LM INNOMARITIME

A BRIEF INTRODUCTION TO

"LEAN SHIPBUILDING"

INTRODUCTION

"LEAN SHIPBUILDING" is the building process of Ships and Offshore Units, ruled and performed by **LEAN PRINCIPLES**.

Like in many other industries, current shipbuilding in most shipyards is full of NON Value Adding Activities (named as WASTE or "MUDA" in lean lexicon) which increase costs, compromise quality and delay the delivery schedule, and are in turn of no contribution at all for fulfilling Client's expectations.

Despite they have to deal with it every day, all this waste is many times not visible to yard's managers, who carry out huge efforts to barely achieve incremental improvements. **Lean Shipbuilding application enlightens and clearly identifies all forms of WASTE**, in such a way that it turns visible to all parties involved in the process. It then provides **tools** to **systematically eliminate** all forms of MUDA and boost the process THROUGHPUT.
Lean Shipbuilding provides as well means to link the yard's process with suppliers and contractors operations, creating a continuous flow of interim products and value adding operations throughout the complete production chain, pulled by the customer.

Management under lean principles has different levels of approach, enabling every manager involved to stay focused. In particular, top management will be given tools to see and deal with the whole value stream, from suppliers' raw materials and components to the final, complex and sophisticated units delivered to Ship Owners.
Lean philosophy pursues operational "perfection", and is therefore the basis for setting an on-going improvement process, involving all shipyard areas.

THE FUNDAMENTAL IDEAS

In general, any building process can be envisaged as a sequence of ACTIVITIES, in which man-power efforts are applied and a number of RESOURCES are consumed. Activities can be graded in two categories:

- Activities which ADD VALUE to the product, being VALUE as SPECIFICED BY THE FINAL CLIENT
- Activities which DO NOT add value (but are, rather, still consuming resources).

The first, underlying, LEAN principle is quite simple: Any activity which does not add value, as perceived by the customer (and is, in turn, only COST increasing) is a WASTE (is "MUDA", as named by the Japanese) and must be ELIMINATED from the process.

Based on this underlying principle, the lean transformation of any manufacturing process is driven by 5 fundamental steps (which are masterly described by James Womack and Daniel Jones in their book LEAN THINKING – Free Press, 2003-):

APPLICATION TO SHIPBUILDING (I)

Currently, and in the past recent years, many shipyards have attempted to implement LEAN TOOLS locally, mainly "5-S" improvement activities, warehouses rearrangement and implementing visual production score cards. Nevertheless, a real LEAN TRANSFORMATION must be based on a much wider scope, and involve all organizational levels, starting by the top management.

In our vision, this lean transformation must be based on the systematic application, to the shipbuilding process as a whole, of the 5 LEAN FUNDAMENTAL PRINCIPLES described.

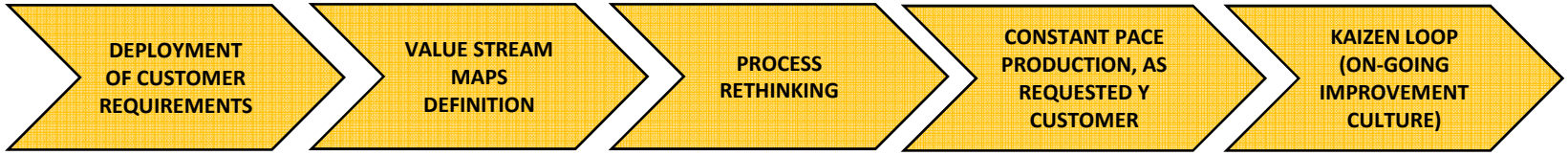
STEP	GENERAL PRINCIPLE	APPLICATION TO SHIPBUILDING
1	**VALUE SPECIFICATION**	**Deployment of customer requirements** Transform the primary set of contractual FUNCTIONAL SPECIFICATIONS , applicable RULES and QUALITY STANDARDS into a comprehensive set of specific TECHNICAL REQUIREMENTS, mandatory for each step of the DESIGN, ENGINEERING, PROCUREMENT and PRODUCTION processes
2	**VALUE STREAM IDENTIFICATION**	**Value Stream Maps definition** Define the whole linked sequence of activities for the four main processes required for building each product or product family: - Product development, from functional specs to shop drawings - Procurement, from engineering specs to physical components storage - Physical production, from raw materials and purchased components, through fabrication of sub-assemblies, interim products assembly sequence, and up to final dock assemblies - Systems integration and certification, from installation through hook-up, mechanical completion, commissioning and final delivery to the client

APPLICATION TO SHIPBUILDING (II)

STEP	GENERAL PRINCIPLE	APPLICATION TO SHIPBUILDING
3	FLOW	**Process rethinking** - Gradually eliminate all forms of "muda" from the value streams, by means of completely rethinking the whole processes, for each of the four main ones described (and their corresponding sub-processes) - Eliminate all "batch and queue" steps, shifting to a continuous set of transformation operations, rather in "piece by piece" flow, or in very small batches / pallets flow - For production processes, define an optimized BUILDING STRATEGY, in which every assembly operation is carried out in the OPTIMAL stage (i.e. the one least costly, with least effort, and with the best working conditions and practices). Reorganize the production value stream according to this strategy
4	PULL	**Production setting to a constant pace, as requested by the customer** For each Value Stream Map, define the PACE MAKER PROCESS, which is the single one process to which work orders will be issued, in order to set production at a constant pace, as requested by the customer. Upstream processes production will be organized by means of "replenishment pull" systems, meanwhile processes downstream of the pace maker will be handled by means of "sequential pull" systems.
5	PERFECTION	**Implement a "Kaizen loop" (on-going improvement culture)** After a first, "dramatic" lean transformation (Kaikaku in Japanese), shift into a "kaizen" loop (incremental, continuous improvement) by means of defining constantly improved "future states" for the value stream maps

APPLICATION TO SHIPBUILDING (III)

The 5 general, fundamental steps for the shipbuilding process would then look like this:



Practical implementation of these fundamental steps involves a whole lot of different technical, managerial, human and cultural aspects, including, in most cases, a complete redefinition of organizational tasks and responsibilities.

The reason why this big transformation is needed is because of the very long tradition and deep roots in shipbuilding of “MASS PRODUCTION” philosophy which –opposite to Lean Thinking- is responsible for a big share of the huge amounts of “Muda” present in most shipyards processes (among others, this philosophy builds incentives for massive, disconnected, “batch and queue” operations, barriers setting between departments, and interim products “pushing forward”).

THE 9 FORMS OF "MUDA"

Japanese Engineer Mr. Taiichi Ohno, precursor and father of "Lean Thinking", identified 7 general forms of "Muda". A few ones have been added afterwards. Here is the complete list, and how they specifically appear in the shipbuilding process.

Item	GENERAL FORMS OF "MUDA" (*)	SPECIFIC FORMS IN SHIPBUILDING
1	Quality defects / lack of quality	a.1.- Lack of an adequate DIMENSIONAL CONTROL for interim products (implies re-works in the downstream assembly processes) a.2.- QUALITY DEFECTS in the heading, upstream processes are not corrected in origin and are slipped downstream, to the final assembly stages a.3.- Physical interference and clashes in the interim products assembly processes
2	Over-production	
3	Inadequate processes / Over processing	a.4.- Lack of an OPTIMIZED BUILDING STRATEGY a.5.- Slipping of WORK CONTENTS to the final down stream building stages a.6.- NON FULFILLMENT of the contractual delivery schedule
4	Inventory	a.7.- Piling of interim products along the process
5	Unnecessary materials movement	a.8.- Long transportation routes for interim products
6	Unnecessary personnel movement	a.9.- Inadequate routes, movements and methods
7	Personnel waiting times	a.10.- Working force non productive times
8	Inadequate products design (non valuable for the final client)	a.11.- Engineering with errors / inaccurate / Non fulfilling with rules and functional specifications a.12.- Designs not fit for production processes
9	Lack of safety in work	a.13.- Lack of safety procedures a.14.- Concurrent, non compatible working activities on board (lack of work coordination)

(*) After Taiichi Ohno (1-7); Womack and Jones (8) and authors (9)