



# The International Maritime Transport and Logistics Conference

## “MARLOG 12”

**Sustainable & Innovative  
Technologies**

Towards a Resilient Future

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# An Overview of Applying Lean Principles To Shipbuilding

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Lean manufacturing is the name given by JAMES P. Womack in his book *The Machine that Changed the World*

It is An Engineering Management Approach Used By Japanese Shipyards To Change The Way of Thinking About Production Processes

Approach To Shorten Manufacturing Cycle Times By Eliminating Anything That Is NOT A Value-Added Activity

Lean Manufacturing uses standardized modular designs with a steady flow of basic and intermediate products.

Materials, are sequenced and moved through the shipyard using the Just-In-Time principle.

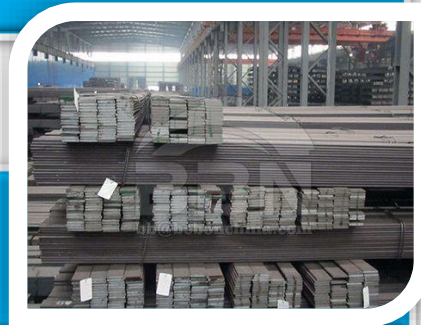
Quality is built in at the workstation instead of being Examined later.



Processes are Timed using takt time and are highly standardized.

Available Time  
Unit Demand

Steel plates are brought in, just in time Instead of being in the stockyard months in advance.



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**Egyptian Shipyards Have Not Yet Entered The Global Market, Preferring To Supply The Domestic Commercial and Military Markets.**

**The Majority of Egyptian Shipyards Still Employs The Conventional Mass Production Management Technique.**





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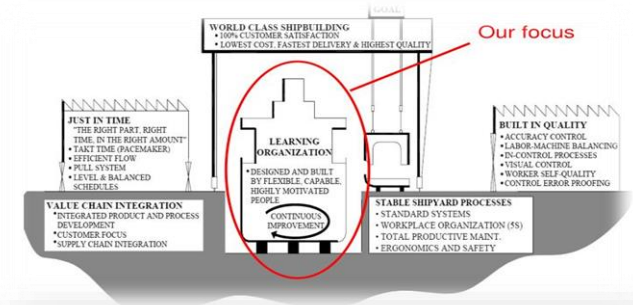
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To Encourage The Egyptian Shipbuilders To Switch To Lean Manufacturing,



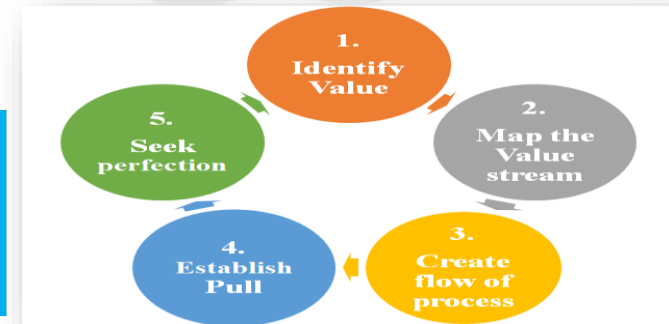
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To Study the implementation of Lean Toward the Egyptian shipbuilding Industry,



3

To provide a framework for to use of lean Shipbuilding Techniques that are compatible with The Egyptian Culture.



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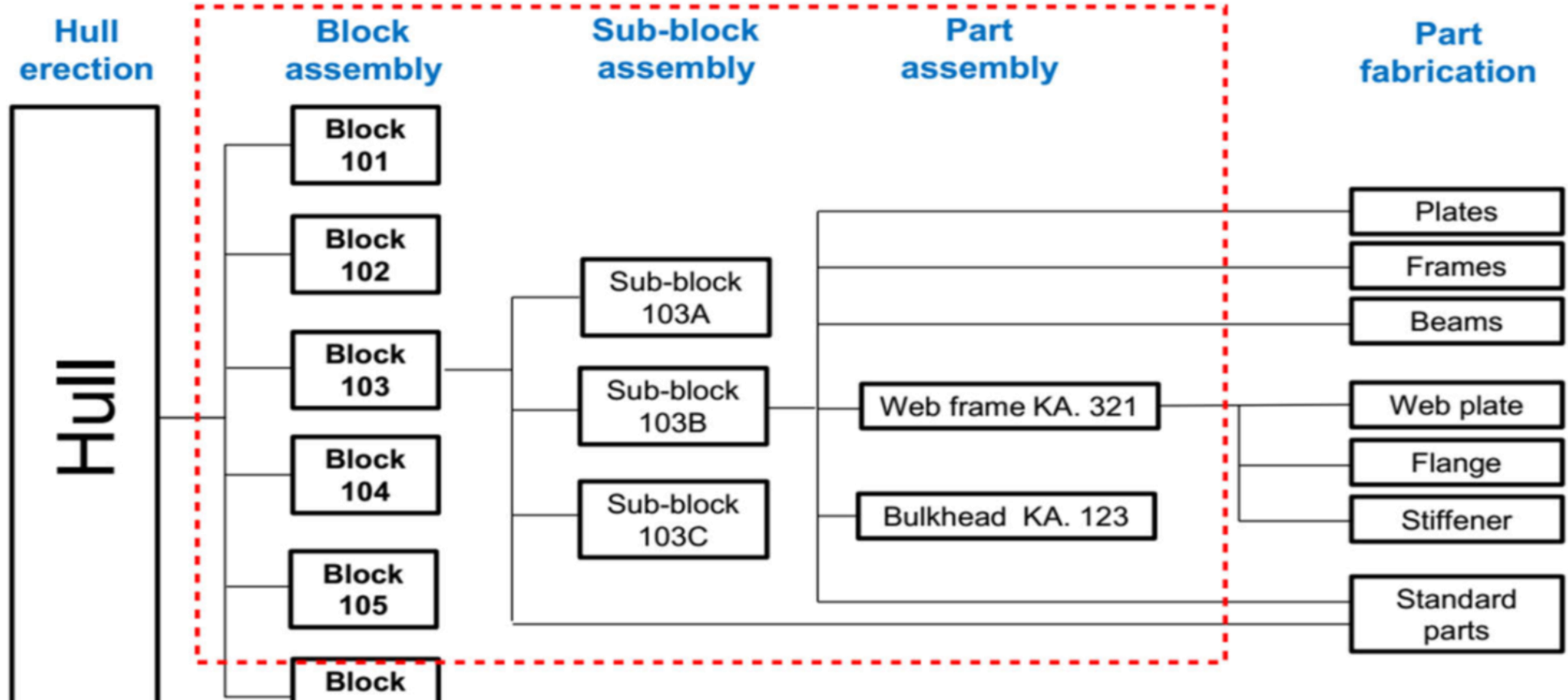
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## Stages of hull production



# WHAT IS LEAN IN SHIPBUILDING



lean Shipbuilding is a system to build a new ship in half the time, using half the labor force, half the manufacturing area, half the tool investment, and half the engineering hours. (Sharma, S., & Gandhi, P. J. 2017)

It Seeks To Shorten Lead Times and Eliminate All Forms of Waste From The Production Process. (Phogat, S. 2013)

It Is Achieved Through A Variety of Techniques, Including JIT, Kanban, Cellular Manufacturing, Total Productive Maintenance, Kaizen, And 5s (Liker, J, & T. Lamb, 2002)

The Objective Is To Keep The Product Flowing and Add Value as Much as Possible, Thus Any Part That Is In Inventory Is Waste. (Poppendieck, 2002)

In The Shipbuilding Industry, Waiting For Not Accessible Workstations Can Slow Down Production Flow. (Liker, J, & T. Lamb, 2002)

# WHAT IS LEAN IN SHIPBUILDING



## \* The Eight Elements of waste (Liker. J, & T. Lamb, 2002)

- i) **Overproduction** - Produce More Before It Is Required.
- ii) **Inventory** - Materials (Space, Money, Likely To Be Damaged)
- iii) **waiting** - Waiting For Materials, Processes, or Machines.
- vi) **Movement**- Any Motion Does Not Add Value.
- v) **Transportation**- Does Not Improve The Value of The Product.
- vi) **Defected Product** - Redundant Operations To Fix Defects.
- ii) **Over-processing** - More Work Than The Customers Require.
- viii) **Misallocated Personnel** - Non-utilized Talents.

Overproduction



Transport



Waiting



Movement



Inventory



Overprocessing



Defects

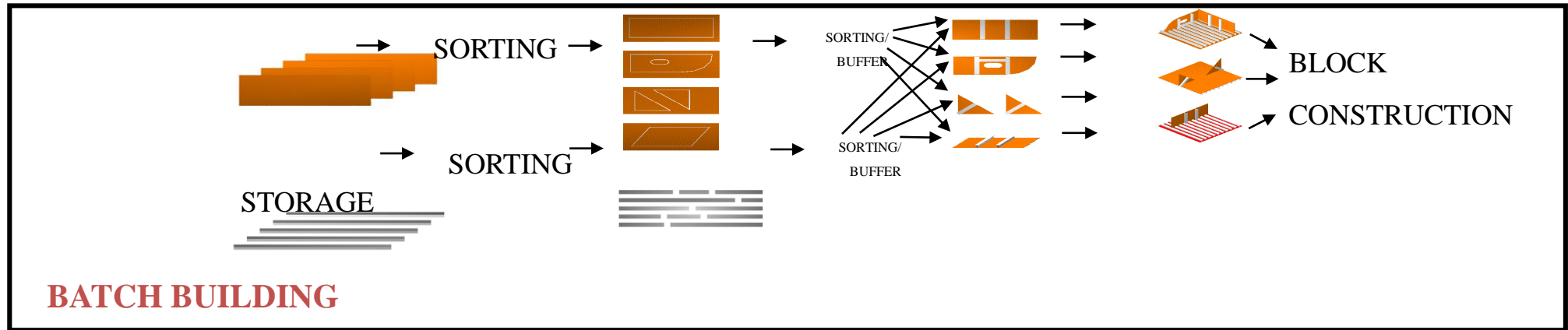


## \* Five S System (Liker. J, & T. Lamb, 2002)

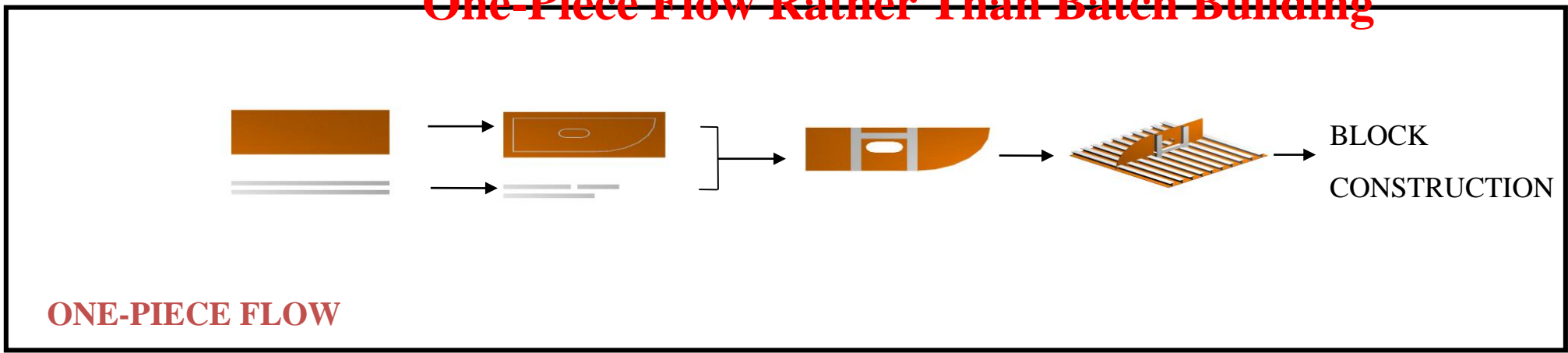
- i) **Sorting**- Keeping Only What Is Necessary.
- ii) **Set in order** - Everything In Its Place.
- iii) **Shine** - Inspection That Reveals Early Failure.
- vi) **Standardize** - Establishing Rules
- v) **Sustain** - Maintaining The New Quality.



# WHAT IS LEAN IN SHIPBUILDING



## One-Piece Flow Rather Than Batch Building



# WHAT IS LEAN IN SHIPBUILDING

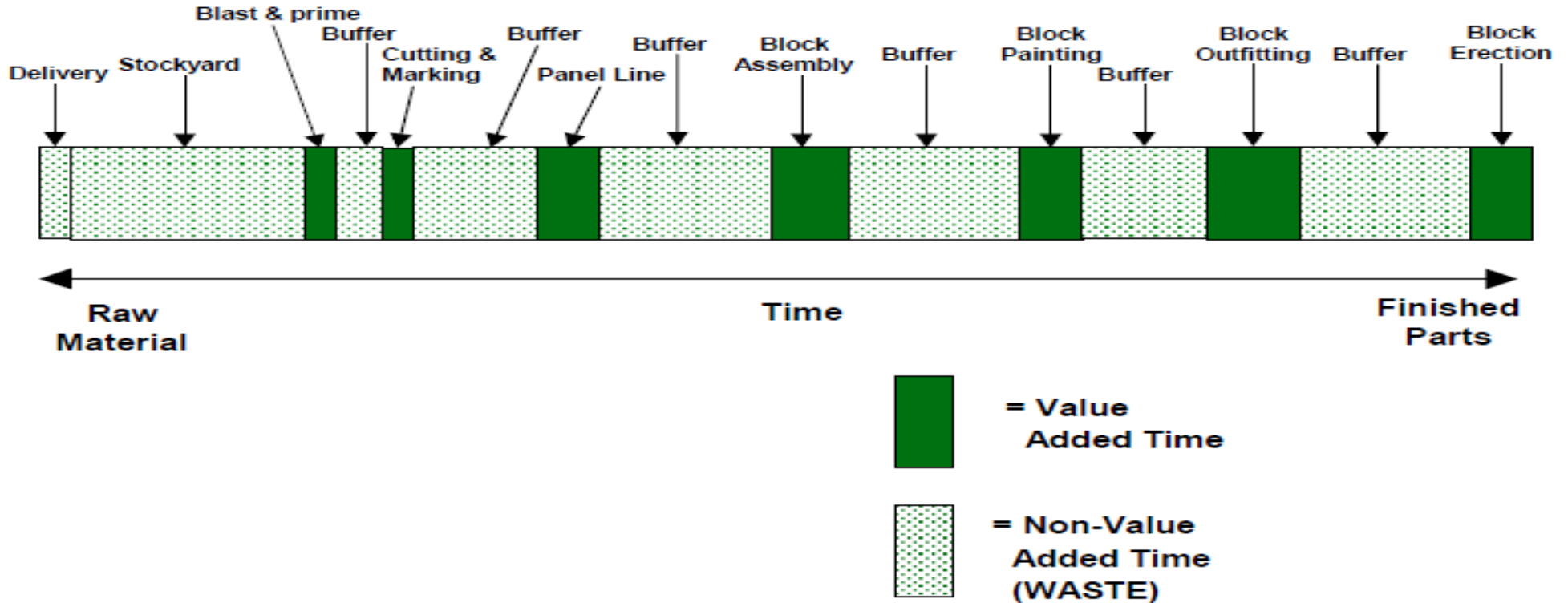
**5-S Opportunity**

**One-Piece Flow Line**



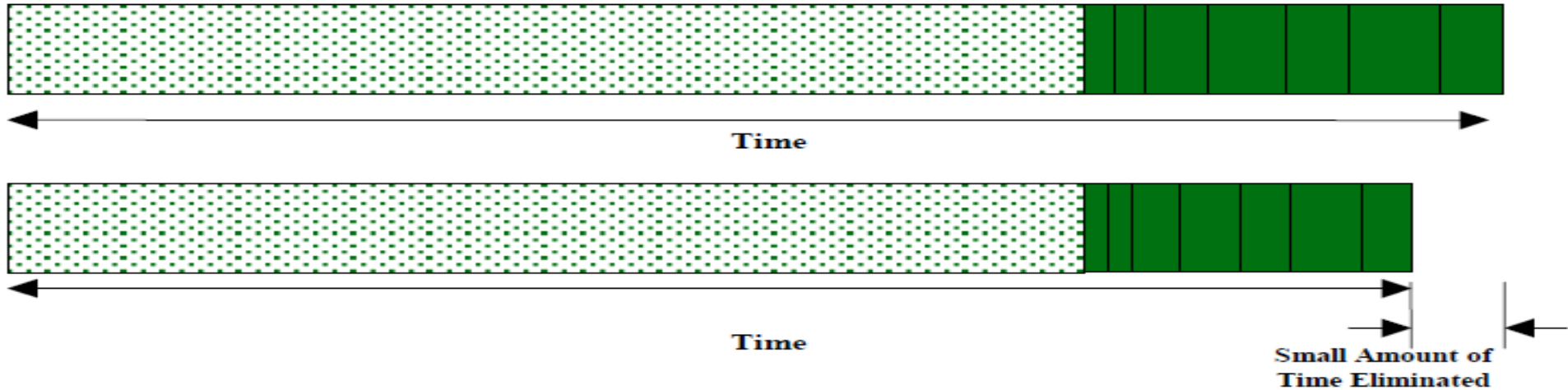


# WHAT IS LEAN IN SHIPBUILDING

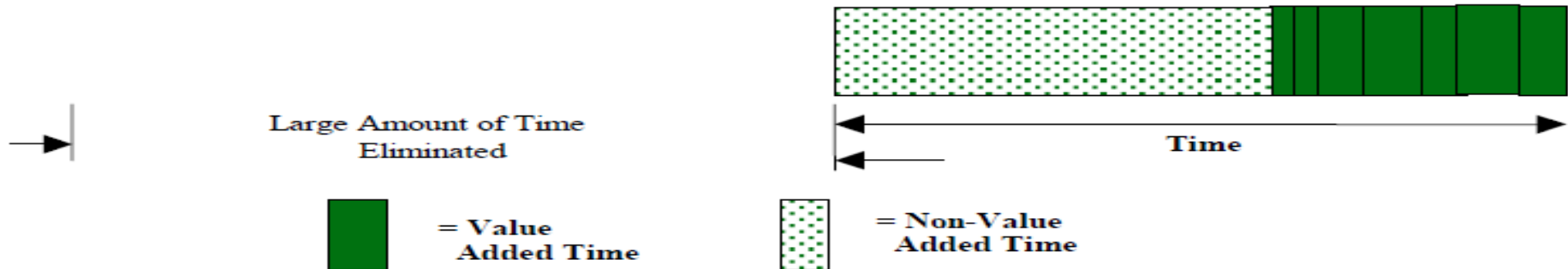


# WHAT IS LEAN IN SHIPBUILDING

## Traditional Results of Manufacturing Improvement



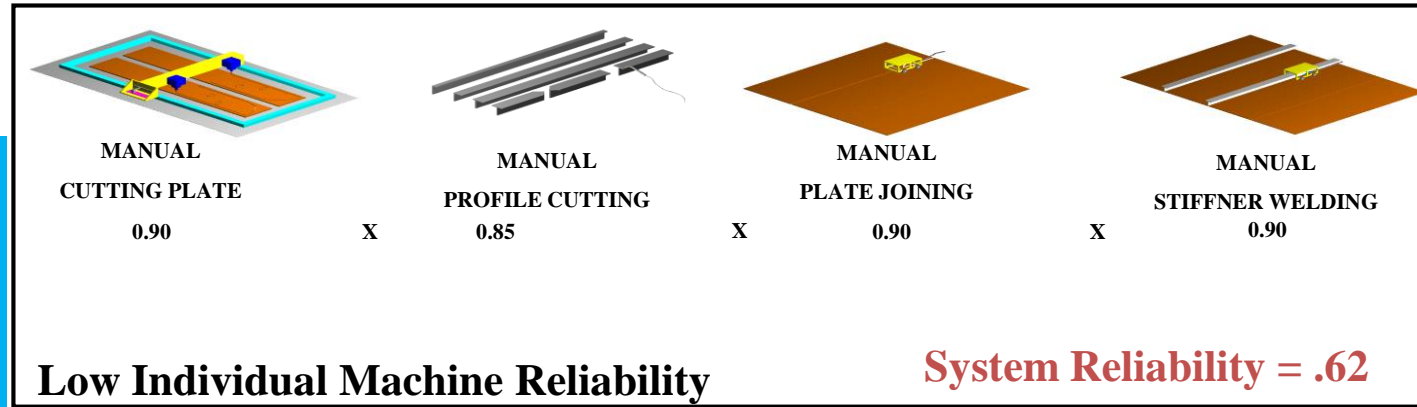
## Lean Focus on Non-Value Adding Wastes



# WHAT IS LEAN IN SHIPBUILDING

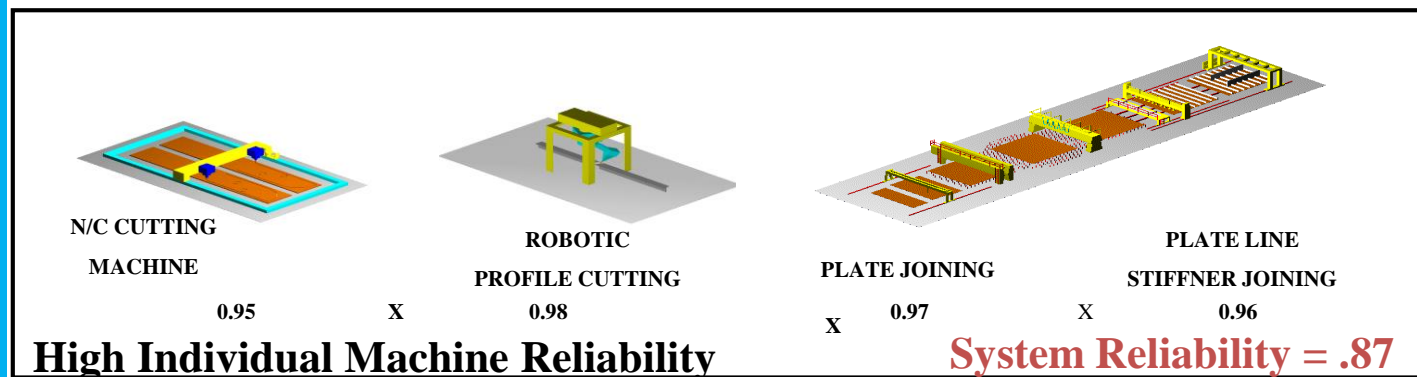
## Built-in quality

Four Individually Reliable Processes (85% To 90% Dependable) Can Cause This (62%).



The Concept Is To Allow Only Good Parts To Move To The Next Process.

The Production Line Needs A Mechanism To Rapidly Identify The Issue And Shut Down The Line In Order To Stop Producing More Defective Parts.



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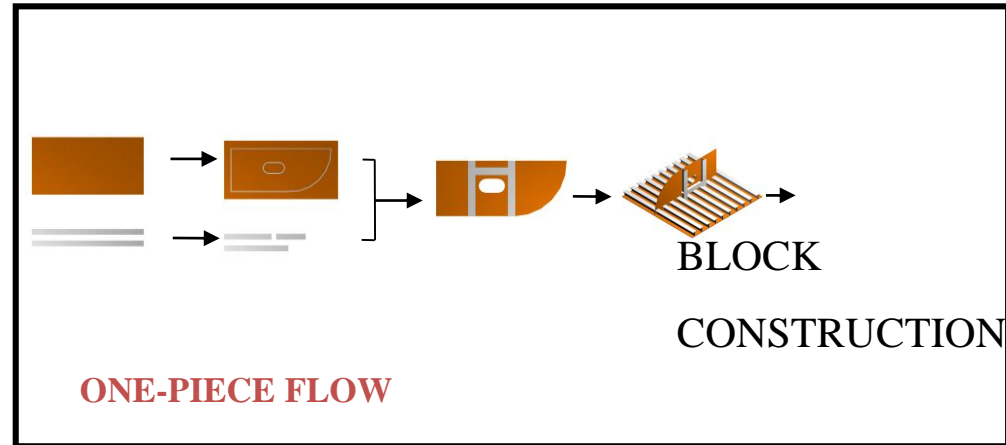
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- **Build flexible, motivated, and capable Teamwork**  
Organizational Structure Based On Teamwork Is Necessary For Maximizing Employee Engagement.

- **Use the Just-in-Time technique**

Obtaining The Correct Number of Raw Materials and Creating The Right Number of parts at The Right Time and Location, The Just-in-time Manufacturing Principles Help to Reduce Waste. (Phogat S 2013 B)  
The Ideal For an on-demand Production System Is a One-piece Flow. (Kolich, Et Al.2012)

A One-piece Flow, Is The Best Solution From The Perspective of Lean Manufacturing. In This Situation, workers Can deal With One Plate and One Stiffener at a Time, Cutting Only The Material they Need, move to the next station, Finish Cutting, move to the next station, Put The Subassembly Together, moving to the next station, and Assemble The Block.

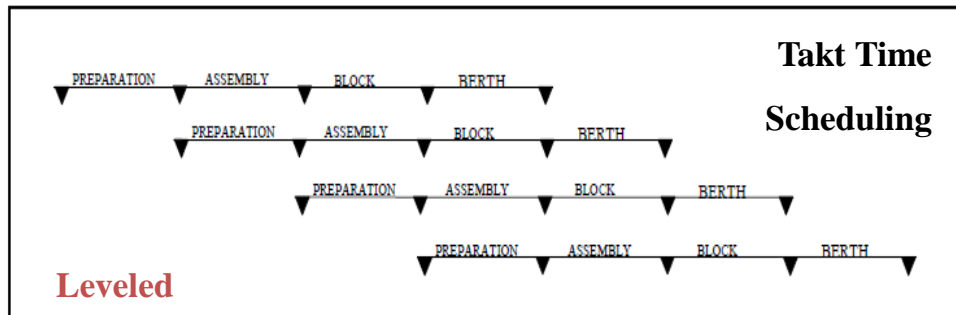
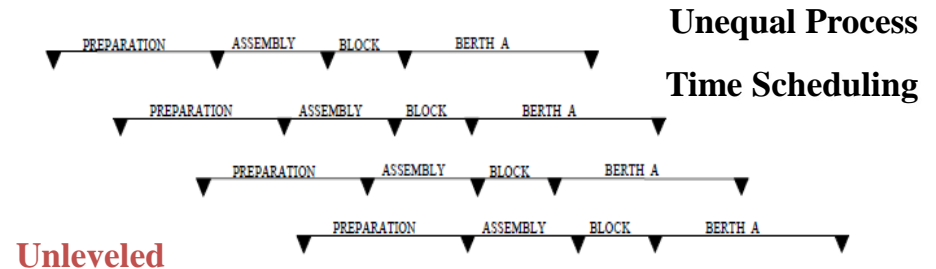


- Use the Takt time technique

Clock Beat", In Music "Beat Indicates The Rhythm

Individual blocks are scheduled so that they will be complete just in time to construct grand blocks, which will be completed just in time for final ship construction in drydock. All individual components for the block are cut and shaped and welded in kits that arrive just in time for block construction.

By using takt time planning, all parts of the process move in synchronization. This allows for flow production, which makes optimum use of all resources.



The figure shows unequal process time scheduling where none of the interim products are ready just when needed by later processes. This will lead to bottlenecks and queues of material waiting to be processed in later stages.

- Use The Group Technology Technique (Shahin, A., & Janatyan, N., 2010)
  - Group Technology Is a **philosophy** or principle whose basic concept is to **identify** and **bring together** related or similar parts or processes, to take advantage of the similarities that exist, during all stages of design and manufacture.
  - Two Classifications and Coding Systems; Ship Work Breakdown Structure and Product Work Breakdown Structure

Hull construction,

Outfitting,

Painting

Material,  
Manpower,  
Facilities,  
Expenses

design function  
System,  
Zone,

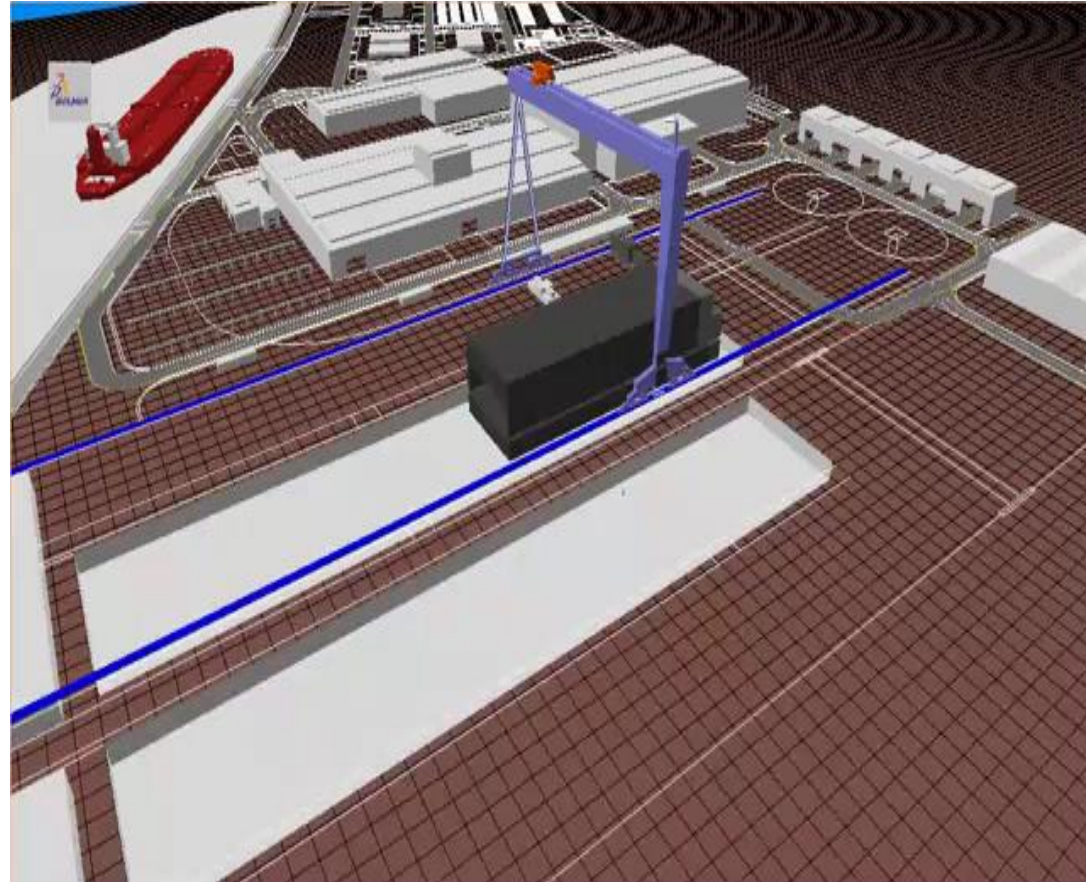
production function  
Area,  
stage,

No.	System
000	General Guidance & Administration
100	Hull Structure
200	Propulsion Plant
300	Electrical Plant
400	Command & Surveillance
500	Auxiliary Systems
600	Outfit & Furnishings
700	Armament
800	Integration/Engineering
900	Quality Assurance

- Use a simulation model (Krause, M., et.al, 2004)

Simulations procedures are:

- 1- Setting goals,
- 2- Collect the appropriate data,
- 3- Building the model,
- 4- Validate the form,
- 5- Run the simulation,  
*if necessary, change some parameters, or go back to step (3),*
- 6- Analyze the results
- 7-Extract Final documentation





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- Shipyard will apply Lean Manufacturing With minor Financial Burdens.
- When Removing Non-value-added Activities, The Block Production Lead Time Will Be Reduced To 50%, which is from Good Labor Utilization and Eliminating Motion Does Not Add Value.

## The Benefits are:

### Quality:

Work is passed directly to next Process with no defects

### Productivity:

Minimize wasted movement, warehouses, and double handling

### Productivity:

Problems are identified and solved real time

### Lead Time:

Shortest supply chain, highest flexibility, satisfies customer demand

### Cost:

Reduced Inventory Levels

**Can Lean Be Applied In Egyptian Shipbuilding? To Answer This Question, Other Studies Are Underworked Right Now.**

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**Lean shipbuilding is Distinguished By Its Low Cost, Low Investment, and Significant Advantages and Reliance on Professional Workers.**

**When Using Lean Shipbuilding, The Shipyard Block Assembly Production Efficiency Can Be Significantly Increased.**

**The Space Required By The Shipyard Production Will Be Reduced, Along With Delivery Time and Consumed Man-hours.**

**When Utilizing The Lean Shipbuilding, Production Balance Will Be Significantly Improved While Time Waste Can Be Significantly Decreased.**

**Lean Shipbuilding will Be an Excellent Application When Applied at Egyptian Shipyards.**

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Thank You For Your Time