MODULE-BASED DESIGN OF FISHING VESSELS

Stud. Techn. Vegard Kristiansen
Supervisor: Professor Stein Ove Erikstad

marin design as

NTNU
Norwegian University of Science and Technology

Introduction

In Norway, the fishing fleet has long been bounded by tradition and less focus on innovation. Despite this, major changes in resource management have formed the development of the fishing vessels, as there is greater focus on operational efficiency, safety, sustainability, environment and multi-purpose capabilities. The major equipment composition of fishing vessels and requirements in order to operate throughout the whole year, has fueled the fleet towards a high degree of customization, despite the fact that the vessels in principle are very similar.

Modular design has successfully been used in both offshore and military purposes. Especially regarding military vessels, modular approaches allows the use of smaller vessels as the modular design makes it possible to reconfigure the ship to individual assignments.

Although modular design has been around for a long time, it has still not yet been used in the fishing fleet. This is mainly because the production of fishing vessels is a limited market, and the ongoing competition to build custom vessels with a large degree of participation from the ship owners in the design phase has not favored the idea of trying something new and unknown. Part of the challenge with implementation of modular design is higher costs, as it must be allocated on a smaller amount of vessels. Despite this, it is important to look at the potential gains that can be achieved for the designer, yard and customer.

Objective and scope

Key aspects underlying the thesis:

1. Regulatory framework
   a. Describe key design methodologies and models with emphasis on Ship Design
   b. Describe key design methods and models for product platforms and modularization
   c. Identify how regulations affect the design of fishing vessels
   d. Summarize state of the art of modular design
2. Function Structure
   a. Describe selected fishery types to identify and understand the interaction between necessary equipment
   b. Describe key methods and models and implement this to map the interaction between fishery processes and equipment
3. Modules and product platforms
   a. Identify modules
   b. Create a common product platform
4. Configuration Process
   a. Present a simple tool that generates a composition of modules and hull sections based on customer specifications
5. Evaluation and Visualization
   a. Visualize use of the method through a case with a selection of real operating combinations and related equipment modules

Method

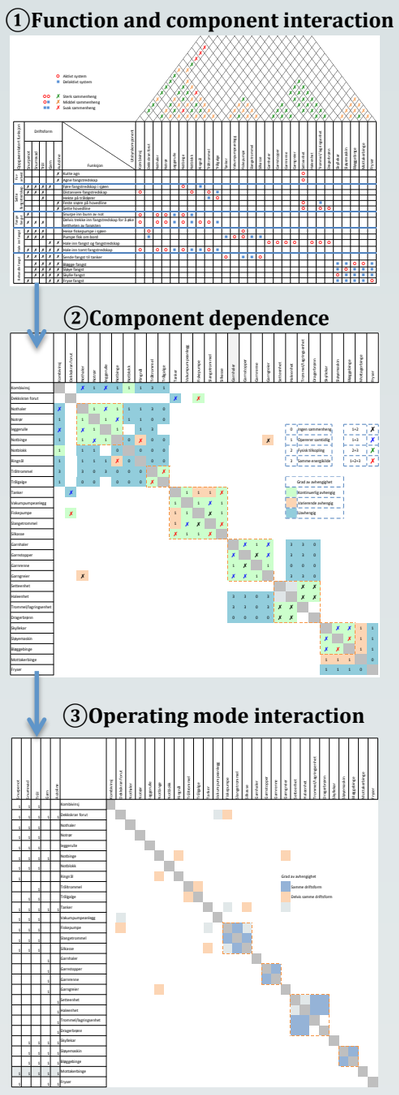
A vessel with length of 27 meters and width of 9.5 meters was chosen as the basis for the thesis at the request of the task initiator Marin Design AS, and also as it is a versatile vessel group. The five operating modes purse seine, danish seine , trawl and autoline were selected to create an extensive and flexible product platform for the selected vessel length.

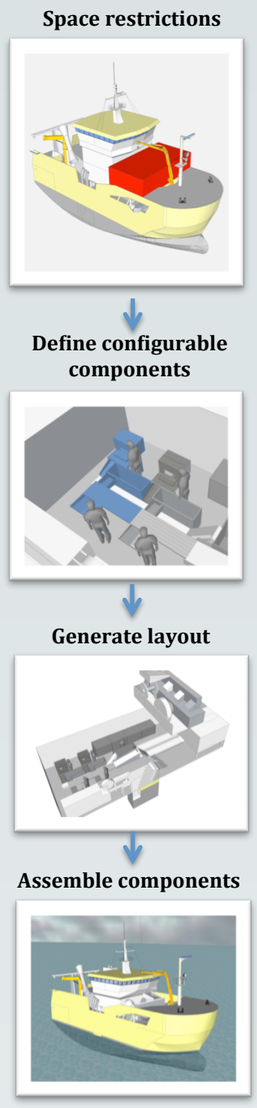
Together, these modes of operations include 28 equipment components. The division into modules were based on:

① A function decomposition
② Whether the interaction between equipment components were continuous dependent, variable dependent or physically connected.
③ Whether the components were part of the same operating mode.

The selection of combinations of modes of operations is based on existing vessels and combinations that are expected to become more common in the future.

An xls based tool allows the customer and the designer to determine the key design choices related to modes of operation, accommodation facilities, range and cargo capacity. From this a composition of predefined modules and hull sections is generated.





		Valgt	Snurpenot	Snurrevad	Trål	Garn	Line
Valg av driftsform:	2		✗	✗			✗
				✗			✗
			✗	✗	✗	✗	✗

		Areal
Arealbehov utstyrskomponenter	Utstyr dobbeltbunn	3,9 m^2
	Utstyr hoveddekk	152,0 m^2
	Utstyr shelterdekk	77,4 m^2
Tilleggsfaktor utstyrsareal		30 %

Sections from the xls tool showing:
- **Choice of mode of operation and corresponding space requirements**
- **Range and capacity selection**
- **Simple presentation of selected sections**

Antall timer i transit per tur (75% MCR)	168	34 m^3
Antall timer under operasjon per tur (50% MCR)	504	70 m^3
Totalt brennstoffbehov		104 m^3
Brennstofftanker dobbeltbunn	Ja	64 m^3
Brennstofftanker akter	5	40 m^3
Total brennstoffkapasitet		104 m^3
Lastekapasitet		200 m^3

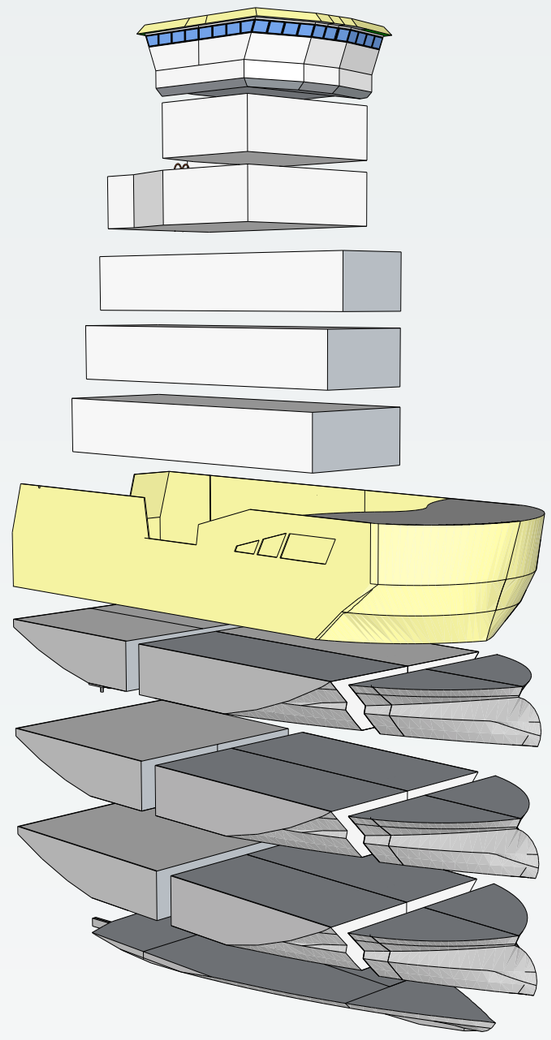
	Innredning	Utstyr
Bro		
Ekstra dekk — Tilgjengelig areal:	0	-
Ekstra dekk — Benyttet areal:		-
Shelterdekk — Tilgjengelig areal:	70	177
Shelterdekk — Benyttet areal:		77
Hovedekk — Tilgjengelig areal:	65	163
Hovedekk — Benyttet areal:		152
Tilgjengelig areal:	135	340
Benyttet areal:	133	229
Under Hoveddekk		
Dobbeltbunn		

	Snurpenot	Snurrevad	Trål	Garn	Line
Nødvendig utstyr					
Moduler					
Kombivinsj					
Dekkskran forut					
Nothaler					
Notrør					
Leggerulle					
Notbinge					
Notblokk					
Ringnål					
Tråltrommel					
Trålgalge					
Tanker					
Vakumpumpeanlegg					
Fiskepumpe	Modul 1				
Slangetrommel					
Silkasse					
Garnhaler					
Garnstopper				Modul 2	
Garnrenne					
Garngreier					
Setteenhet					Modul 3
Haleenhet					
Trommel/lagringsenhet					
Dragerbrønn					
Skyllekar					
Sløyemaskin	Modul 4				
Bløggebinge					
Mottakerbinge					
Fryser					

Results

From the total of 28 equipment components, 40% could be divided into a total of four major modules. Remaining equipment components follow basic requirements in the processing section, where requirements for open space regarding specific components ensure that the vessel can be easily reconfigured for other operating combinations. Hull sections included are:

- 3 different cargo tank modules of 200, 220 and 240 m^3
- 3 different engine room sections of 80, 90 and 100 m^2
- 3 different accommodation sections on the main deck of 60, 80 and 95 m^2
- Fixed accommodation sections on the shelter deck (70 m^2) and bridge deck (50 m^2)
- Optional accommodation section between the bridge and shelter deck of 45 m^2.



Conclusion

The thesis focused on finding a structured and efficient method for modular design of fishing vessels in an early stage. Through methodological approaches and 3D-visualization methods, the thesis has shown that there is great potential in modular design of fishing vessels, but there still remains much work to provide a tool with significant value in the design process.

Although modular design concepts are constantly evolving, it has not yet been used on fishing vessels. There are some challenges associated with the implementation of modular design on fishing vessels, as the vessels originally are built for a limited selection of the huge amount of modes of operations and number of equipment components.

A modul-based design may compromise the level of customization, which the industry has been accustomed to. However it is important to look at what can be gained from standardization over time, both in terms of design, cost, construction or operational flexibility.