Systems Engineering Advancement Research Initiative

NTNU – Trondheim
Norwegian University of Science and Technology

# COMPLEXITY IN CONCEPTUAL SHIP DESIGN

## A SYSTEMS ENGINEERING APPROACH

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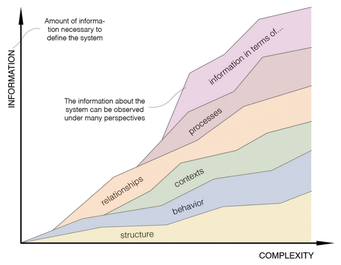
### Biography

PhD candidate at the Dept. of Marine Technology at NTNU (Norway, 2011). Visiting PhD student at SEAri-MIT (USA, Spring 2011). MSc (2007) and BSc (2003) at University of São Paulo (Brazil), graduating as a Naval Architect and Maritime Engineer. Internship at the University of Southampton (UK, 2002). Besides SEAri, participation in projects in partnership with DNV, Petrobras, Brazilian National Petroleum Agency and engineer companies.

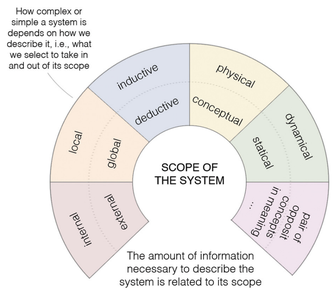
### Related Publications

Gaspar, H. M., Rhodes, D. H., Ross, A. M., *A System Engineering Approach to Address Complexity in Conceptual Ship Design* (expected Fall 2011)
Gaspar, H. M., Ross, A. M., Erikstad, S. O., *Handling Temporal Complexity in the Design of Non-Transport Ships Using Epoch-Era Analysis* (expected Summer 2011)

## Defining Complex Systems




complexity defined as amount of information

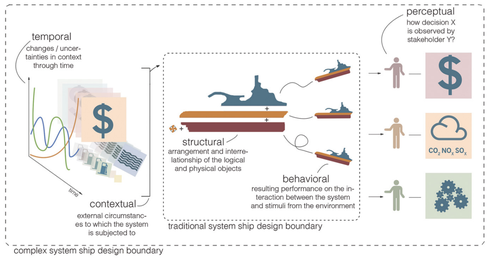



scope of the system based on defining opposite meaning concepts

## 5 Aspects of Complex Systems

| | |
|---|---|
| **structural**<br>**behavioral** | *State of Practice* systems architecting and design, and model-based system engineering approaches |
| **contextual**<br>**temporal**<br>**perceptual** | sources for new constructs and methods for advancing *state of art*, such as: epoch-era analysis, multi-stakeholder nogiations, visualization of complex data sets. |

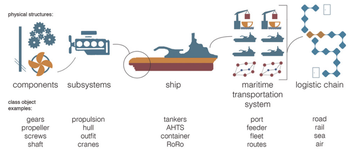
## Ship as a Complex System




## Complexity Aspects in Conceptual Ship Design

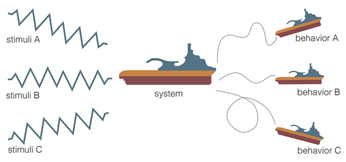
key complexities

**structural**



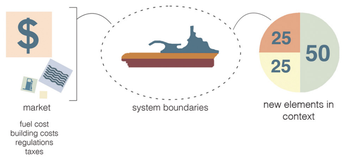

interaction between components, i.e., strongly coupled design

**behavioral**



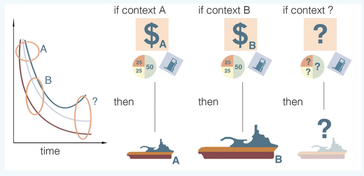

the correct mapping between form and function, i.e., a ship must perform its mission

**contextual**



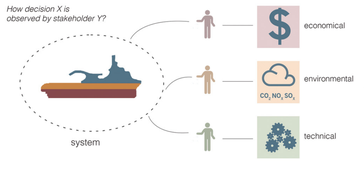

extension of the context entities, taking into account new elements, such as environment and risk

**temporal**




uncertainty towards future scenarios and context changes

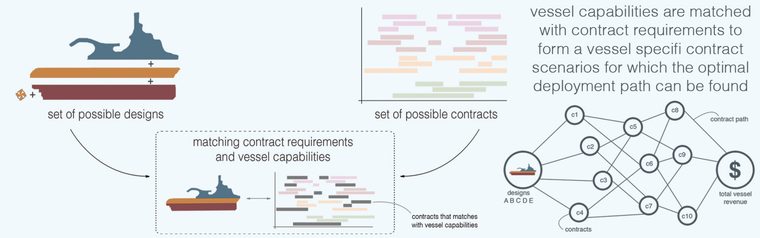
**perceptual**




*What If* situations to document different stakeholder preferences

## Handling Temporal Complexity in the Design of Non-Transport Ships Using Epoch-Era Analysis

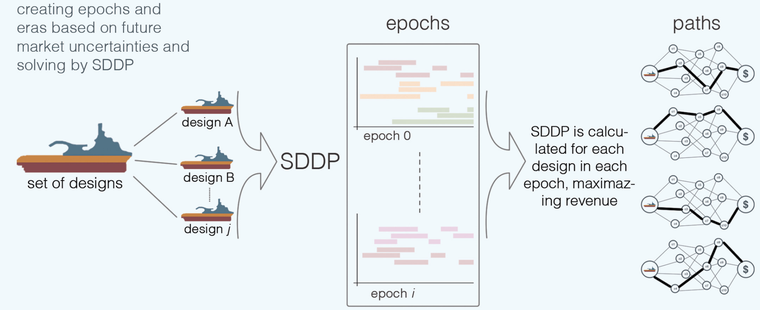
### Ship Design and Deployment Problem




vessel capabilities are matched with contract requirements to form a vessel specifi contract scenarios for which the optimal deployment path can be found

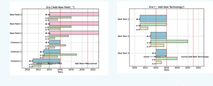
### Epoch-Era Analysis applied to SDDP

creating epochs and eras based on future market uncertainties and solving by SDDP




### Example

uncertainties as new field & new technology



creating epoch space and design spce

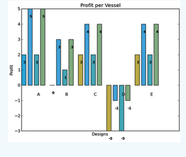
designs set (A B C D E)

SDDP

*Short Run*
SDDP in epochs, calculating optimum path for each design

*Long Run*
Construct eras based on selected rules for epoch and designs, then applie SDDP in eras, calculationg optimum path for each design

revenue
vessel per epohc & era



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