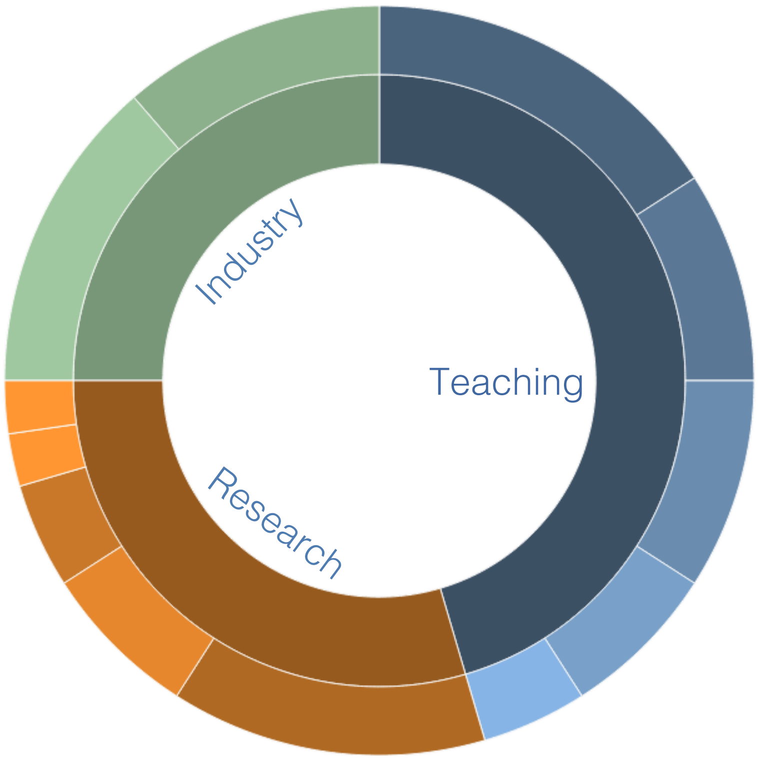
Ulstein Ship Design Professorship – 1st Year Report



Henrique M. Gaspar
Associate Professor

Gaveprofessorater Ulstein
1st Year (2013/2014)

HØGSKOLEN I ÅLESUND
Aalesund University College

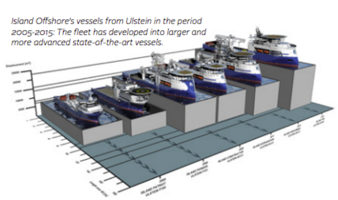
Three Fundamental Branches

Teaching

classes, MSc supervision, international students, extra-curricular activities

Research

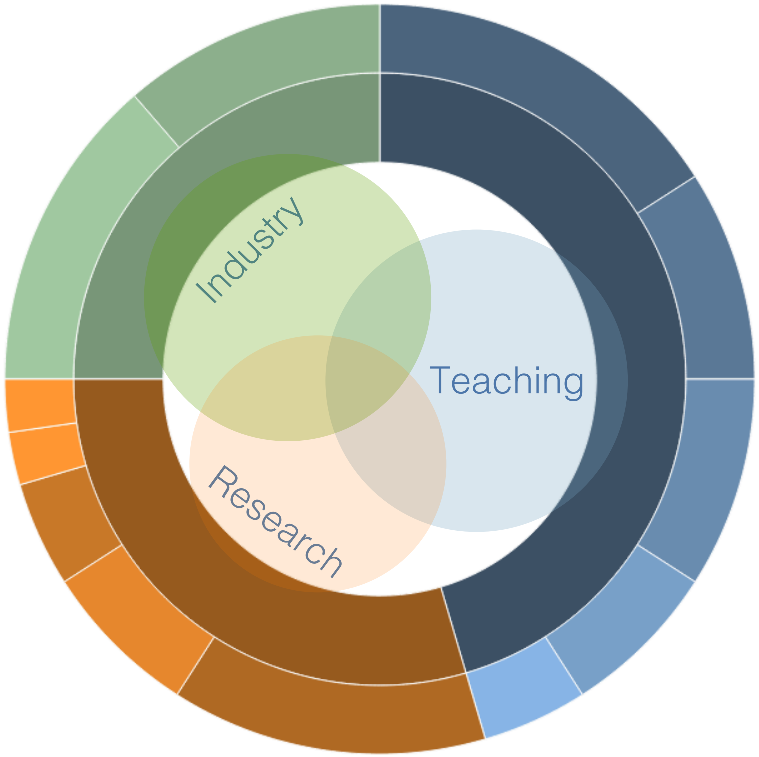
cooperation within HIALS, maritime knowledge hub and international institutions



Industry

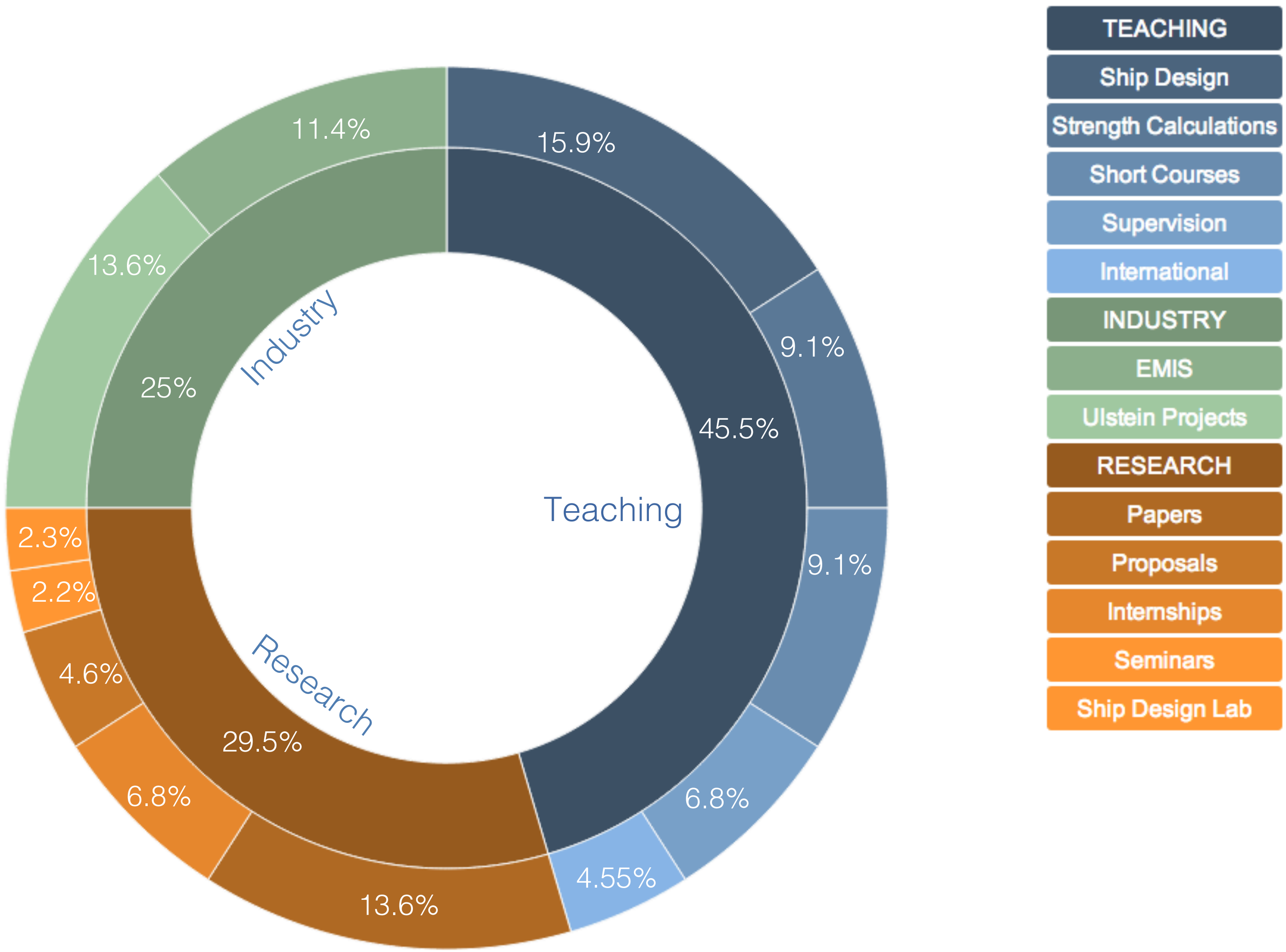
strong cooperation with Ulstein group and related companies in the region

Agenda

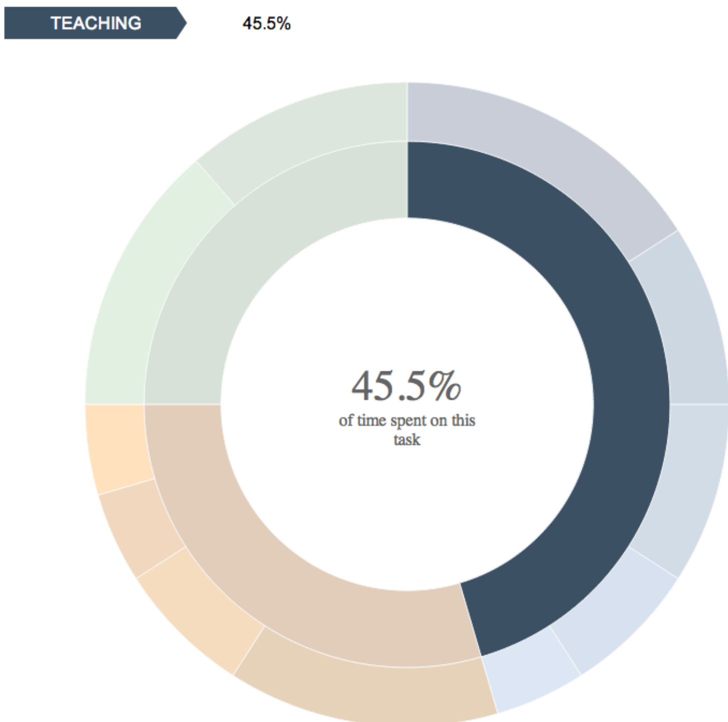


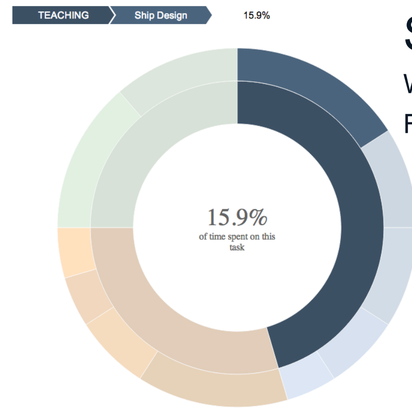
- Teaching
  - Ship Design (fall&spring, w/ Arne Jan)
  - Strength Calculations (fall w/ Arne Jan)
  - Short Courses (Matlab, Research Methods)
  - Best Practice Systems Engineering (from Fall 2014)
  - Bachelor and Master's Supervision (HIALS, NTNU, UFSC)
  - International Cooperation (USP, UFSC, MIT, UCL)
- Industry (Ulstein Group)
  - EMIS
  - Ulstein Internal Projects (Parametric Design, Multi-objective methods, Custom and Standard design)
- Research
  - Ship Design Lab
  - NTNU/MIT/USP/UFSC Research
  - Internship Supervision
  - Project Proposals (BIP, SFI)
  - Scientific Papers (Journal/Conferences)
- Future Tasks

Time Breakdown



Teaching





Ship Design

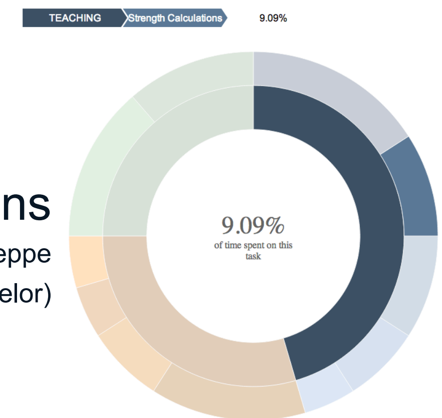
With Arne Jan and Øyvind Kamsvåg)

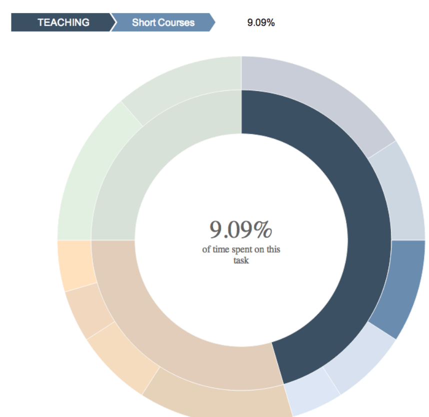
Fall & Spring Ship Design course (2nd year, Bachelor)

Strength Calculations

With Arne Jan Paul Stephen Kleppe

Fall Product and Ship Design course (2nd year, Bachelor)



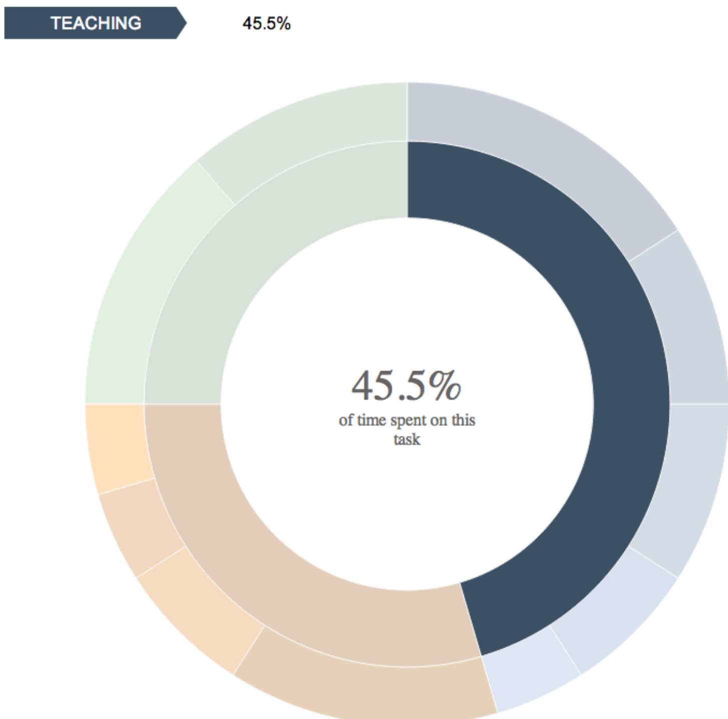


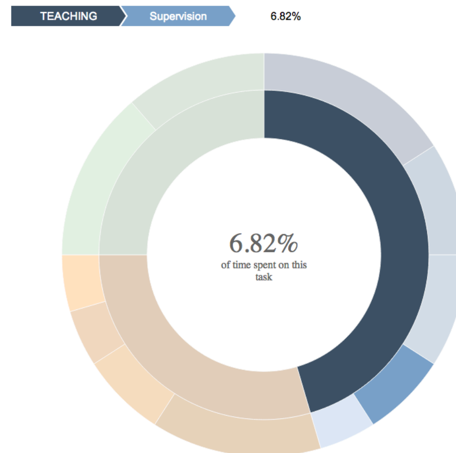
Short Courses

With Karl Henning and Vilmar Æsøy

(Matlab, NCE Seminar, Design Methods, Science w/o borders)

Teaching





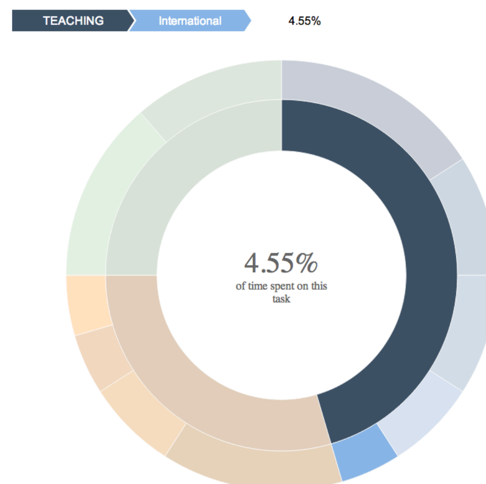
Supervison

Bachelor HIALS (2 students)

Bachelor UFSC (1 student)

Master NTNU (co-supervision, 1 student)

PhD advice NTNU/HIALS (informal)



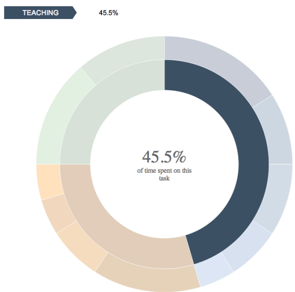
International

UFSC and USP (Brazil) cooperation (students, quota scheme, etc)

UFPE (Brazil) agreement in progress

CIAGA/CIABA partnership (paused)

Teaching



Travel Salesman Problem Exercise

Exercise:
a) For the coordinates presented below, develop a code to find all possible paths, plus the minimum path – distance and paths
b) Adding E = (40,30) , F=(80,70), G =(60,30), H = (90,30), I =(30,30), what is the minimum path(s)? What is the minimum distance?
c) Present your code and a plot of the cities. Explain your code.

Coordinates of each city → Create all paths → Check every Path → Select smaller distance

A = (0,0)
B = (100,100)
C = (0, 80)
D = (50,50)

A B C D
A B D C
A C B D
A C D B
A D B C
A D C B

A B C D = ?
A B D C = ?
A C B D = ?
A C D B = ?
A D B C = ?
A D C B = ?

Min: [A B C D, A B D C, A C B D, A C D B, A D B C, A D C B]

HØGSKOLEN

Grounding

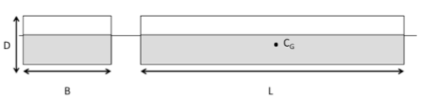
- Ship Design for a certain draft
- Shallow water areas
- Unpredictable changes in tode
- Human Error
- Structural damage
- Critical draft
- Instability and capsizing

http://www.youtube.com/watch?v=lHsG-ABCEbQ
http://www.youtube.com/watch?v=e4Aq1VY3XmA
http://www.youtube.com/watch?v=v9P99xhLgjU

Ship Design 1 - Spring 2014		HØGSKOLEN I ÅLESUND
Semester Exam	DATE: 03 Jun 2014	Faglærer: Henrique Gaspar, Arne Jan Sollied

For non-given information, use your assumptions.
Questions can be written in: Engelsk, Bokmål, Nynorsk, Portugisisk og Spansk :)

1) Consider a rectangular prismatic barge, where: breadth = B; length = L = 6B; depth = D = B/2; center of gravity = C_G = D/3; floating at a draft = T = 2D/3:

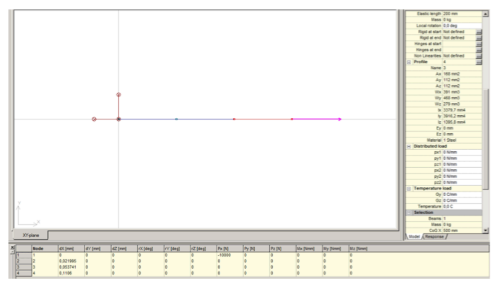


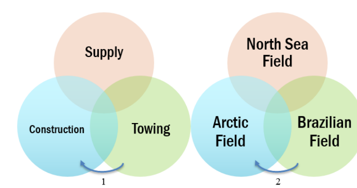
a) Calculate the transverse and longitudinal metacentric height (GM_T and GM_L) in function of the breadth (B).
b) Using the expression calculated in a), find $\overline{GM_T}$ and $\overline{GM_L}$ for B = 30m.

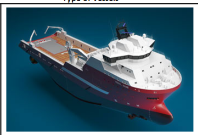
2) Consider a prismatic barge from exercise 1, for B = 30m:
   a) Calculate its submerged volume $\nabla$and displacement Δ in the sea (ρ_{water} = 1.025ton/m^3) for the following drafts T: 2m, 5m, 7m, 10m, 12m.
   b) Consider the draft of T = 2m when the barge is not loaded, that is, only the lightweight is considered. What is the maximum cargo allowed for a freeboard of 1m?
   c) What is the highest C_G that the cargo found in b) can be placed if the barge is to sail with a minimum $\overline{GM_T}$ of 0.4m? Consider the $\overline{KG}$ of the lightweight barge equals 5m.

3) Consider a prismatic barge from exercise 1, for B = 30m and T = 7m and KM = 5.5m:
   a) Calculate its GM if KG = 4.5m.
   b) Find its new GM if the following cargo is loaded: 5000 tons (KG = 3.5m) and 2000tons (KG = 8.5m) - assume KM constant.
   c) Consider KG unknown. A weight of 30 tons, when moved across the deck though a distance of 20m, causes a list of 2.3°. Find the KG.
   d) Consider the KG calculated in a), the ship with no list and the same displacement (for T=7m). What is the maximum list during the operation of loading two 50tons lifts with her own gear, given that the first lift is placed at the a 9m deck, 6m out of the center line, and the second lift is 15m above the keel and 12m far from the center line.

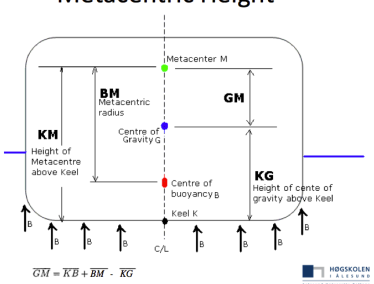
3D Beam Example





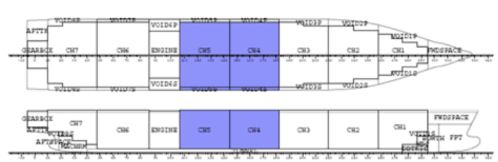
	Type of Vessels	Main Missions
AHTS		• To handle anchors for oil rigs. • Towing and mooring platforms and drilling rigs. • To make deck handling operations.
PSV		• To operate from shore to the platform carrying supplies and personnel. • To be able to stay right next to the platform.
OSCV		• Building and maintaining platforms, well heads and power cables. • Diving support.

Metacentric Height

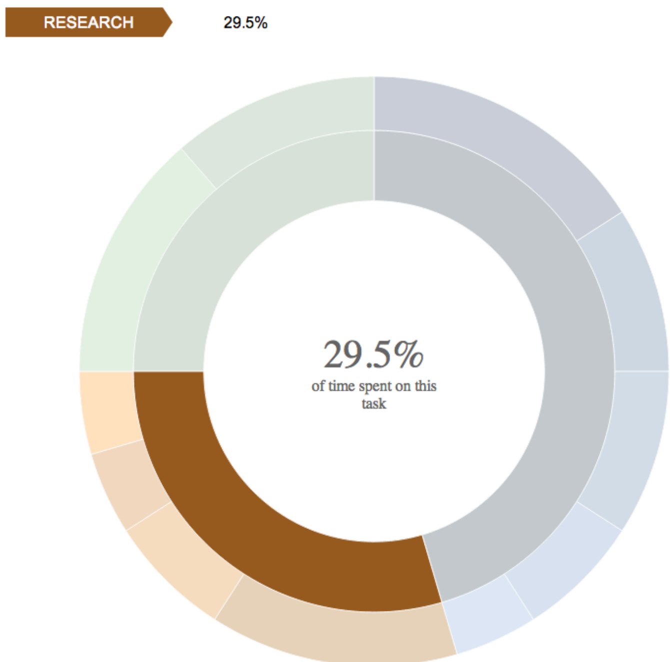


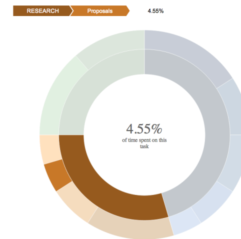
Damaged Stability

- Method of lost buoyancy
- Method of added weight



Research



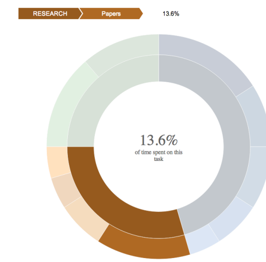


Proposals

BIP (w/ Ulstein, 3yr project, 5MNOK)

SFI (multi-partnership project)

Pre-projects sketch



In progress:

6 Conference papers (IMDC/SOBENA)

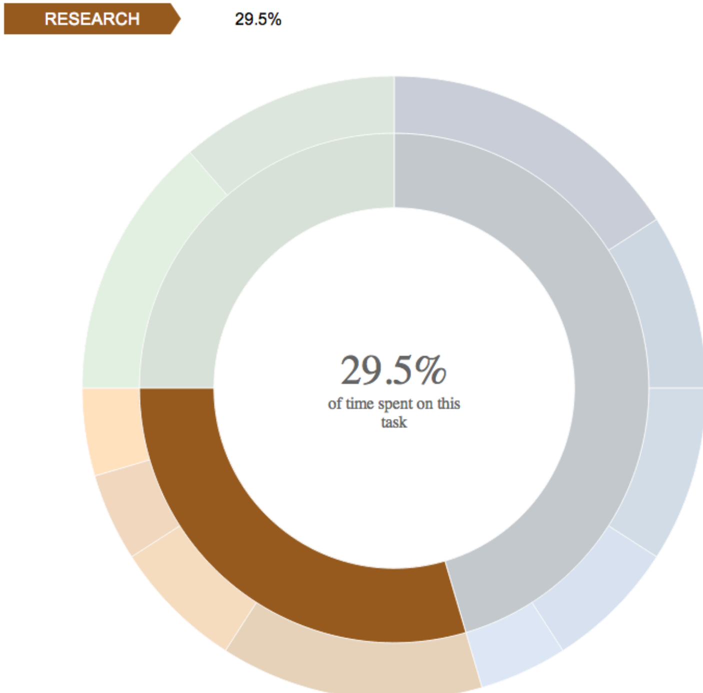
2 Journal Papers

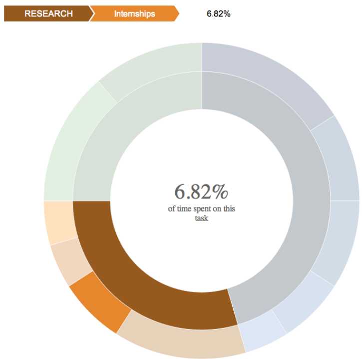
Diverse reports

Publications

- *Gaspar, H., et al., "Assessing Air Emissions for Uncertain Lifecycle Scenarios via Responsive Systems Comparison Method," Part M: Journal of Engineering for the Maritime Environment (NTNU research) (2014)*
- *ÉMIS - Effective Ship Design, Engineering and Fabrication: - Facilitation of beyond state of the art modular and standardized ship design, engineering and fabrication approaches,* HM Gaspar, Brett, PO, Hildre, HP – BIP project application (2013)
- *New vessel design approaches and the gradual obsolescence of the current designers' software application toolbox,* HM Gaspar HIALS Research Seminar (2014)
- *Data-Driven Documents (D3) applied to Conceptual Ship Design Knowledge,* HM Gaspar, PO Brett, A Ebrahim, A Keane, COMPIT 2014 (UK)
- *Data-Driven Documents (D3) applied to Conceptual Ship Design Knowledge – Online Examples* , HM Gaspar, HIALS (2014)
- *Challenges for Using LNG fueled Ships for Arctic Routes*, Gaspar, H.M., Ehlers, S., Æsøy, V., Erceg, S., Balland, O. and Hildre, H.P., in OMAE 2014, San Francisco, CA, USA
- *Simplified OSV Parametric Design MethodologyApplied for Ulstein International SA Case*, HM Gaspar, Ulstein Internal Report (2013)
- *Comments for Report "Hull Vision PSV – Parametrics Study and Benchmark Analysis, Rev .01" by Ulstein International*, Ulstein Internal Report (2013)
- *Parametric Ship Design A Simple Application in HTML + Javascript*, HM Gaspar, HIALS (2014)
- Lifecycle Model for LNG fueled Ships Operating in the Arctic via Epoch-Era Analysis, HM Gaspar, HIALS (2014)
- *Epoch-Era Analysis using Blue Ship Invest case as Example - A Simple Application in HTML + Javascript*, HM Gaspar, Ulstein Internal Report

Research



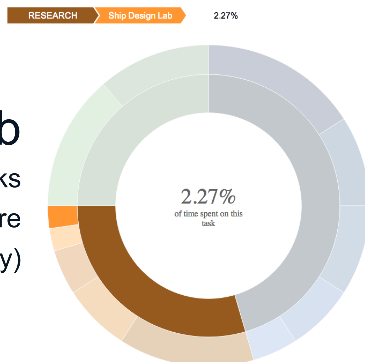


Internships

2 bachelor levels (Brazil)

1 Master level (France/Brazil)

Co-supervision (w/Ulstein)

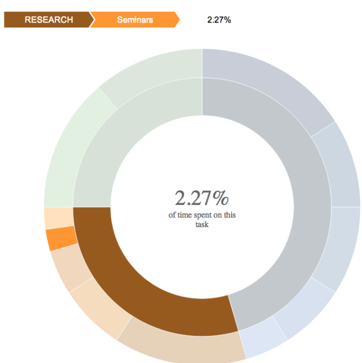


Ship Design Lab

Initial tasks

Infrastructure

(w/ Karl Henning and Vilmar Æsøy)



Seminars

Research Seminars AMO/AIR

Research – OMAE 2014

Proceedings of the ASME 33rd International Conference on Ocean, Offshore and Arctic Engineering
OMAE2014
June 08-13, 2013, San Francisco, CA, USA

OMAE2014-23914

CHALLENGES FOR USING LNG FUELED SHIPS FOR ARCTIC ROUTES

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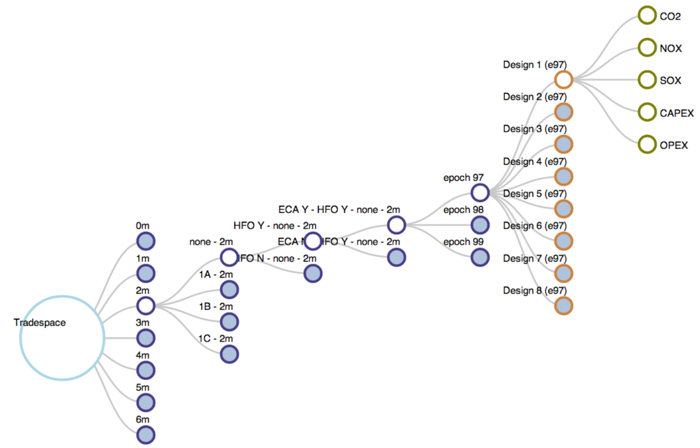
ABSTRACT

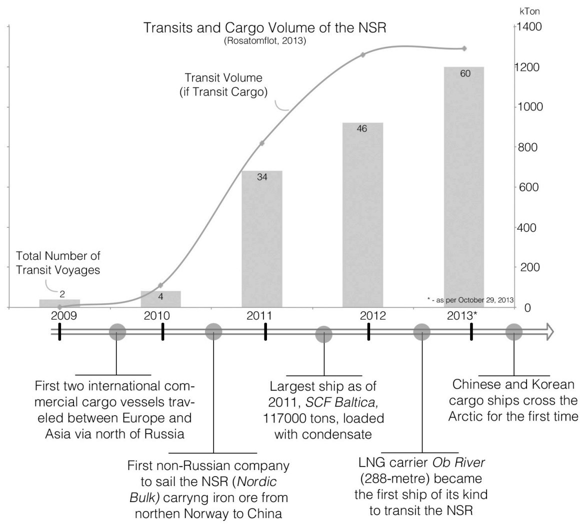
The utilization of the Northern Sea Route by commercial ships is an official fact. Since 2009 the number of international cargo vessels using the passage has been increasing, and a continuous raise in these numbers is expected if the route establishes itself as reliable. The route saves vessels approximately two weeks' time in summer over a route via the Suez channel, but the increase brings concerns, regarding environmental impact, safety, and operability on the route.

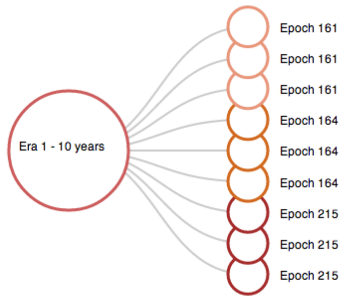
This paper investigates the current challenges of using LNG fueled ships for arctic transport routes. A panorama of the recent conditions and predictions for the arctic environment regarding ice concentration and seasonal route availability is presented. The current development of LNG as a commercial fuel is discussed based on this arctic panorama, approaching key topics such as infrastructure, economic viability, propulsion requirements, and environmental impact. Special attention is given to the performance of LNG propulsion systems under arctic conditions, focusing on powering and air emissions. We conclude the paper by proposing the implementation of a lifecycle model to predict economical and environmental performance indicators when simulating a fleet of LNG fueled ships operating under many possible future ice conditions scenarios.

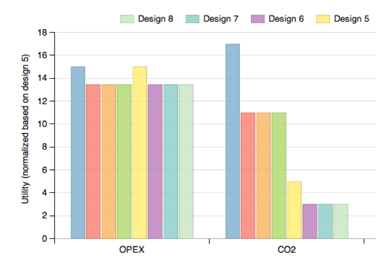
INTRODUCTION – THE ARCTIC AND LNG FUELED SHIPS

The Russian Federation opened up the Northern Sea Route (NSR) for foreign traffic in 2009 and thereby a new transport route connecting Europe to Asia. By July of 2013 the administrators of the NSR had granted permission to 204 ships to sail this year (Milne, 2013). Moreover, some activity also occurred on the Northwest Passage, with the ice-strengthened bulk carrier Nordic Orion transporting coal from Vancouver to Finland. Figure 1 provides an overview of the routes in the arctic (McAlaster, 2013). The implications of the diminishing Arctic icecap for maritime transport are unclear. On the one hand, a possible opening of the Northern or Trans-Arctic Sea route represents about 50% reduction of the sailing distance for several trading routes. Those vessels that can exploit this opportunity are likely to improve their competitive position significantly. On the other hand, the operational challenges in these waters, and the corresponding risks and uncertainties involved, are considered very severe. This includes political factors (Russian territorial waters), environmental concerns (possible oil spills and air pollution), operational conditions (harsh environment, distance to nearest land base, rescue time etc.), ice navigation (possibility of drifting ice), contractual and insurance issues (increased probability of delays) and the length of the season that is sufficiently ice free. As a result, arctic transit is not even considered by most shipowners. However, *DNV* (2010) expects 480 container transit voyages across the Arctic Sea in 2030, primarily using the NSR. Arctic areas are also very important for marine biomass production, and highly sensitive to environmental impacts. Therefore, emissions to sea and air must be kept to a minimum, and care must be taken when activities expand into these areas. Direct oil spill and air emissions such as sulfur (SOx), nitric oxides (NOx) and particulate matter (PM) are the result of burning residual fuels such as heavy fuel oil. As a consequence, heavy fuel oil is banned in the Antarctic and coastal waters of Svalbard. In this context, LNG is now introduced as a very clean alternative fuel,









Research – Data Driven Documents

Data-Driven Documents (D3) applied to Conceptual Ship Design Knowledge

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Abstract
This paper focuses on data-driven documents (D3) examples applied to the conceptual ship design process, especially in how to effectively and quickly filter and present complex input, multilevel and multiclient interactions, associating into design knowledge. The traditional ship breakdown structure, with cost and subsystems elements, is encapsulated via analogous representations, such as tree layout, force layout, pack layout, sunburst layout, and Sankey diagrams. Large dependency matrixes are represented via interactive chord diagrams (dependency wheel and hierarchical edge bundling). A parametric design web application is used as example, to tie in a single structure knowledge representation. An overall discussion is presented, focusing on how this approach improves the expressiveness of data and interactions in an industrial ship design context, allowing the designer to better interact with a conceptual ship design dataset, as well as facilitating the presentation of the expectations of stakeholders involved.

1. Knowledge in Conceptual Ship Design

A good functional design description requires gathering conceptual ship design knowledge, that is, an efficient exploration of existing and related information. Even as the freedom to change the primary variables of the design decreases as a design progresses through phases, the engineer's knowledge of the problem and how the design could be adapted to the situation increases (Erikstad 1996; Brett 2012). In other words, as one goes to a more detailed part of the process, the decisions narrow toward a certain set of solutions. Ontologically, to make a decision means giving up other options, thus decreasing the freedom to modify the design parameters in future stages of the process. The idea of conflict between design knowledge and freedom to change is presented in Figure 1a.

The objective of every design method during the conceptual phase is thus to create knowledge as early as possible, without compromising much of the freedom, as observed in the lighter line from Figure 1a. In other words, a designer would like to have as much flexibility as possible to improve vessel parameters while acquiring fast knowledge about her decisions, hopefully decreasing risk and uncertainty (PMBOK, 2008).

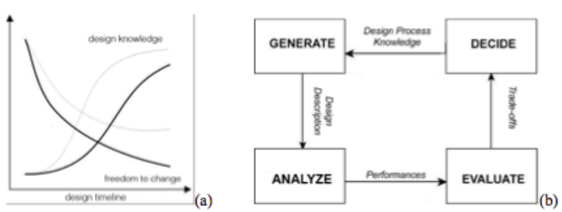
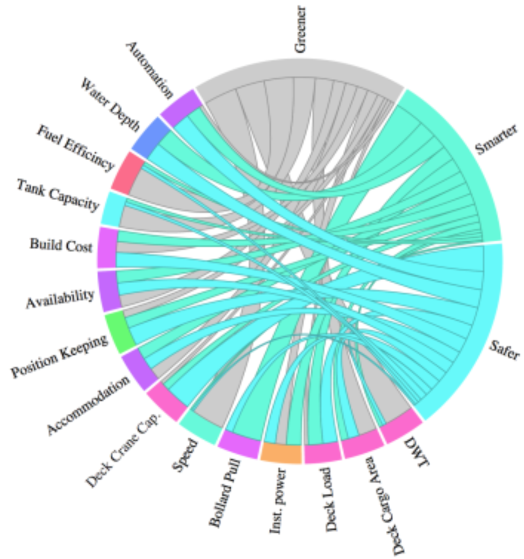
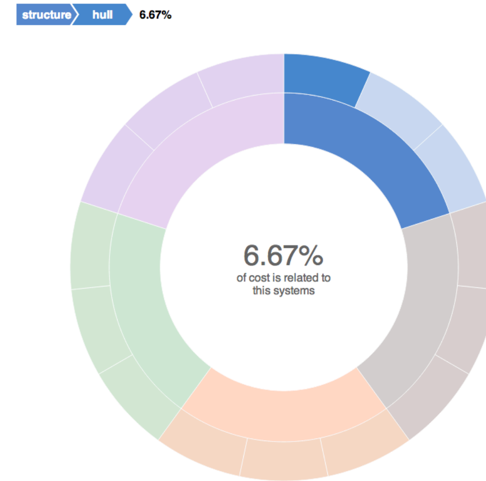
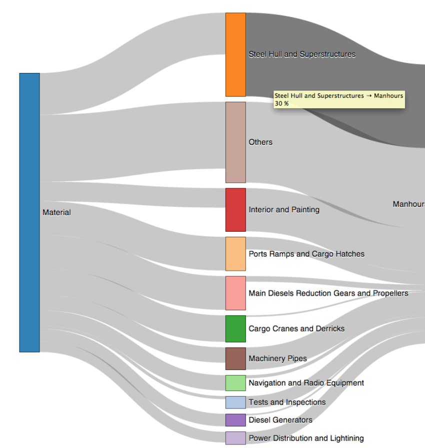


Figure 1 - Trade-off between freedom to change a design and the knowledge acquired during the process (a) and basic design process (b), based on Erikstad (1996).

In addition, designers must seek elucidation of the requirements proposed by Andrews (2003, 2011). The author contrasts fixed and straightforward approaches to a pre-established list of requirements,

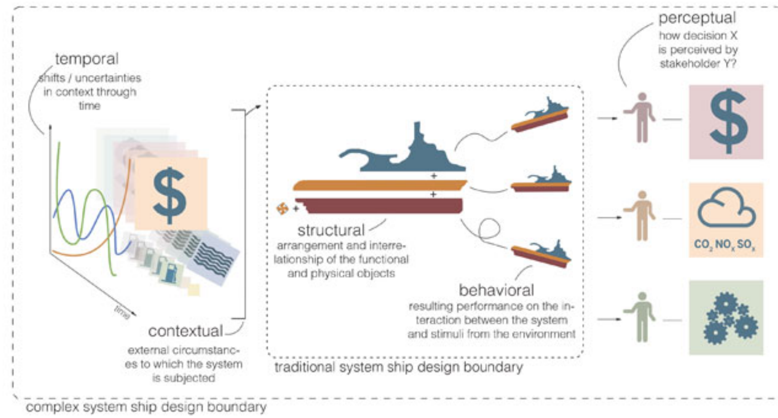




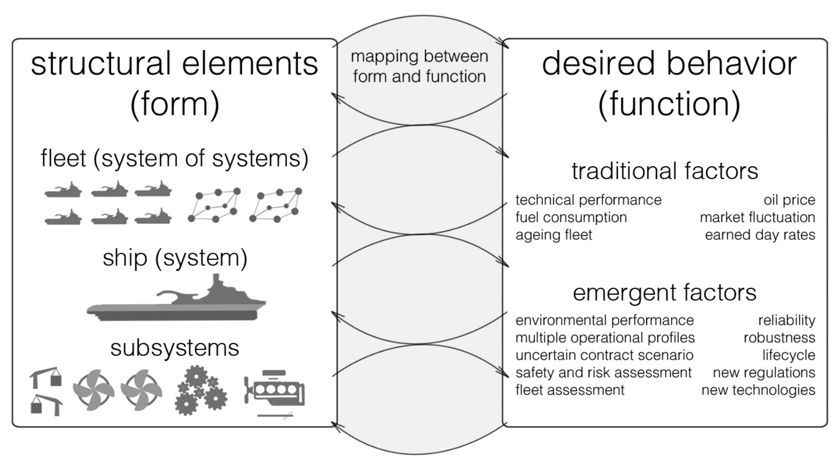


Research – Ship Design Lab

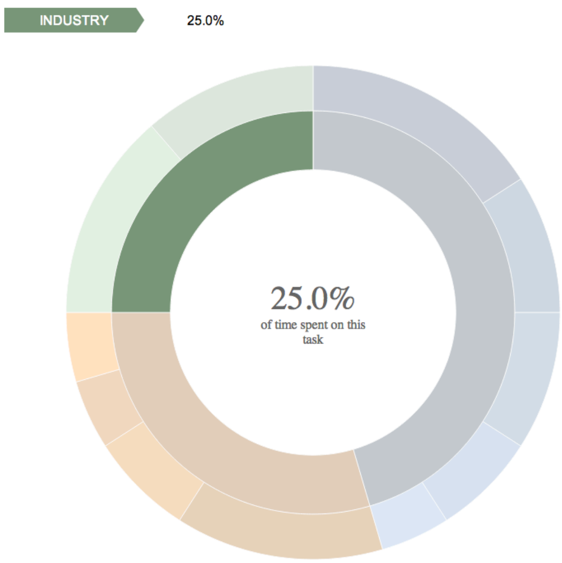
- Develop applied research in design and behavior performance of ships for complex offshore maritime design and operations
- Contribute to establish a strong research group at AMO
- Apply for projects and funding from research council and industrial partners
- To involve competent and motivated colleagues (researchers, students, visitors) to take part in the activities
- Balance between teaching, research and industrial collaboration

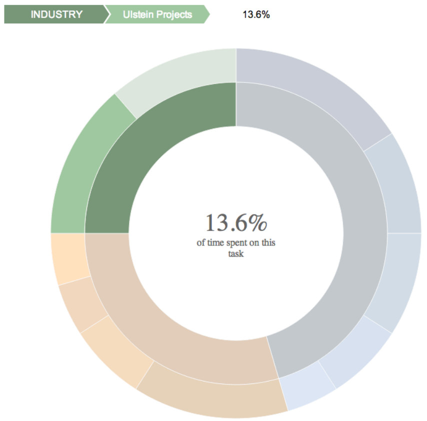


ship design domain



Industry



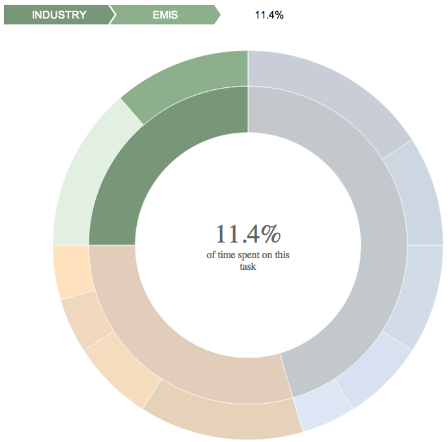


Ulstein Internal Projects

Design Best Practice

Systems Engineering

Industrial Approach

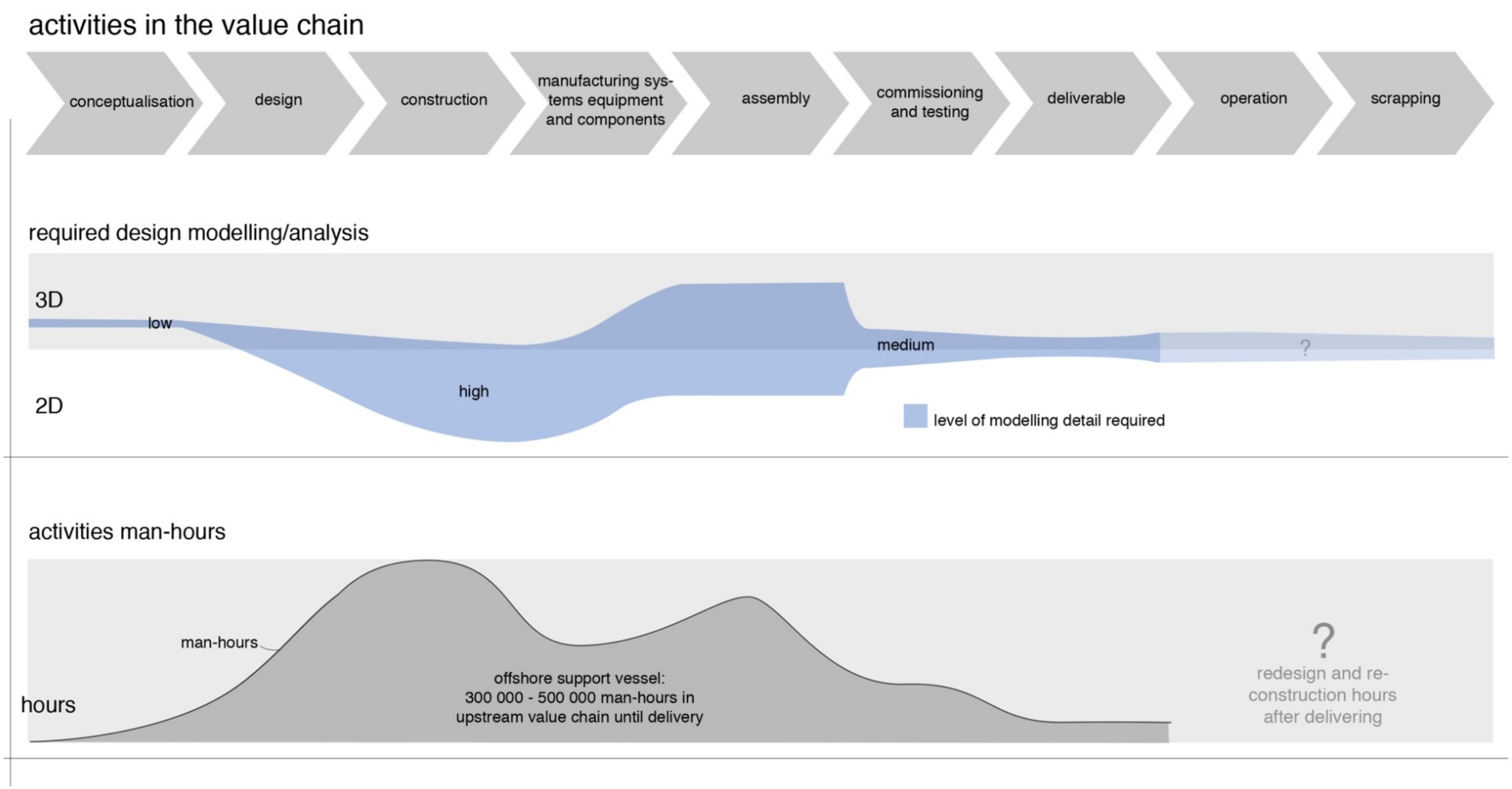


EMIS

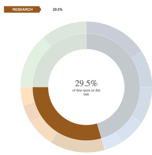
BIP Project

Applied research

Research + Industry – EMIS BIP

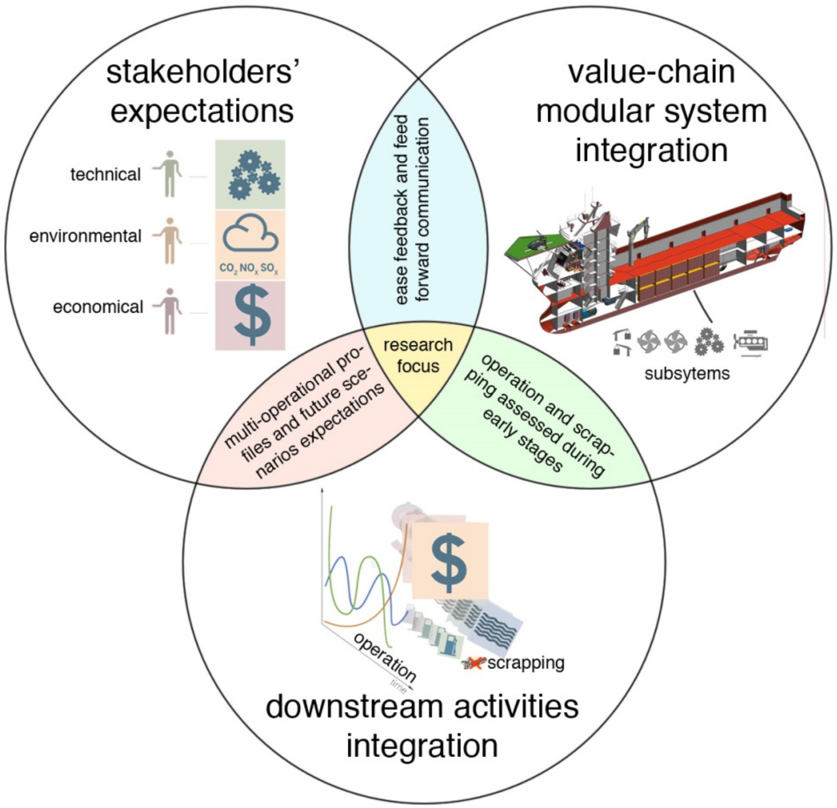


Research + Industry – EMIS BIP



3 Main Objectives:

1. Develop a cost-effective **framework for design and engineering of Offshore Vessels** based on a modularized and standardized approach, through the whole value-chain, from the conceptual design of the vessel until scrapping
2. Develop a system theory based prototype design tool able to concurrently **integrate the framework with the current module work** at the value-chain
3. **Test and implement** the framework within the value chain elements



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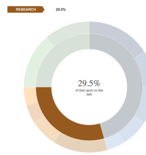
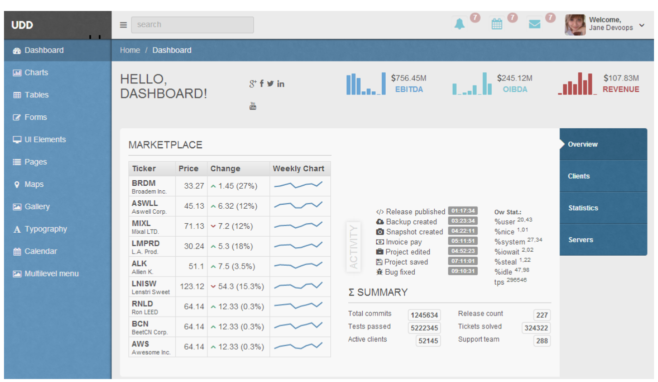
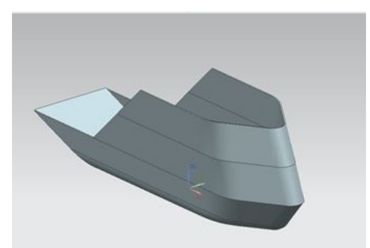


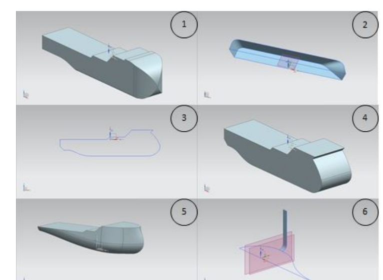
2 research lines: Framework and 3D Modular System Integration

UDD FRAMEWORK TASKS JUNE 2ND	AUGUST 5TH UPDATE
Study on an multi-stakeholder/multi-platform framework needs and functionalities, which integrate the multi-levels of the ship design value chain (Ulstein Design Dashboard - UDD)	*UDD Presentation July 8th [1]* *Requirements to be sketched on August/September, based on Hydro tools and/or catalogue vessel.*
Sketch of a prototype version of the framework, integrating designers and clients approaching conjointly a conceptual design	*Functionalities presented in [1].* *Waiting feedback for requirements from Øyvind Kamsvåg, Per Ivar Roald and Stein Frode Haugen.* *Prototypes activities starting in August.*
Integrate basic parametric equations for a fast first approach design in the framework	*Meeting with Ali & Per Olaf during August.* *Implementation Framework starting from August.*
Study on the level of detail required to jump from fast to customized design in the framework	*Study requiring feedback from other tasks, probably starting around October/November*
Sketch methodology for integrating the framework with Ulstein tools from 2015	*Study requiring feedback from other tasks, probably starting around October/November*
Summary of the pros and cons of the approach	*Study requiring feedback from other tasks, probably starting around December*



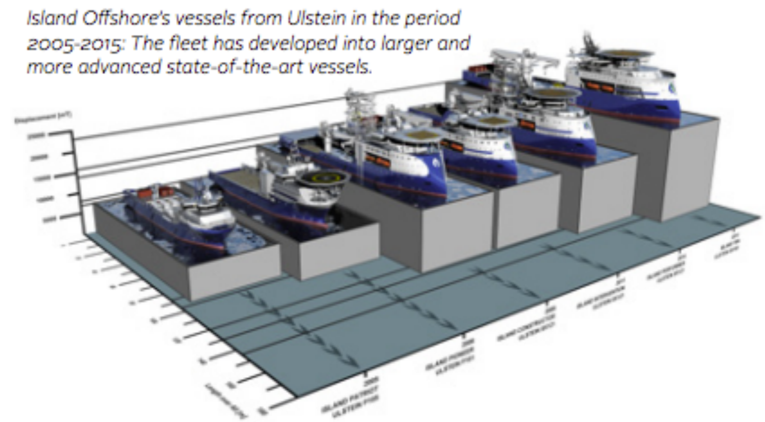
CAD/CAE SOFTWARE TASKS	AUGUST 5TH UPDATE
Study on using NX as tool for rapid ship design prototype: first phase - conceptual design	*Short example during April's workshop [3] and another case during Allan's internship [4].* *A more robust case connecting MaxSurf and/or Napa should be done during September/October*
Tutorial on how to draw a simple hull in Siemens NX (conceptual design)	*Sketch from Allan's internship [4]* *A more robust case using MaxSurf and/or Napa should be done during September/October*
Tutorial on how to parameterize a simple hull in Siemens NX	*Sketch from Allan's internship [4]* *A more robust case using MaxSurf and/or Napa should be done during September/October*
Study on which calculations are provided "out of the box" for Stability and Structural analysis	*Requiring NX server implementation, probably starting around October/November*
Study on the level of detail required to jump from conceptual to basic design in Ulstein case	*Requiring NX server implementation and Ulstein design team feedback from the prototype, probably starting around October/November*
Proposal for methodology to merge CAD/CAE with the UDD framework from 2015	*Study requiring feedback from other tasks, probably starting around November/December*
Summary of the pros and cons of the approach (bottlenecks)	*Study requiring feedback from other tasks, probably starting around December*



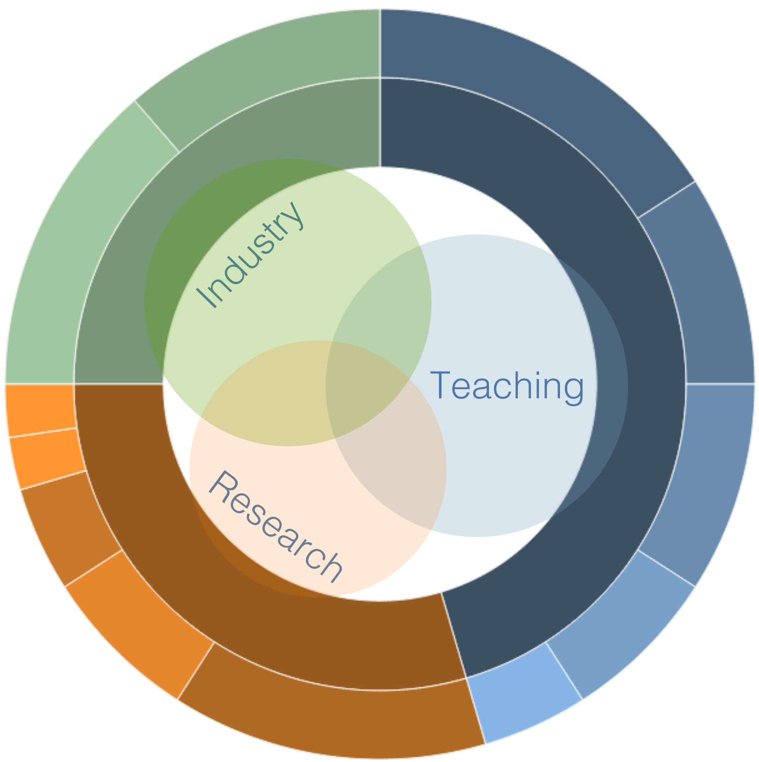


Ulstein Internal Projects

Internal projects on Ship Design and Modular Integration (confidential)



Future Tasks



- Teaching
  - Improve current courses
  - Intensify International Cooperation (USP, UFSC, MIT, UCL)
- Industry (Ulstein Group)
  - EMIS 2+ years
  - Ulstein Internal Projects
- Research
  - Ship Design Lab Starting
  - Integration with other Labs
  - NTNU/MIT/USP/UFSC Research
  - Integrate Science without Border Students with Projects

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