Danish frigate program

Setting a new standard for affordable defense procurement

OMT

Introduction to Danish frigate program

The aim of the Danish frigate program is to provide the Royal Danish Navy with a platform capable of operating independently or as part of a group (i.e. NATO). The frigates have a flexible design to ensure that multiple tasks can be carried out efficiently, effectively and economically, performing tasks ranging from sea control to warfare.

The platform is designed for a 30-year lifespan and modularity enables technology refresh and insertions. Navy ships today have the perfect opportunity to raise standards by looking at new and efficient ways of operating.

The modularity
The Danish Defence and Logistics Organization (DALO) ran the program with inspiration from the world's largest shipping company, Maersk.

The result was a new frigate procurement model based on fixed prices and open book principles, leveraging commercial shipbuilding principles from Maersk (Odense Steel Shipyard) and DALO's military acumen, combining the best from both worlds. The ships can be delivered on budget and on schedule and are exceeding the required specifications from DALO.

By demonstrating respect for taxpayers' money and using common sense, DALO has created a new standard for affordable defense procurement.

Flexible Navy concept

– the background

The standard flex concept was developed in the eighties when the Danish Navy faced the urgent need of replacing their old ships on a limited budget while being unsure about the future type of missions that the Navy would be engaged in. In other words, the situation required innovation.

The flexible navy concept was developed in close cooperation between the Danish Navy and the Danish maritime industry. The concept allowed a standard vessel to be configured for various roles and to share modules across the fleet.

The advantage of the modular concept is the ability to reconfigure the platform into new roles as well as the ease of future upgrades and retrofits. With platform flexibility, DALO is able to operate at higher levels of availability by optimizing:

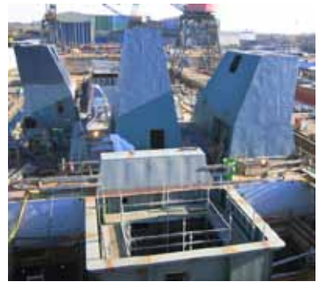
- System reliability/portability
- Small logistics footprint
- Low maintenance
- Life cycle cost

The innovative platform allows DALO to postpone specific investments and reduces the time the ship will be out of service during in-service support retrofits. The modularity offers the Navy an effective way of adapting to technical uncertainty.

The platform meets standard IMO, SOLAS and MARPOL requirements for a vessel with 165 persons on board and features a life-saving system for dry evacuation of the entire crew.

The hull structure meets DNV ice class C standards and the entire ship is designed and tested to withstand shock from underwater explosions. The hull is divided into five gas-tight citadels with external wash systems for chemical warfare. It features a degaussing system for mine avoidance and sensitive electronic equipment is EMC protected. Stealth low radar signature design; low infrared exhaust signature. Propulsion set-up with two Controllable Pitch propellers, each connected to two diesel engines delivering 8.2 MW each.

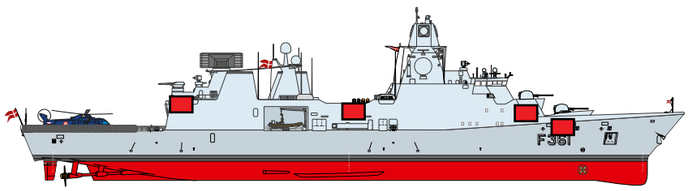
Armament	
Missiles	Lockheed Martin MK41 VLS Harpoon Block II missiles, Evolved Sea Sparrow missiles, long-range missiles for area air defense (vertical launch)
Guns	Oto Melara 76mm Super Rapid guns, one of which is prepared to be substituted with a 127mm gun. Furthermore, the Danish Iver Huitfeldt has a 35mm CIWS gun and several 12.7mm machine gun positions Boeing Harpoon anti-ship missile system, a twin torpedo launcher in each side
Sonar	Atlas ASO 94 hull-mounted active search and attack medium range sonar
Torpedoes	Fixed ASW launchers
Countermeasures	Terma 12-barrelled decoy launchers for 360° coverage against incoming anti-ship missiles. Decoys, chaff and ESM
Radars	Thales AESA multi-function radars for surveillance and fire control. Medium- to long-range air and surface surveillance radars Terma SCANTER 6000 surveillance and helicopter guidance radar Saab CEROS 200 fire control radars ES-3701 Tactical Radar Electronic Support Measures (ESM)
Combat Management System and intelligence	Terma C-FLEX command, control, communications, computers and (C4I) systems, link 11 and 16, commercial and military SATCOM
Helicopter	Helicopter deck and hangar to support the operations of medium-sized helicopters (EH101). Flight deck can handle larger and heavier helicopters of up to 20 tonnes
Miscellaneous	Prepared for tactical, unmanned aerial vehicles and unmanned underwater vehicles, cargo space for 20-feet ISO containers



Flexibility provided

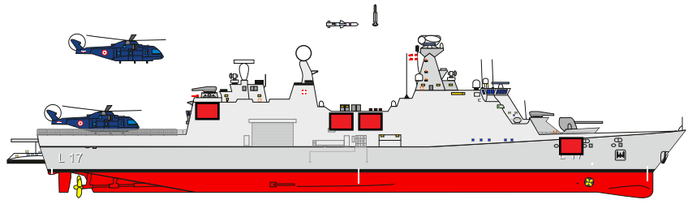
Iver Huitfeldt Class

Frigate



Absalon Class

Command and support ship



Knud Rasmussen Class

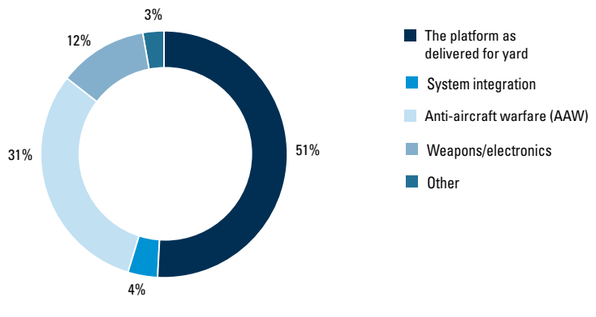
Offshore patrol vessel

Danish Iver Huitfeldt Frigate

– cost

Total cost for the frigate was USD 325 million in 2010. This is only USD 80 per kilogram frigate or just 1/3 of what has been reported as low-end prices in Europe. The Royal Danish Navy, DALO and OMT (OSS) have accurately tracked the Danish Iver Huitfeldt program expenses and have an indisputable assessment of costs.

Figure 1: frigate cost



The platform has been designed, developed and delivered with standardized equipment, combat systems, weapons and sensors from global suppliers.

Public and private partnership

Collaboration between DALO/the Royal Danish Navy and the OMT (OSS) on ship design which significantly minimized program risk and production costs.

Commercial off-the-shelf components

Off-the-shelf component robustness is tested 24-7-365 on commercial ships and considered for the frigate program. The target was long-term cost savings but not if robustness and reliability were compromised. The ships are shock tested according to NATO standards.

Efficient manufacturing set-up at the yard

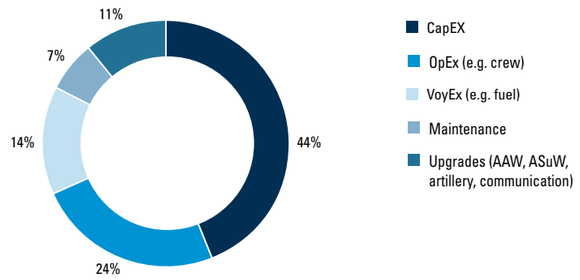
Efficiency assembly measures formed the basis for the production set-up of the Danish frigate program and created a new benchmark for productivity in naval shipbuilding. The Danish frigates were assembled in 56 days followed by 146 days for outfitting, commissioning and trials. 700.000 hours was used to construct the vessel.

Project model

The shipyard was allowed to make a decent profit on the ship platform itself. The shipyard had nothing to do with procurement of weapons, AAW and system integration. DALO had the role of main contractor and system integrator and saved Danish taxpayers approximately USD 65 million per ship with this project model.

Designed for life cycle cost

Figure 2: total average cost to tax payers: USD 67 million per year



The Danish frigate program targeted total life cycle cost and applied principles from commercial shipping. In commercial shipping focus is on reduction of crew cost, fuel cost and emissions. Understanding these commercial cost efficiency principles gave DALO another perspective on the frigate program.

Striving for low fuel cost at cruising speed (18knots) while meeting the requirements for fast acceleration and high top speed became a core part of the propulsions system concept developed for the frigates.

The result was a propulsion system giving best-in-class fuel economy. At 18 knots cruising speed, the frigate requires 31 tonnes of fuel per day giving an endurance of 9,300 nautical miles. This endurance is 80-100% better than other new frigate designs on the market today.

Despite the excellent fuel economy at cruising speed, the frigate can reach 29.3 knots in less than 120 seconds. A propulsion system based on a gas turbine could deliver a slightly higher maximum speed but it was not selected as it significantly increases CapEx and fuel costs and reduces endurance by approximately 50%.

In short, Navy ships must be role models and set new standards by continuing to look at new efficient ways of operating.

Life cycle cost
– operating expenses (OpEx)

The platform is largely based on commercial off-the-shelf equipment. Real operating costs have proven to be even lower than expected.

An important cost driver is crew, inspired by Maersk. For example, an ultralarge containership can be operated by 14 crew members. The Danish frigates can be operated by 20 crew members.

To operate the frigate during missions, a total crew of 100 is required with additional space for 60 mission-dependent crew members.

The space in the super structure can potentially accommodate up to 200 crew members. However, DALO and the Danish politicians decided to stick to the lean crew concept and used the space for a supplementary missile launcher.

Passing on maintenance tasks to the crew has not been a problem. Project Manager for Danish Frigate program, Commander Senior Grade Hesselberg explains why: "A busy soldier is a happy soldier".

Maintenance cost

The modularity concept and the standard software architecture enable efficient upgrades during the 30-year life of the frigate. The open architecture design provides flexibility, allowing military systems to integrate with one another, for example Thales AESA multifunction radars assimilating with Terma Surveillance Radar.

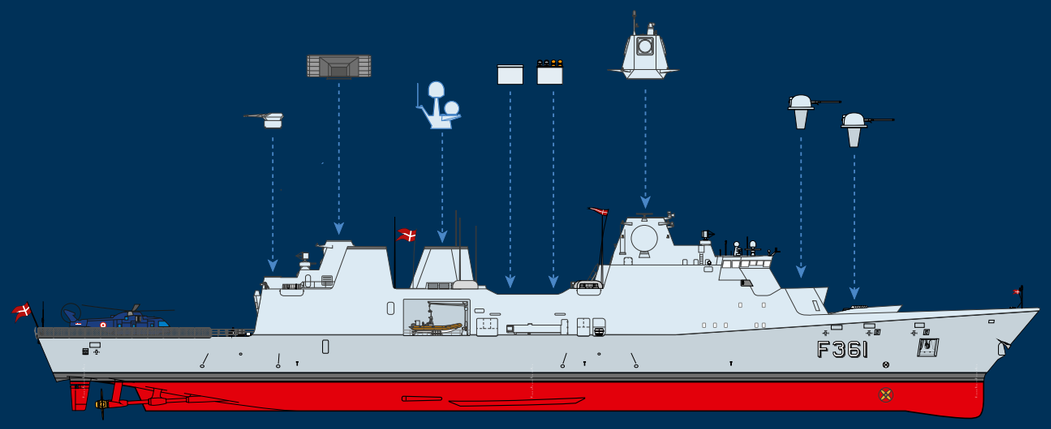
DALO decided to use DNV navy classification for the vessel. This means that the frigate will be subject to docking every five years. It also means that the crew has to comply with DNV maintenance procedures as part of their daily job. This has a positive effect on the maintenance costs and reduces the in service support cost. The budget for maintenance is expected to be less than 7% of the total life cycle cost.

The modularity ensures easy upgrades, a longer lifespan for the platform and more value for money.

Main data
– Iver Huitfeldt Class Frigate

Length o.a.	138.7 m
Beam, max.	19.8 m
Draft, design	5.8 m
Draught, max.	6.45 m
Displacement, design	5,452 tonnes
Displacement, max.	6,649 tonnes
Weapons and deadweight	App. 1,200 tonnes
Speed, design draught	29.3 knots
Endurance, design draught	9,300 nm (18 knots, seastate 0)
Fuel oil consumption, endurance	31 tonnes/day
Basic crew	99
Max. crew	165

Iver Huitfeldt Class Frigate with plug-and-play features



The modular platform designed by OSS-OMT worked across the industry to ensure best value for money over a 30-year life.
The Danish Defence Acquisition and Logistics Organization is the system integrator: weapons, sensors and combat management system.

About Odense Maritime Technology (OMT)

OMT traces its heritage back to 1917 when Odense Steel Shipyard (OSS) was founded by A.P. Møller in Odense, Denmark. The OMT Company was founded in 2010 as a spin-off from the OSS. Key focus areas for OMT are design of cost-effective and fuel efficient commercial ships and navy ships.

Likewise, retrofit of existing vessels to make them more fuel efficient and compliant with new regulations is a key focus area. Our solutions are based on new technology that delivers energy efficiency and improved environmental performance. The result is proven quality, reliability and operational high performance of our design. OMT scope involves full design packages but can be extended to include procurement and production optimization as well.

OSS (OMT) designed and manufactured the Royal Danish Navy's Absalon Class Supply and Command Ships and the Iver Huitfeldt Class Frigates. Three frigates of the Danish Iver Huitfeldt Class Frigates were designed and built for the Royal Danish Navy by OSS (OMT) in Denmark between 2006 and 2012. After the first three years in operation, the Navy reports are very positive on functionality, reliability and with maintenance costs lower than expected.

OMT has an agreement with the Royal Danish Navy to market military platform designs to other countries. OMT and the RDN continue to work together to ensure that combat-capable, multi-purpose vessel designs are kept up to date.

About DALO

The Danish Defence Acquisition and Logistics Organization

The Danish Defence Acquisition and Logistics Organization (DALO) is the specialized materiel center and logistics authority of the Danish Defence. The organization acquires, maintains, develops and phase out material capacities and ensures provisions in due time for the Danish Defence operations.

DALO administers a budget of approximately DKK 7 billion of the total defense budget. This amount is used to provide efficient support, primarily to international operations and operational units.

DALO has approximately 2,400 employees. Headquarters is situated in Ballerup near Copenhagen.

Furthermore, DALO comprises the Danish Maintenance Agency East and the Danish Maintenance Agency West with their respective headquarters in Korsoer and Aalborg, under which a large number of maintenance workshops are placed throughout the country.

The main depot of the Danish Defence Supply Agency is situated in Skrydstrup with a number of store facilities, reload centers and depots throughout Denmark.

OMT

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