



engineering and construction contracting association

Modularization: When Is It Effective?



Russell Shulz

Project Director; Fluor

Modularization

Overview

- Introduction
- When is Modularization Effective?
- Industry Implementation of Modularization
- Industry Terminology
- When Modularization Decision Needs To Be Made
- Execution Approach Differences
- Benefits of Modularization
- Challenges
- Market Trend
- Conclusion
- Q&A



Modularization

Introduction

- Modularization is an execution approach for design, procurement, contracting and construction that shifts site construction hours away from the site
- Includes skids, pre-assemblies, entire process structures, machines, and other structures including bridges



Modularization

Introduction – Very Large Module (>600Tons)



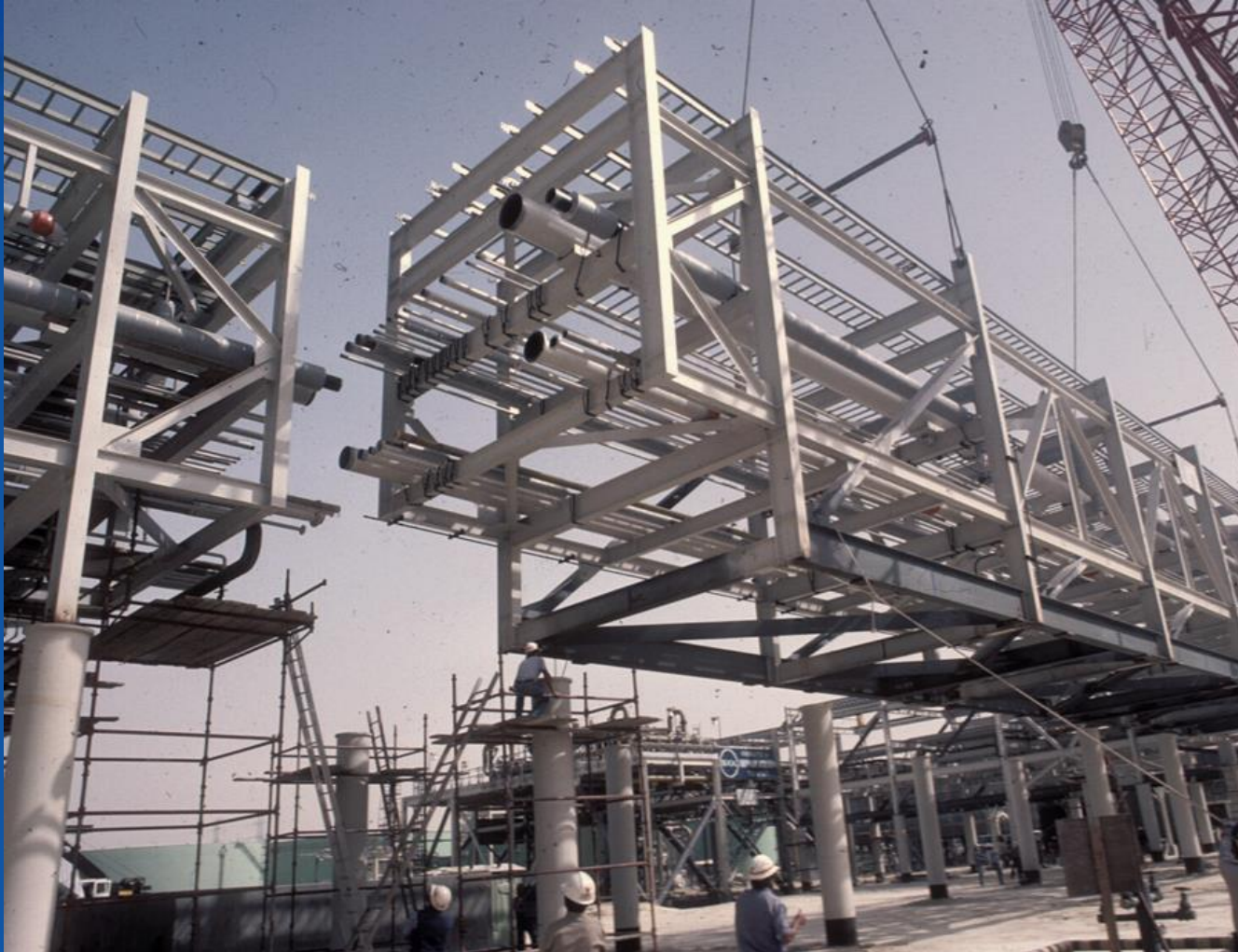
Modularization

Introduction – Small Truck-able Module (<60Tons)



Modularization

Introduction – Pipe Rack Modules



Modularization

Introduction – Ship Mounted Module



Modularization

When is Modularization Effective?

- Client business drivers supporting module design:
 - Remote site access
 - Severe site weather constraints
 - Schedule-driven improvement
 - Limited availability of regional skilled labor/ imported construction labor/ man camps
 - Extensive Factory Acceptance Testing (FAT) desired
 - High module potential / repeatable facility construction
 - High density piping areas
 - May be the only option



Modularization

Industry Implementation of Modularization

- Modular facilities world-wide
 - Fixed and floating offshore applications
 - Onshore production and pipeline projects
- Remote arctic & temperate locations
 - Remote from tidewater, with constraints of land transport logistics and cost
- Global Industries using Modularization
 - Infrastructure (bridge sections, buildings)
 - Power (HRSGs, equipment and piping, piperacks)
 - Manufacturing and life sciences (process buildings)
 - Mining (process facilities, piperacks)
 - Upstream (offshore installations)
 - Downstream (process equipment, piperacks)



Modularization

Industry Terminology

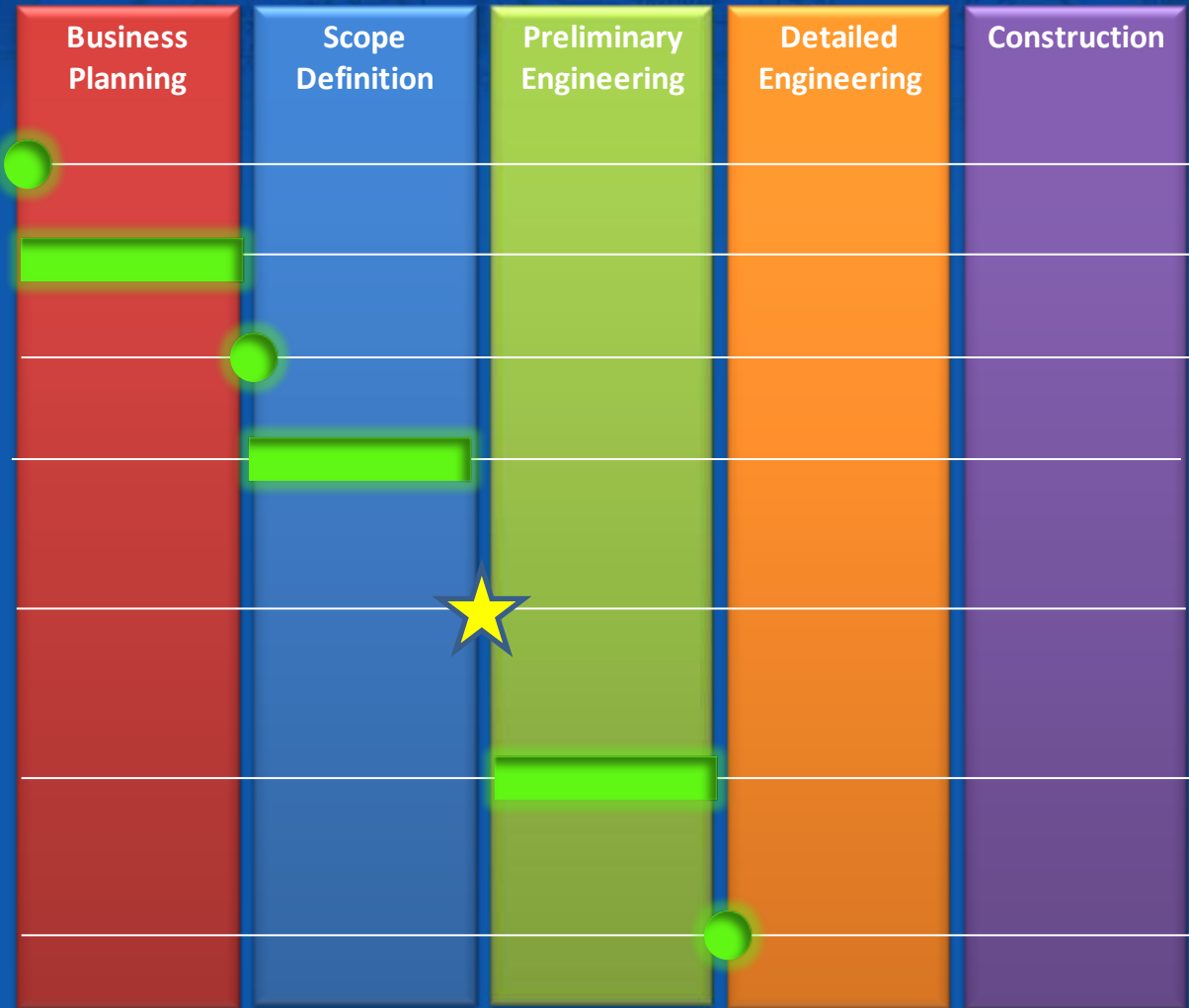
Module Type	Size
Very Large Modules (VLMs)	> 600 tons
Large Modules	100 to 600 tons
Intermediate / Medium Modules	60 to 100 tons
Small / Truckable Modules	60 tons or less
Piperack Modules	
Skid-mounted Equipment Modules	
Hybrid Modules	Partially in the fab. Yard Finished and assembled on site
Barge / Ship Mounted Modules	Such as FPSO, FSOs, FLNG



Modularization

When Modularization Decision Needs To Be Made

1. Define Business Drivers
2. Accumulate Information
3. Strategic Evaluation
4. Develop Alternative Cases
5. Decide Level of Modularization and Complex Preassembly
6. Develop Estimates, Quantities, and Schedules
7. Complete Project Execution Plan



Modularization

When Modularization Decision Needs To Be Made

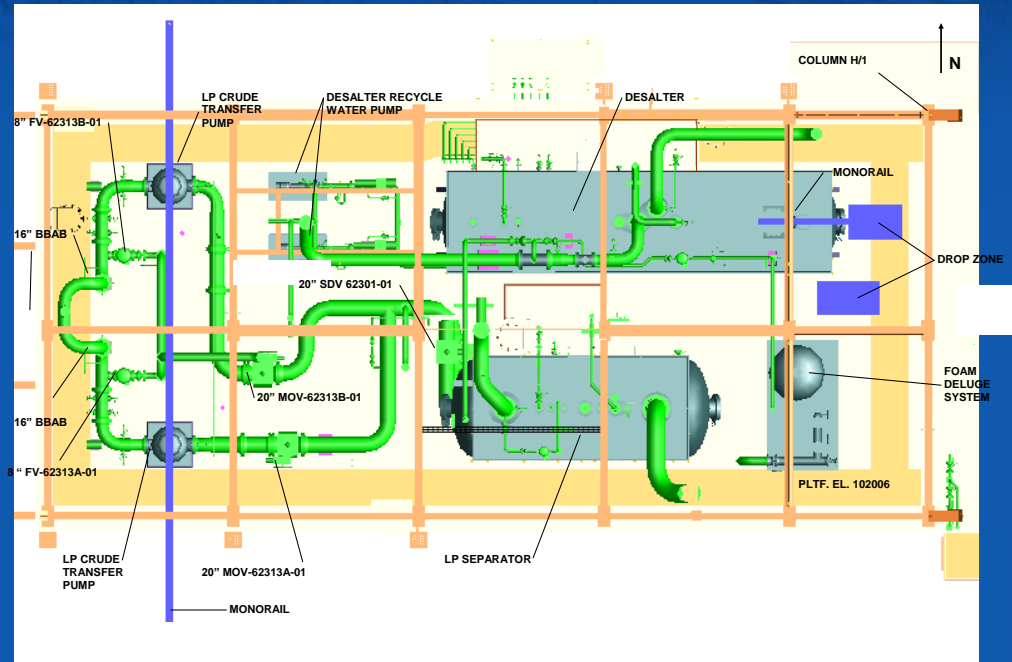
- The decision to modularize on a project needs full and early commitment from all stakeholders.



Modularization

Execution Approach Differences

- Early Engineering
- Early Procurement
- Activities Sequence
- Fabrication Organization
- Interface Management
- Operations & Maintenance



Modularization

Benefits of Modularization



Modularization

Benefits of Modularization

- Safety
 - Work shifted to controlled shop environment
 - Reduced total site hours
 - Reduced work at high elevations
 - Potential reduction in crane usage

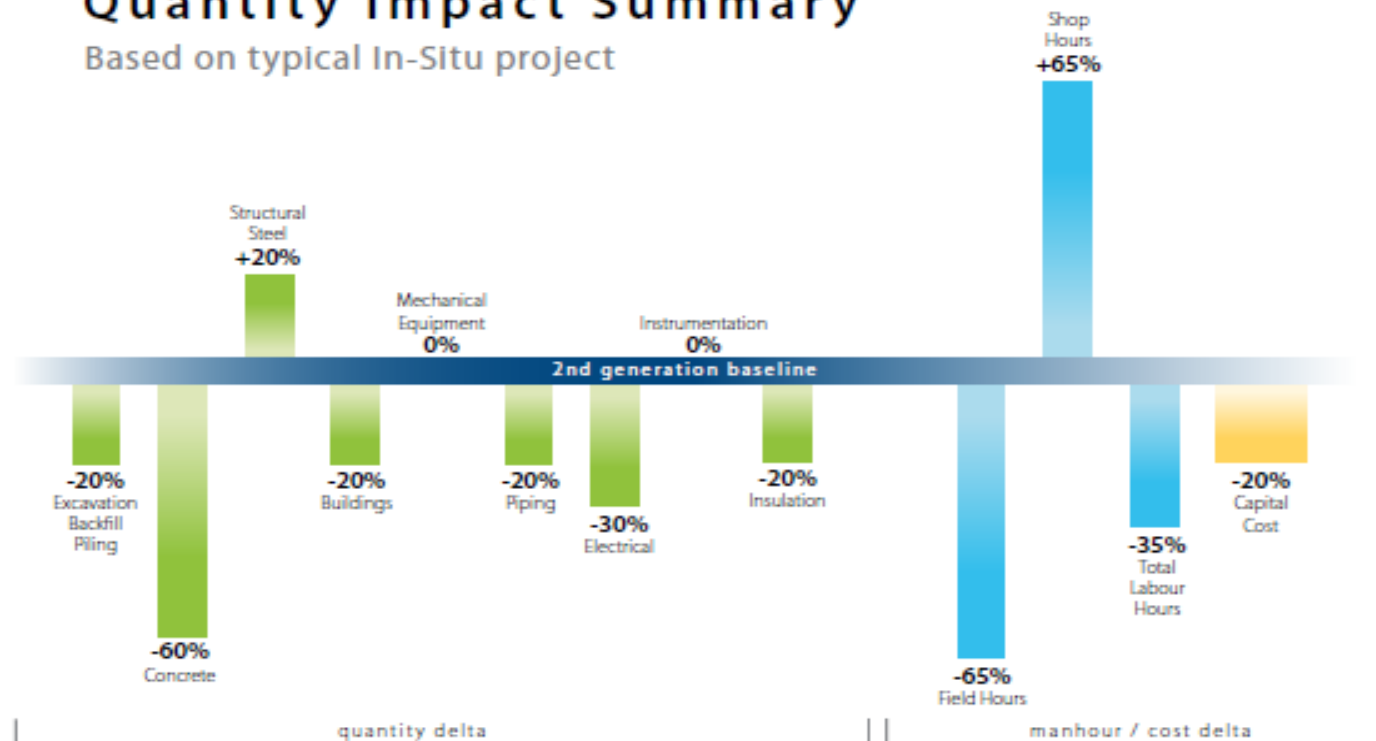


Modularization

Benefits of Modularization

Quantity Impact Summary

Based on typical In-Situ project



Modularization

Benefits of Modularization

- Cost Savings
 - Reduced quantities for smaller footprint
 - Productivity gain for work shifted to module yard
 - Reduced indirects with less field hours



Modularization

Benefits of Modularization

Materials Quantities Comparison *	
Prime Account	Quantity Delta (%)
Excavation, Backfill & Piling	-5
Concrete	-30
Structural Steel	45
Mechanical Equipment	0
Piping	-15
Electrical	-20
Instrumentation	0
Insulation	-15

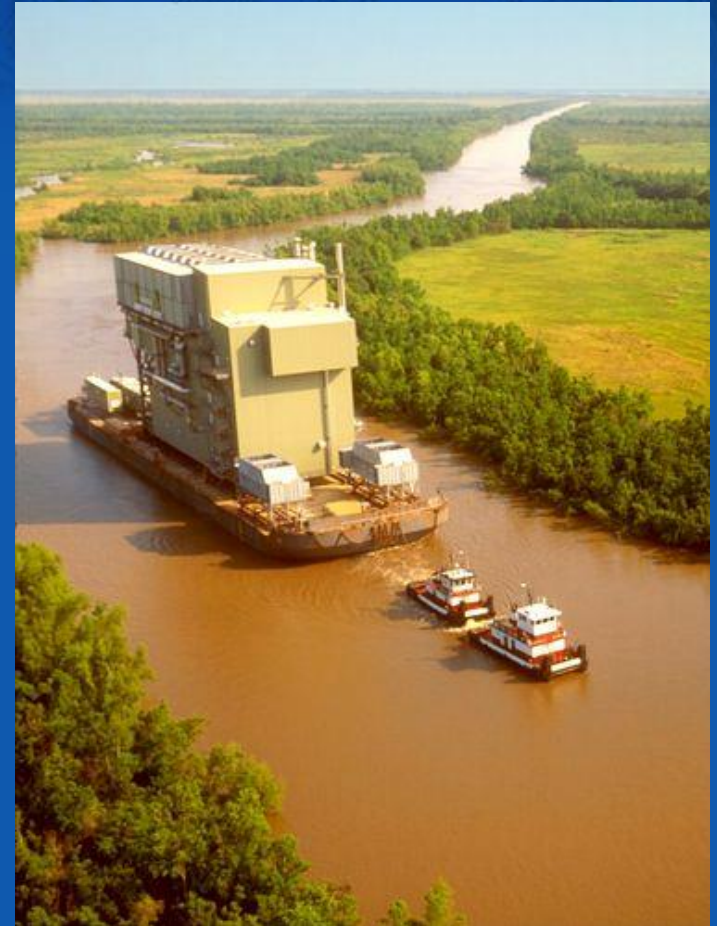
*Maximized Process Units and Pipe Racks Modularization



Modularization

Benefits of Modularization

Labor Relocation to Module Yard(s)	
Direct Field Cost	Percent Work in Module Yard(s)
Civil	0%
Concrete	0%
Structural Steel	80%
Buildings	30%
Mechanical Equipment	30%
Piping	63%
Electrical	20%
Instrumentation	20%
Insulation	65%
Average*	44%



Modularization

Challenges

- Increased Planning
 - Logistics
 - Engineering / Procurement
- Early Engineering / Procurement
- Increased Cost of Engineering
- Increased Shipping Cost
- Increased Steel Quantities
- Increased Equipment damage potential
- Additional rigging / lifting requirements
- Module plan interfaces



Modularization

Market Trend

- Modules are becoming more condensed
- Dependence on fit for purpose designs to drive down costs
- Start up times after minimized
Shipping solutions are very creative, nothing too big or too small
- Project & risk management overcoming challenges to deliver success



Modularization

Conclusion

- When is it efficient to Modularize?
- Decision Timing & Planning
- Modularization Benefits and Challenges
- Owner operations personnel to be involved from start
- Design takes longer, but installation at site means overall project schedule improvement
- Complete project team buy-in and alignment



Modularization

Q & A





engineering and construction contracting association