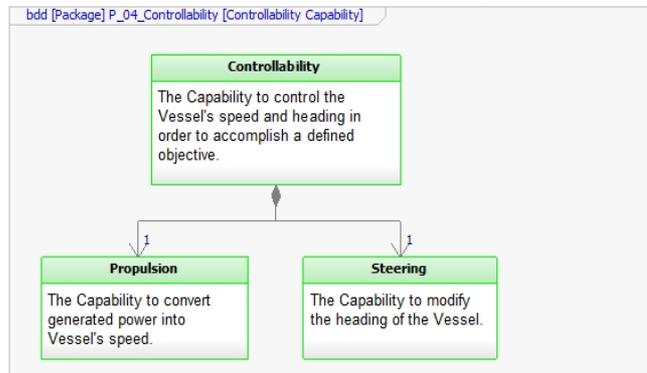
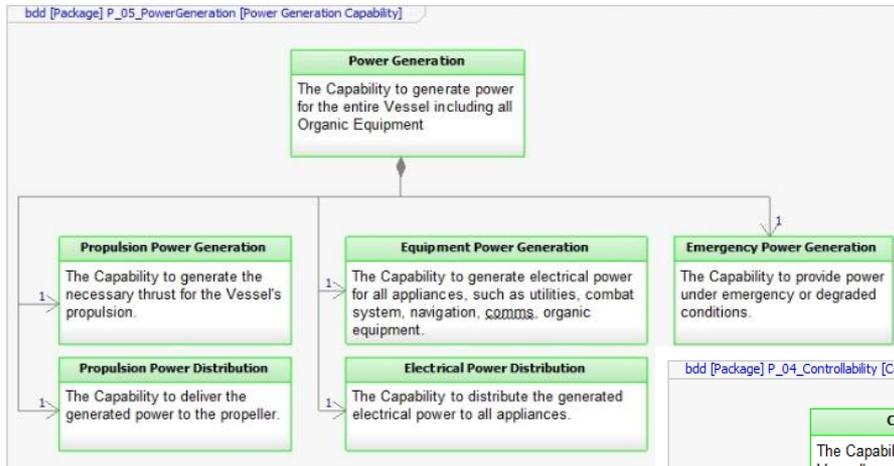
- ❑ **Safety:** no humans, or their properties, or the environment, should be harmed
- ❑ **Security:** it should not be tampered with malicious intent



Taxonomy of Capabilities (4/6)

The next step is to consider the Capabilities that are necessary to make use of such platform as a “ship”:

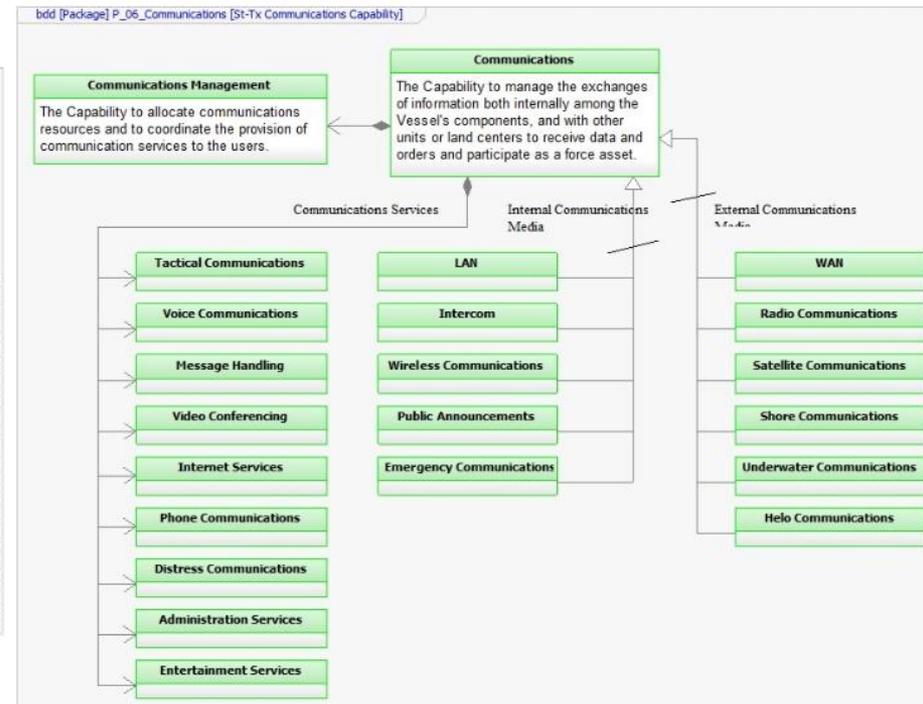
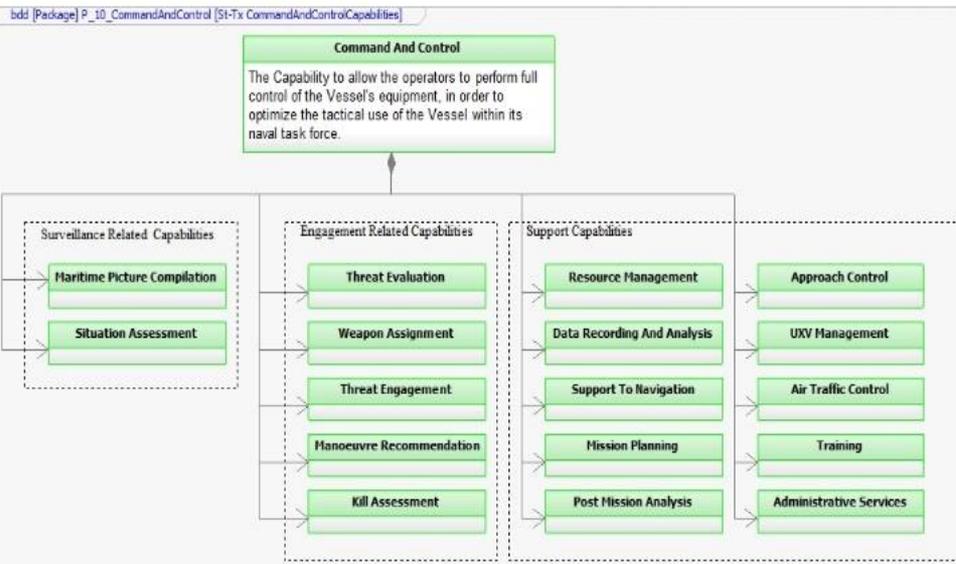
- ❑ **Power Generation:** either by oars, sails, or engine and propeller, the platform needs to sail
- ❑ **Controllability:** the operators need to control its heading and speed
- ❑ **Navigation:** the operators need to know where it is located on the earth surface, and where they intend it to sail



Taxonomy of Capabilities (5/6)

The type of ship we are interested in is a modern platform, with automated functions, and technology aiding the human operators in all their tasks, and this brings to the next required Capabilities:

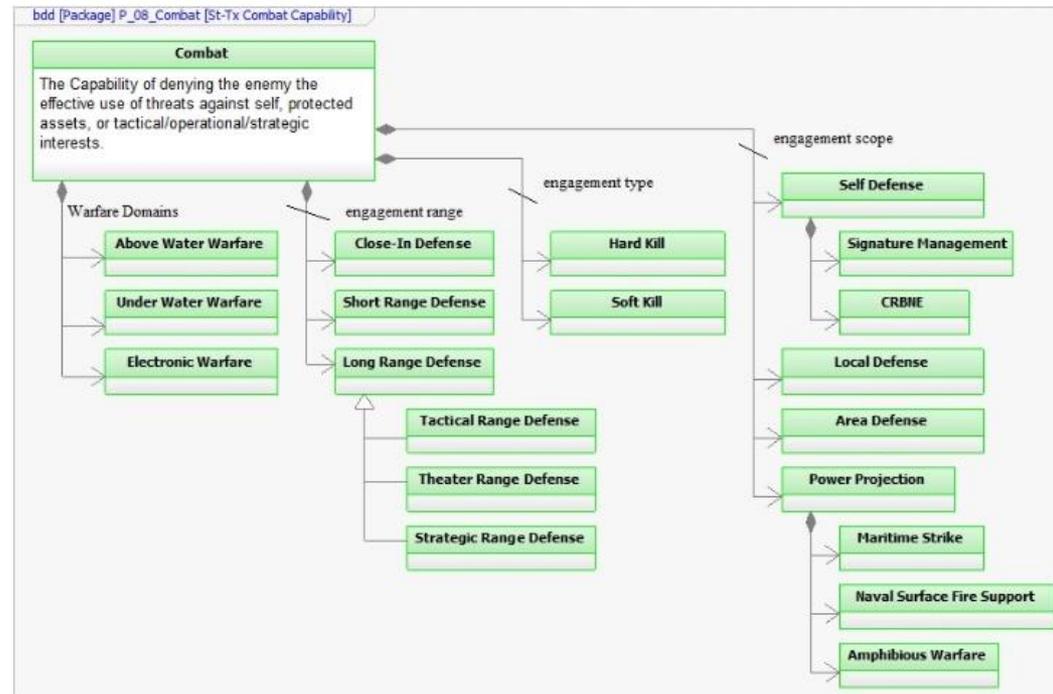
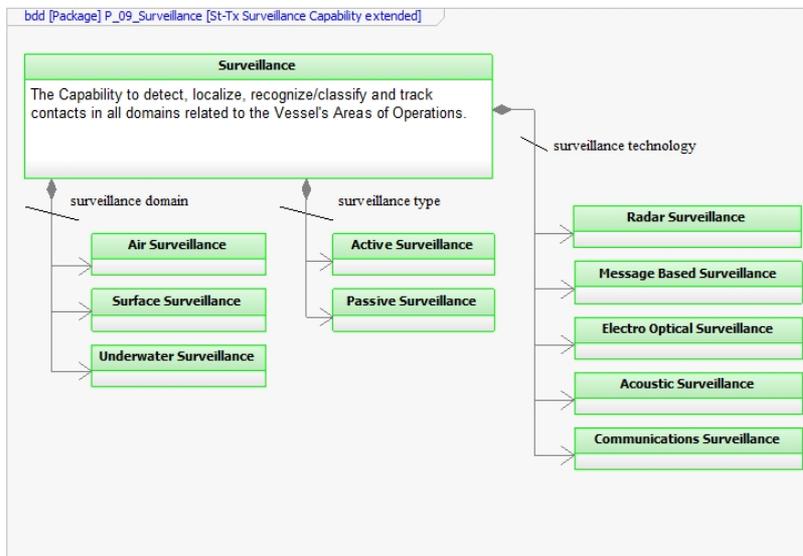
- ❑ **Command and Control:** the computer based automation of all operations performed through the ship's equipment
- ❑ **Communications:** the means to exchange voice, data, and other types of information, among the on board persons, and with the outside world



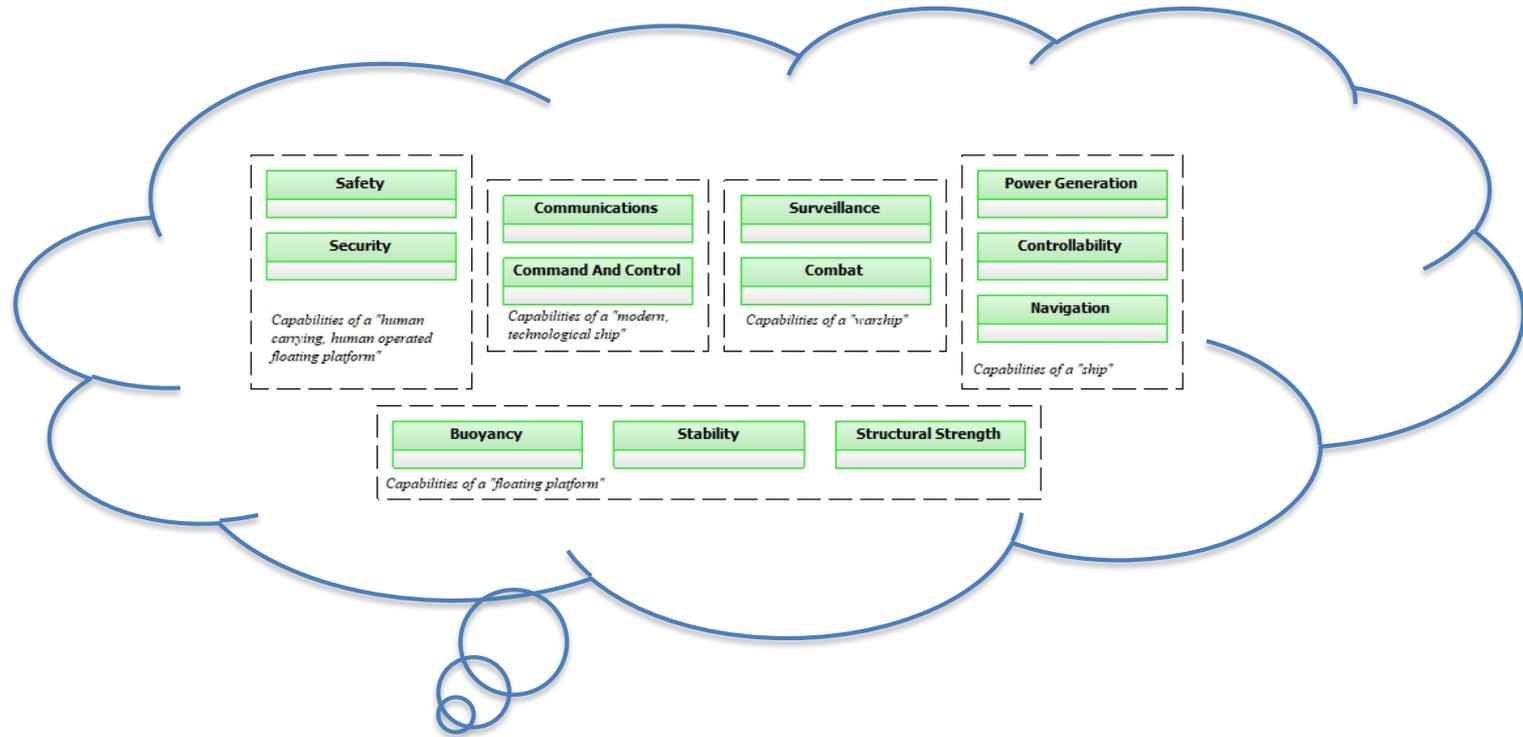
Taxonomy of Capabilities (6/6)

Finally, we reach the ultimate Capabilities that make our ship a Warship, able to carry out its intended missions:

- ❑ **Surveillance:** the Capability to discover and monitor any potential threats (to the Warship itself, or to any other asset protected by the Warship, including the natural environment or political and strategic national interests)
- ❑ **Combat:** the Capability to neutralize those threats



Capabilities Interdependencies



An holistic view is available about the entire Warship as a whole that can be discussed in relevant operational environment

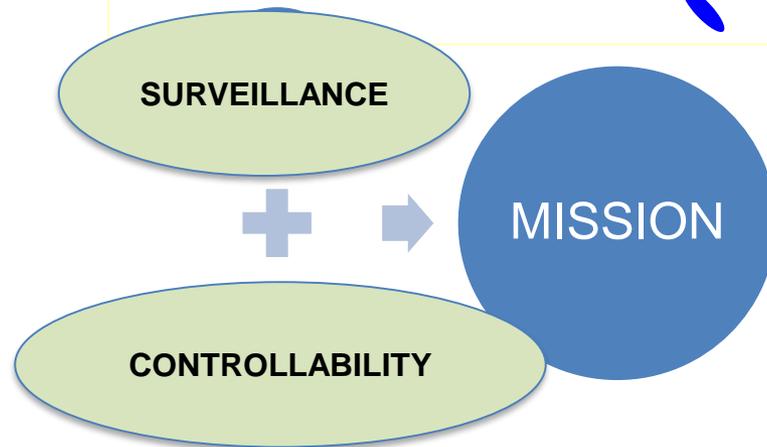
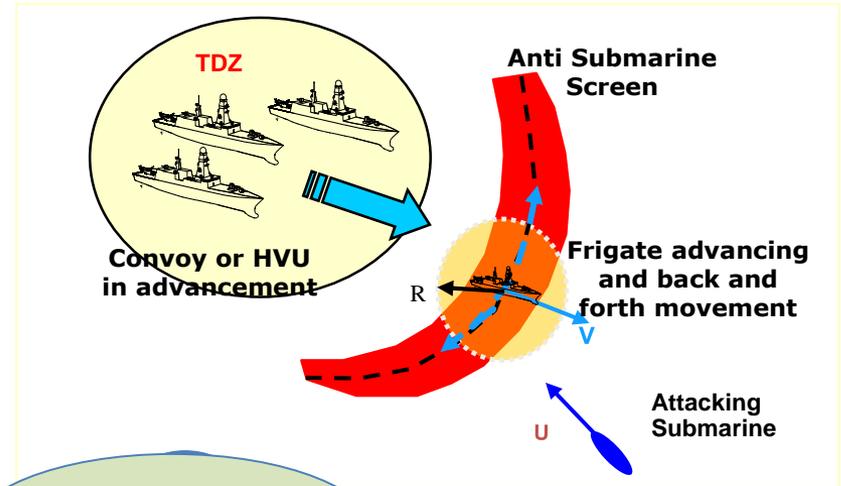
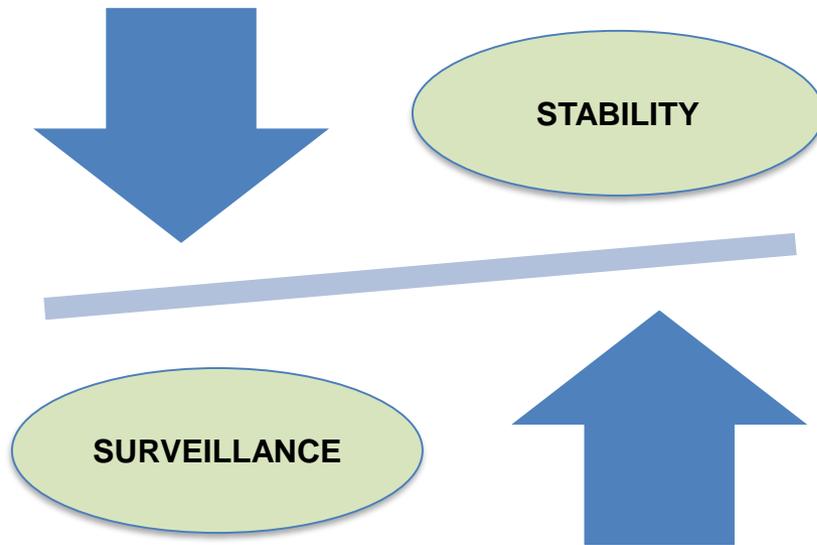


mutual interactions
interdependency

Capabilities Interdependencies

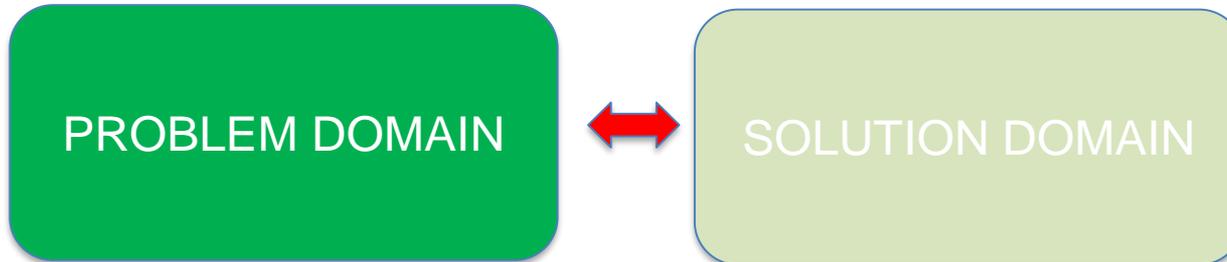
mutual interactions

interdependency



Conclusions

During the design process of complex Warships, attention is necessary to the **problem domain**. Focus on the level of the whole warship's capabilities, rather than on its components and subsystems that belongs to the solution domain.



- ❑ A **set of twelve Capabilities** characterizing the naval vessel has been proposed, further detailed and commented. Their identification enables and instructs the investigation and development of the solution domain.
- ❑ They are assumed to be effective to comprehensively represent all the necessary Capabilities for the Warship **to fulfill a superior mission by means of proper implementation of the operational requirements**.
- ❑ All the **identified Capabilities are meant as Warship emergent properties** deriving from the successful and concurrent interaction among the different parts and systems.

Conclusions

The Capability formulation enables also:

- ❑ the systematic identification of the **necessary technology** to be installed onboard with specific reference to their interfaces and interference characteristics with the ship platform.
- ❑ the identification of workable **Measures of Effectiveness** and derived **Measures of Performance**, to afterwards give evidence of the Warship compliance with design goals.
- ❑ In conclusion the content of this paper represents a proposal to better set out the **naval ship design process** since the very beginning for a comprehensive and robust final fulfilling of the customer needs following a documented and informed process.

