Lean and Green Shipbuilding at Shipyard Brodotrogir

Shipyard Brodotrogir, Trogir, Croatia
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Outline

• Introduction to Shipyard Brodotrogir d.d.
• Characteristics of Shipbuilding
• Developing a Lean and Green Shipyard
• Conclusion
Shipyard Brodotrogir d.d.
Divisions: Shipbuilding & Shiprepair

- Hull erection on launching berth
- Parts manufacturing, section assembly, outfitting and painting
- Ship conversion on the wharf
- Ship repair on the quay
- Ship repair on the floating dock
- Outfitting, Test & See trial

Recently the Shipyard was the subject of new investments (from a private owner)
Shipyard Brodotrogir d.d.
Main product: Chemical tanker 47.000 TDW (T-Design)

MAIN CUSTOMERS: JSC “Novoship” (Russia); Sovkomflot (Russia); Laurin Maritime AB (Sweden); Eitzen Chemical ASA (Norway)
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Characteristics of Shipbuilding
Engineering to order vs Mass production

Shipbuilding main characteristics:
• Customization to order
• Customization within certain constraints
• Product is partly designed and engineered to order
• Modular design where some modules are standardized and other are customized
• Low volume
• Complex, non-repetitive production
• 80% repetitive on process/product level – 20% is engineered and produced to order
• Production in loose networks
• Manual processes
• Handcraft
• Long through-put time
Characteristics of Shipbuilding

Business process: Streamline and Milestones

Based on the basic specifications provided by customer, Brodotrogir made a broad design to get a rough overall picture of the ship and subsequently offer a proposal to the customer. The bid proposal is a very important step of Brodotrogir’s business since customers largely depend on this proposal to decide whether to place an order or not. Therefore, Brodotrogir try the best to show own full ability.

Use of various CAX technology for perfect planning sizes and shapes of all elements for building ship form and for perfect planning resources and technology of production.

Steel parts are assembled in form of mikro panels, panels, eggboxes and huge boxes – sections by high class of welding.

Not only for the estetic, but for the protection against the corrosion, is applied excellent painting to sustain severe conditions in the sea.

Celebration of ship completeness on slipway, Christening of ship by the owner, cutting the supporting rope with bottle of champagne for this celebration day, launching a ship in the seawater, and pulling the ship to the outfitting berth.

Confirming the function and performance of ship and of all equipment with the same condition of the voyage.

Once bid proposal is accepted, Brodotrogir proceed to discuss the specifications in detail and settle on the final price of the ship. Once the ship price, shipbuilding process, general layout, specifications, etc. are determined, an agreement is made and Brodotrogir produce Basic design of ship. There are various factors that influence ship performance: load capacity of cargo, ship stability, speed, fuel cost and so on. The key function of basic design is to design the ship so that all those factors comply with the specifications.

After the design is done, steel plates nad profiles are cut based on the design with high accuracy on the numerical controlled cutting machines.

For bent the steel plates and profiles for the curved parts of ship hull are used pressing and rolling machines with special manufacturing technique.

Outfittings, such as piping, stairs hand rail and so are fitted to the section.

Cranes of 100 tons and 50 tons lifting the sections up to 100 tons and erect hull of more then 10.000 tons.

Finishing and testing of all ship systems and finishing of accomodation space (furniture, fixtures).

Celebrating a completeness & maiden voyage of the ship. Ceremonial opening of the bridge and changing the ship flag.
Characteristics of Shipbuilding
Basic concepts in engineering: Project and Process Management - Streamline

CONTRACT
- DFE
- CAE
- Contract And Basic Design
- Detailed Design, Preparing Parts Manufacturing and Assembly (Hull and Outfitting)

Project management
- DFE, DFM, DFR
- CAD, FEM
- CAM, CNC, CAT
- WBS, PWBS
- PPC
- Production Planning and Engineering

DELIVERY
- PRP/MRP
- ERP
- SFC
- PLM
- Materials Planning and Procurement
- Shop Floor Control
- Design Data Management

Naval engineering

Industrial engineering

Engineering

Shipbuilding Project management and Process Management
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Developing a Lean and Green Shipyard
Main concept: Do simply and green by removing the waste!

Traditional focus
- Work longer-harder-faster
- Add the people or equipment

Lean focus
- Improvements to eliminate waste in the value chain and improve environmental protection

Lean = eliminating waste
Developing a Lean and Green Shipyard Systematic modeling of future state

1. Current state

2. The use of set of tools to view current state

3. Identification of potential improvements

4. Development of future structure (FMC i FMS)

5. Design of the future structure

6. Future state

To build a successful Lean companies is needed: energetically and fairly systematic presentation rated where the company is, where it should be, how it will get there by applying Lean principles and what are the benefits of it.
Developing a Lean and Green Shipyard
Systematic modeling of future organization

1. Identification of potential improvements

2. Development of process based organization

3. Implementing process based organization

Further analysis identified several opportunities across Change Modules for operational improvement that could be initiated immediately:

- BT needs to increase project management capacity (skills and number of resources) and lay down the foundation of the transformation project office—PM is BT core skill needed both for the transformation and for the production
- Current BT management will need to execute the transformation—the first step is to raise above day-to-day operations, transform yourself and your team; strong leadership skills will be needed both at the board level and in the top management echelon
- BT workers need to be better informed, more engaged and proactive in the transformation which calls for more interactive approach using available channels and opening of the new communication channels
- BT needs to advance its current HR management activities beyond HR admin—new performance benefits as well as career/skill management capacities are essential elements of the transformation
- The shipyard needs to improve its quality control and asset management processes and establish an independent form production processes to improve quality of interim products and therefore the end product quality as well as improve asset management capabilities

Cjelovita izgradnja Lean tvrtke sadrži: Usklađenje i integriranje svih dijelova organizacije tvrtke i lanca dobave u procesno strukturiranoj Lean organizaciji samoprilagodljivog oblika i veličine sukladno promjenama koje zahtjeva kupac.

Developing a Lean and Green shipyard
Result of systematic modeling of Lean structure

Example: Brodotrogir hired Fraunhofer, IBM, SMDS and others to help them with the transformation planning and implementation—extreme makeover: half the size, double the output, three more business models

The shipyard itself becomes a completely different animal—lean and mean profit machine and still building, repairing and/or servicing ships
Developing a Lean and Green Shipyard
Main tool for implementation and for continuous change process (Becoming Lean): 5S+1 and 5S+1 Office
Developing a Lean and Green Shipyard

Value stream mapping (Material and Information flow mapping):
Basic tool for identification improvements and manage 5S actions

VSM mikro

LEGENDA:

Brodotrogir d.d.
Developing a Lean and Green Shipyard

Change management: Do it every day, planned, in small steps

LEARN PRODUCTION
Implementacija 6S

Result of the pilot project 5S+1 Pipe & Locksmith Shop

LEAN PRODUCTION
Implementacija 6S – S6 Protection of the environment

OSTVARENJE PLANA
Implementacija 6S – S6 Protection of the environment

S1 – nástavak: Ostvareno

6S – Implementacija Pipe & Locksmith Shop
Developing a Lean and Green Shipyard Measure improvements: Tangible and Intangible

**LEAN PRODUCTION**

Implementacija 6S – S6 Zaštita okoliša

**POLAZNO STANJE**

Pipe & Locksmith Shop

1. Funkcijska organizacija za 6S – Samoocjena 1/5

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6S rutina – Audit

Tvrtnica/Organizacijska jedinica: Brodotrogir d.d. / 21 samoocjenjivač

Naš cilj je iskakati rutine okruženja sa svjetskom raminj

Ocjena postotak usklađenosti za svakoj mjerilo: 1 - 0%, 2 - 3N%, 3 - 6N%, 4 - 9N%, 5 - 100%

**MIN** 1 2 3 4 5

**MAX** 1 2 4 5 6

**PROSJEK** 3 4 5 6 5

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**LEAN PRODUCTION**

Implementacija 6S – S6 Zaštita okoliša

**POLAZNO STANJE**

Pipe & Locksmith Shop

1. Funkcijska organizacija za 6S – Samoocjena 4/5

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Jednokomadni tok (“one piece flow system”) umjesto guranja (“Push system”)

OSTVARUJE SE UKLANJANJE SVIH 7+1+1 RASIPANJA I SMANJUJE EMISIJA PLINOVA U ATMOSFERU ZA PREKO 50%(W10)!!!

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**Prvi prioritet u akcijskom planu dobivaju najlošije ocjene**
Developing a Lean and Green Shipyard

Don’t forget people: They are the most valuable asset that the company has
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Lean – Measurement of improvement

<table>
<thead>
<tr>
<th>Scorecard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Known best practice: Without implementation plan</td>
</tr>
<tr>
<td>1</td>
<td>Implementation plan: No ongoing activities</td>
</tr>
<tr>
<td>2</td>
<td>Ongoing activities on best practices</td>
</tr>
<tr>
<td>3</td>
<td>Best practice implemented in some manufacturing cells</td>
</tr>
<tr>
<td>4</td>
<td>Best practice implemented in all manufacturing cells</td>
</tr>
<tr>
<td>5</td>
<td>Model of Company for best practice</td>
</tr>
</tbody>
</table>

The simplest measure is carried out by comparing their own productivity and business process management with best practices.
Thanks four your attention!

Questions?

And what do you think about lean?