

# **“From Fabricated to Casting”**

**How to reduce cost and increase competitive force by selecting**

**optimal solutions by the design-, chose of materials- and the supply chain by utilizing the latest leap in foundry technology.**

# Optimization of Commercial Products

Since the beginning of our history, manhood has always tried to optimize available technology with product requirements.

Available technology has always developed and is still developing.

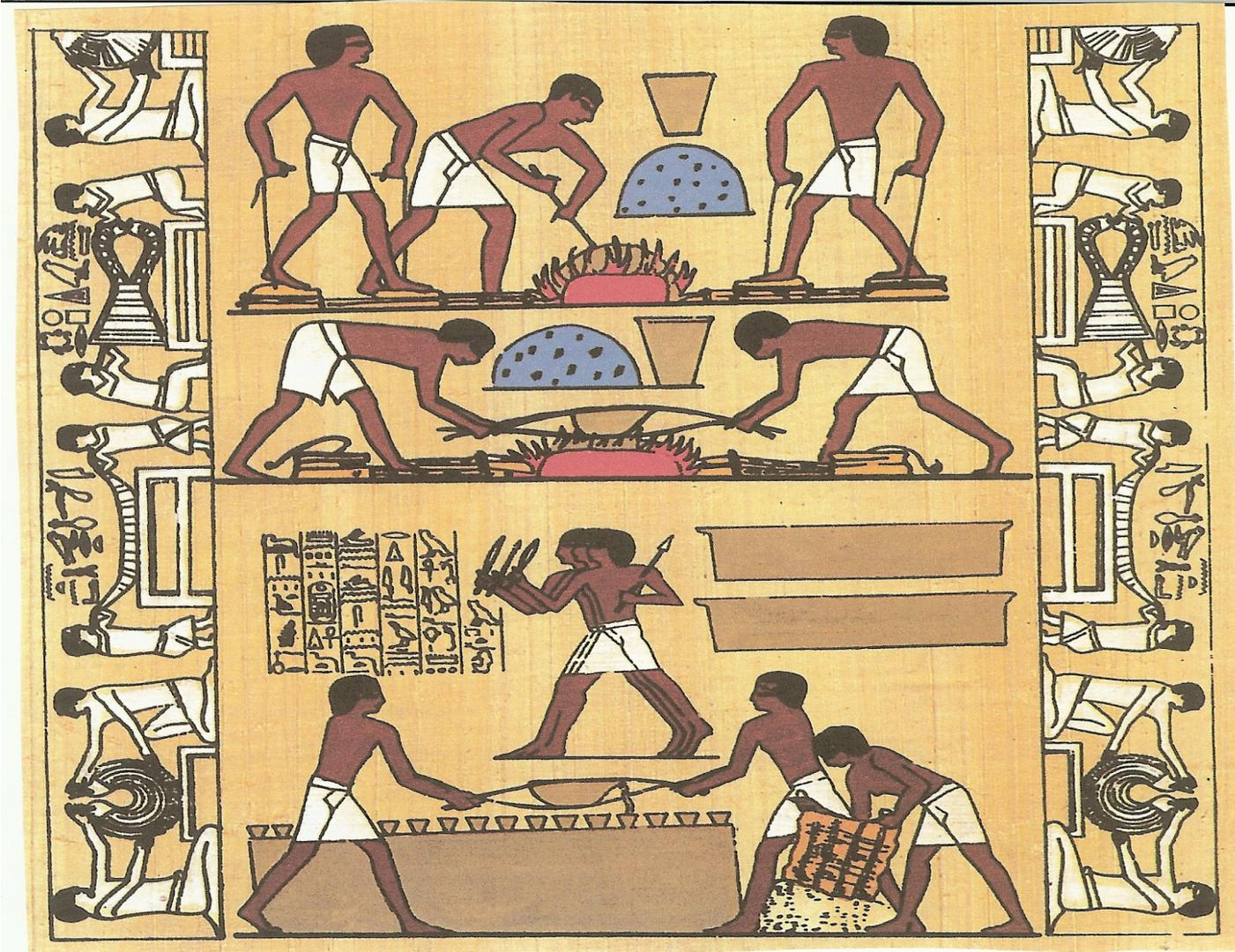
Our task is to learn what is available technology and how to utilize it.

As product requirements increase, our understanding and use of available technology and our capability to use it, is our competitive edge.

Developing new technologies gives new opportunities. The one who own a better technology, has a competitive edge.

The one who can combine more of the best technologies, has a possibility to find a quality- and price optimal solution

# Historic development



Foundry in Egypt 1450 b.Chr. Tomb painting

Available technology has always developed and is still developing.

Some times the development takes a leap.



Welding by forging.

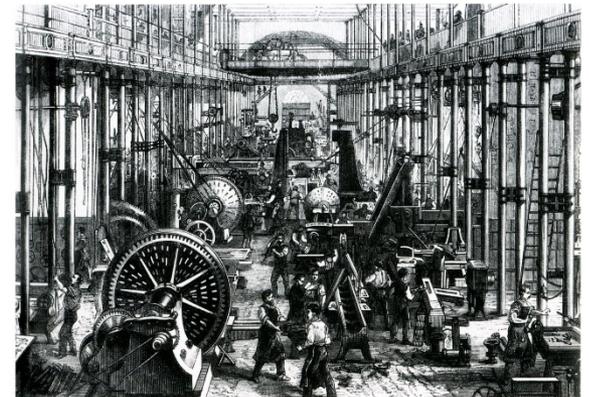
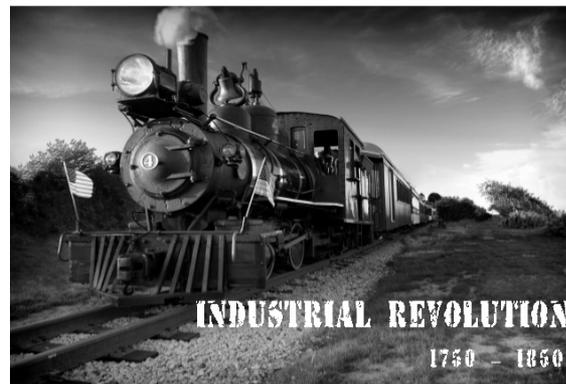
**“Maybe it is a great idea to make a casting?”**

(Apollo in the Forge of Vulcan, painting from 1630)

# A technical and social development started a new leap; the industrial revolution 1750 -1850

The use of charcoal had until then limited the foundry capacity in Europe.

But when the use of coke was invented, the way was open to mass production of castings – for use in steam engines, - spinning machines, railways, household equipment etc.



# Another big leap took place; during the WW II and after. Welding technology and steel qualities developed rapidly.

- The steel materials, the welding methods and control possibilities made products better and cost effective.
- The cutting of steel sheets and welding was automatized.
- The process was competitive and with good quality and documentation.



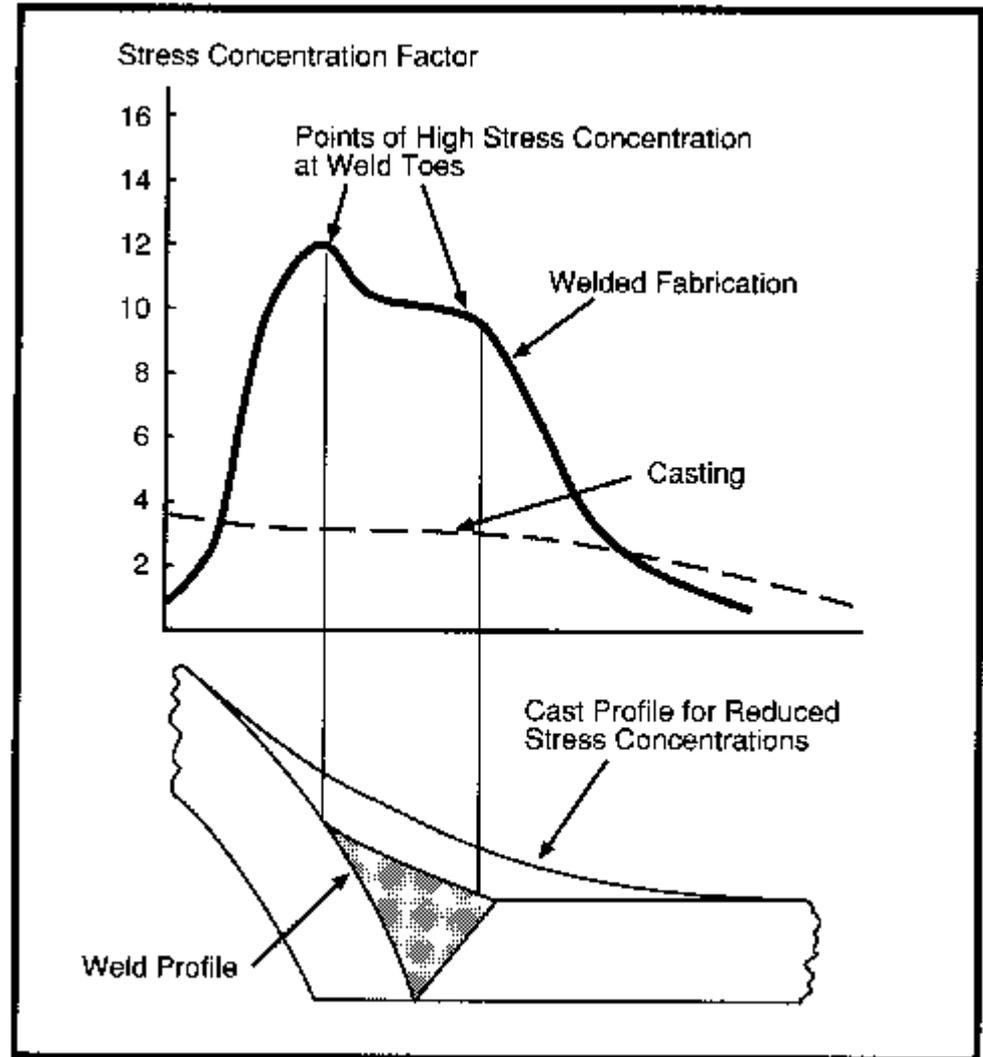
# Cast Components versus Fabricated

Castings give freedom for an ideal design.

Stress-concentration factors, as experienced in fabricated, can be minimized with a casting.

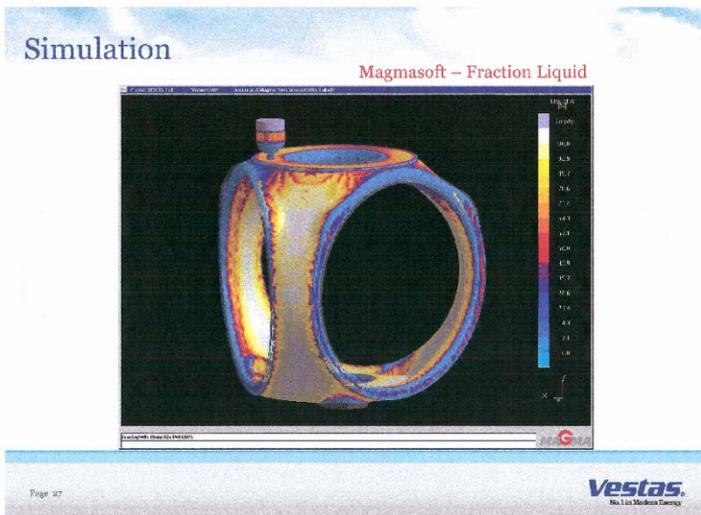
“All that can be drawn can be cast”

Henry Ford



# But during the last 20 years, foundry technology have again taken some big leaps forward.

- It is the essence of this paper to show these new possibilities which not all are aware of.
- Properties in the real casting is introduced in the standardization instead of separate cast test bars.
- Modern process regulation techniques gives better materials- and consistent products.
- Ultrasonic control has been taken into operation and showing internal defects.
- Computerized simulation programs has been developed for simulation of casting and solidification. Casting defects can be avoided.



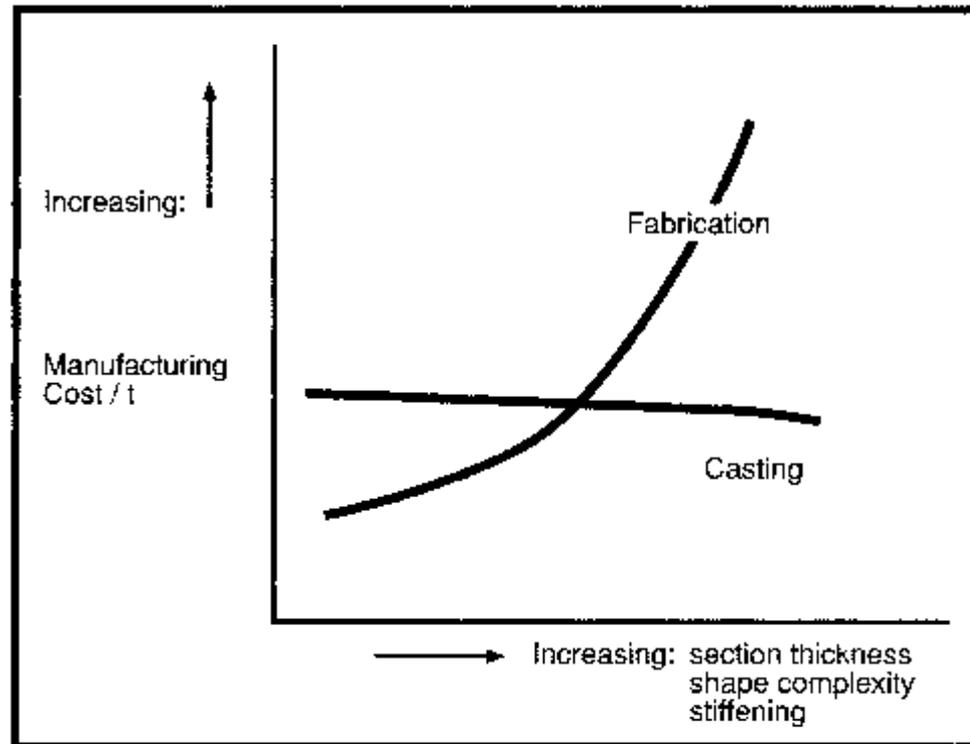
Hub cast in  
Ductile iron.  
Left solidification  
and right  
ultrasonic testing



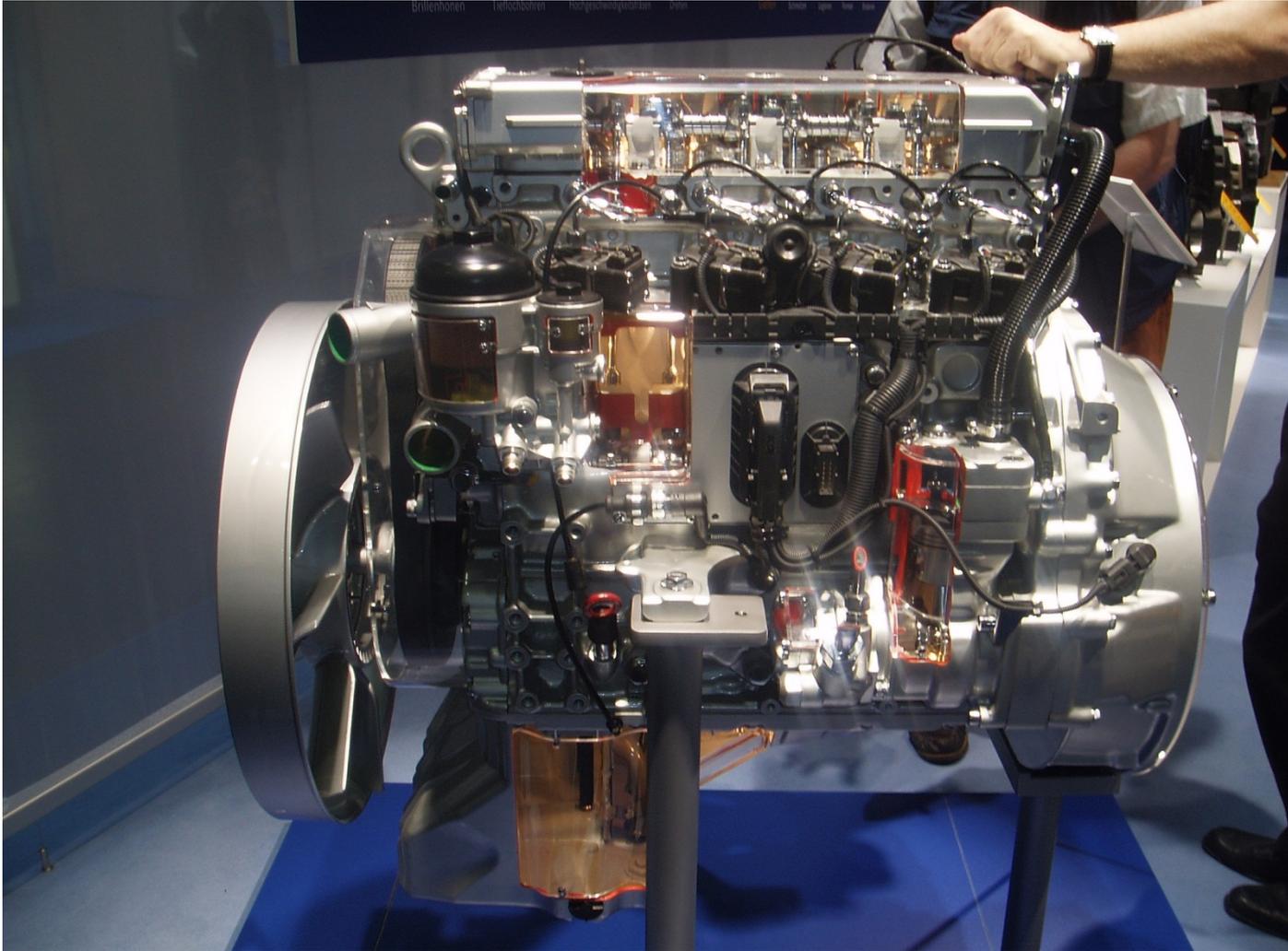
# Cast Components versus Fabricated

## - General cost optimization

By increased complexity or thickness- a casting will be more economical than fabricated solution.



# State of the art



Modern truck engine consists mainly of castings

# State of the art



Cylinder bloc for diesel engine in ductile cast iron

# How has the latest developments influenced foundry technology?

- In the table in next picture, the time areas are defined as:
  - “Earlier situation” - > 40 years old.
  - “Yesterday’s situation” – 40 – 20 years old.
  - “Present situation” - <20 years old.
- It is frightening that even today so many engineers, technical educational institutions and even foundries still live in the time of “Earlier” - or “Yesterday’s situation”.

# Cast components

How the latest developments have changed the situation?

<b>Process</b>	<b>Earlier situation</b>	<b>Yesterdays situation</b>	<b>Present situation</b>	<b>Challenges</b>
<b>Pattern production</b>	Hand made in wood.	Handmade in wood and plastic	CAD/CAM	Cost/ benefit
<b>Simulation of casting</b>	Experience	Trail and error	Computer simulation	Eliminating casting defects
<b>Casting defects</b>	Natural appearance	Trail and error	NDT Control defect elimination	Technology knowledge
<b>Real properties in the castings</b>	Estimating and guess	Casting properties	Casting properties with documentation	Exact properties and lower uncertainty factor
<b>Process control and regulation</b>	Natural process black-magic	Process_control	Process regulating	Only small variations acceptable.

# The latest leap in technology have opened for a new markets for castings.



## Modern wind power turbines has developed during the last 25 years

The tower is in fabricated steel.

The blades are in glass-fibre composites.

The hub, base frame and main shaft are cast in ductile iron.

The gear is made mainly in forged steel.

The requirements for the castings as hub or main shaft are high fatigue, low weight and low cost.

# Product optimization:

The one who can combine the best technologies, has a possibility to find a quality- and price optimal solution.



“Jacket” platform for offshore oil- and gas production ”

Fabricated in steel.  
Requirements are stiffness and strength.

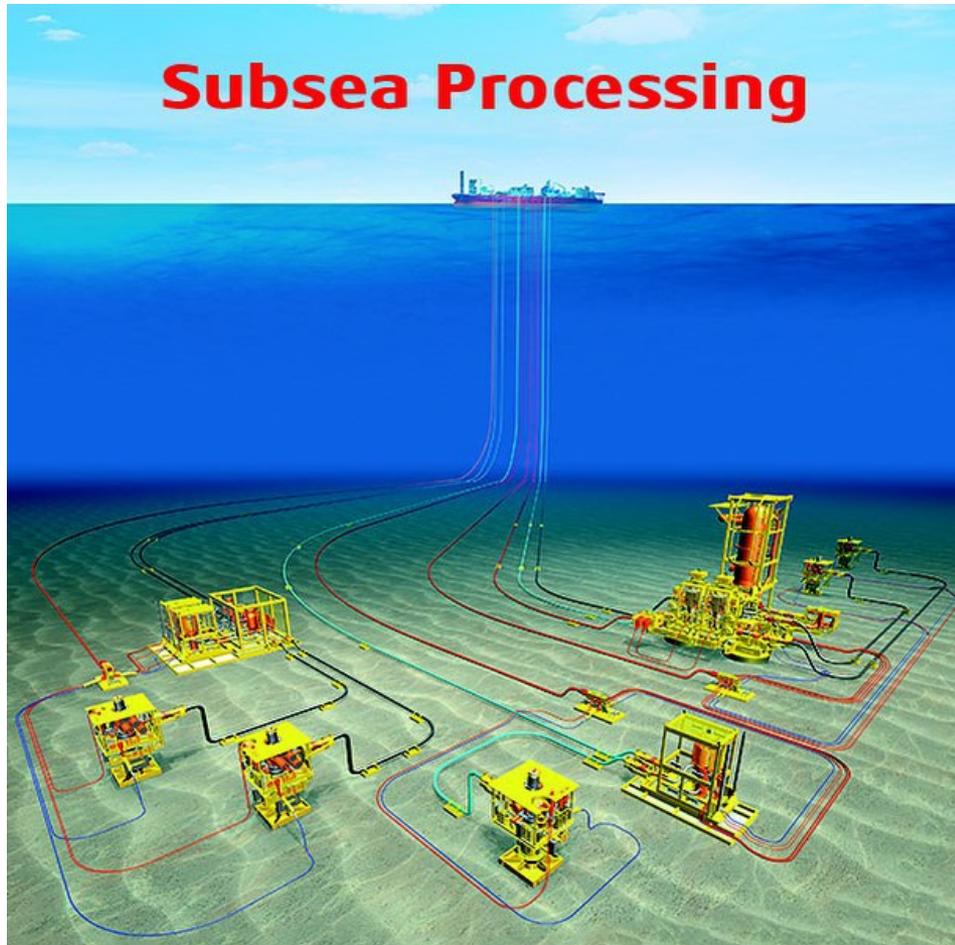
**The most complicated nodes are cast in steel.**

# Quality- and price optimization.



- “Node” with a lifting trunnion for a flare tower in oil- and gas production.
- Lifting trunnions are made in cast steel due to heavy wall thickness.
- Node will be welded into the structure.
- Requirements are weldability and strength.

# Optimized products in an optimized process.



## FMC Technologies - Subsea equipment

The coupling mechanism is developed by FMC and produced by KSMV Norway.

*Together they have during the last 10 years, converted several fabricated solutions to optimized cast design.*

# Optimization of Products and Supply Chain.



KSMV Norway has over years developed a supply chain of foundries and pattern shops. KSMV have taken advantage of the latest developments foundry technology and have actively implemented the procedures and technology at the supply chain.

FMC redesigned the equipment from fabricated to castings.

Cast in ductile cast iron.

KSMV delivers finished machined products ready for installation by FMC.

# Optimized products and optimized supply chain. Products converted from fabricated in steel to a castings in ductile iron.



With a consistent strategy for assisting the supply chain in upgrading the foundry technology-  
with an open mind for the benefits by changing from fabricated to castings-

the results are often  
***50 % cost reduction, increased sustainability and increased quality.***

**Approved** by critical companies as BP, SHELL, Statoil, GE, ENI etc.”

# Quality control and quality assurance by cast components.

- A modern foundry will use systematic process- and quality regulation in all process steps.
- A modern quality assurance system gives conditions for good quality control.
- A modern foundry use computerized simulations to optimize the foundry processes.
- A modern foundry utilize NDT tools for securing castings without any casting defects.
- A modern foundry documents the mechanical properties in the casting together with certification showing that the casting is without any defects.

Together these give a true information about the properties of the real casting.

- An optimized product is the most competitive product.
- ***A product with complex design is often more competitive as a casting than as a fabricated one.***

# Summarizing.

- During the last 20 years foundry technology has again taken some big steps forward.
- Systematic simulation- process- and quality regulation in all foundry processes are common.
- NDT techniques have opened for definition of casting defects and their removal.
- It is possible to use cast products with documented properties in the casting.
- Present and future market of cast components rely on confidence in the products.
- Complicated cast components are often more competitive than fabricated products.
- The one who can combine the best of several technologies has a competitive advantage.



**THANK YOU**  
for your  
**ATTENTION!**