MODULARIZATION STRATEGIES FOR MAJOR PROJECTS

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Modularization can produce substantial cost and time savings in large industrial projects. But these gains are not guaranteed with the mere mention of the word “modularization”. It is an execution strategy that requires significant forethought, planning, structure, organizational discipline and alignment of interests by all parties involved.

This workshop will address the key elements of a successful modularization strategy and give participants an understanding of:

• Drivers and motivations of project owners and the module supply chain
• The necessity and features of the execution framework
• The make-or-break influence of the project ecosystem
• The importance of the planning process
• The benefits of a four-part process for invitations to tender (ITP), requests for proposal (RFP) and contract awards.
• Obstacles, risks, dangers and remedies to a globally distributed setting
The success of the fabricator is the responsibility of the owner.
The success of the owner is the job of the fabricator.

1. About your speaker
2. Setting the scene
3. How to get there
4. Contracting strategies
5. Execution
6. Long distance relationship
7. Two suggestions
8. Concluding remark
1. About your speaker

Steven Keays is a 30-years veteran of aerospace, defense, manufacturing and O&G industries, founder of NAIAD, and a graduate of the Royal Military College of Canada.

His experience with Oil and Gas projects spans water, oil and gas pipelines, upstream gas treatment plants, SAGD, Oil sands facilities and LNG plants, with projects located in North and South America, China, Japan and Russia. He has been intimately involved with large scale modularization strategies since 2011.

Mr. Keays is the author of an upcoming book featuring a complete methodology for managing complex industrial projects.

Mr. Keays resides in Calgary, Alberta with his wife Margaret and their three children.

Sample of experience

- PD – Suncor Fort Hills Secondary Extraction (TIC $2B)
- PD – Statoil Expansion ($360M)
- PM – Spectra Energy pipeline expansion ($240M)
- PM – LNG Canada (Shell), Site development ($1.5B)
- PM – TransCanada Coastal Gaslink pipeline ($4B)
- PM – BP Noel full field development ($1.0B)

PD = Project Director
PM = Project Manager
1. About your speaker

NAIAD at work

NAIAD’s delivery strategy strengthens the Client’s return on investment. It’s a strategy engineered to conquer the profound challenges of today’s global economic environment.
a. No longer a question of whether, but where.

The fundamental point of owners going modular boils down to one thing: to get a profitably performant asset.

1. What kind of role modularisation is playing in the major projects you’re involved in at present? Modularization has become a strategic imperative to every single project with which I have been involved since 2012. Modularization has effectively become a mandatory element of these delivery schemes.

2. Latest trends and technological advancements in modularization and prefabrication

Trend 1: widening application of modularization.
Trend 2: Plug and play interfaces. The ideal module is one that can be delivered to site and installed on the foundation in a single operation, then rapidly “connected” to the rest of the plant by physical interfaces that eliminate in situ fabrication.
Trend 3: Standardization of standards.
Trend 4: Diffusion of advanced electronics. Control systems are forced to evolve in lock step with the relentless advances of the IT industry.

3. Drivers of modularization. Costs are front and centre. Easy access to global supply chains. Solution to high construction labour costs.
2. Setting the scene

a. No longer a question of whether, but where.

*Price, at the cost of schedule, kills modularization.*

4. **Benefits of using modular techniques**
   Answer to high local labour costs. Answer to low-skill labour pools. Solution to domestic bottlenecks. Faster site construction. Higher end product quality. Access to leading edge technologies from wherever they are designed and created, rather than make due with whatever was historically possible from a domestic supply chain.

5. **Lessons from the offshore construction world**
   Offshore design is constrained by four exacting requirements, among many: constricted spacing, salt-water corrosion resistance, unsteady foundations (rolling oceans) and high reliability operations (distant maintenance capabilities).

6. **Key considerations behind a modularization strategy**
   Never justify on the sole basis of capital costs. Modularization is not a panacea that solves all problems, especially cost concerns. Know your project ecosystem (PECO) - i.e., the environment in which the equipment will be operated. Reach the inner core, the kernel, where the plant is physically located. Adopt a four-part contracting strategy - qualification, specifications, selection, and award. **OPEX costs can destroy your investment returns.** Will your asset be capable of being repaired, overhauled, expanded, modified and sold? Vendor after-sale support is essential (especially documentation).
2. Setting the scene

b. What the owner wants.

*Exercise one: sitting on the other side of the table*

*Owners and Vendor expectations*
2. Setting the scene

b. What the owner wants.

To get what he paid for: the profitably performant asset

The reality of projects is somber: up to $20M, 30 to 40% will fail. Above $100M, the rate can go up to 50%. Beyond the $1B mark, at least 60% will not realize their economic objectives. In an age of depressed commodity prices, who can afford those kinds of odds?

**Performance** implies guaranteed nameplate throughput over the economic life of the asset.

**Profitable** implies optimized operating costs, high plant reliability and availability, predictability of revenues, and valunomic maintainability over the economic life of the asset.

**Asset** is the machinery that will produce predictable and sustained investment returns to its owner.

**Expectations of owners:** Speed to market, cost and risk containment, security of supply, certainty of quality and competent supply chain partners.
2. Setting the scene

b. Fabricator’s perspective

Vendors want three things: succeed, be profitable and get repeat business.

Vendor expectations:
1. Know exactly what is to be delivered
2. Understand fully the ecosystem in which the module will be operated
3. Know exactly how the work will be assessed and approved
4. Understand completely how to interact with the owner
5. Respect of timelines imposed by the contract
6. Owner abiding by his own contractual obligations
7. Orderly execution of works
8. Competent oversight devoid of dabbling
9. Timely profits
3. How to get there

a. Risky business.

*Exercise two: sitting on the edge*

*Owners and Vendor risks*
3. How to get there

a. Modular projects are risky

*Modular projects are akin to icebergs: most of what matter lies beneath the surface.*

**Risks are everywhere:**
- Large projects are inherently complex
- Global executions are more complex
- Disconnects between expectations
- Working across time zones burns people out
- Corporate mandates don’t align
- Execution strategies assume too much
- Cultural differences are misunderstood
- Currency fluctuations
- Logistics and transportation nightmares
- Egos, hubris and the perils of PECO dismissal
- Project management
- Meddling and dabbling
- Illusion of contract supremacy
3. How to get there

a. Modular projects are risky

Keep your focus on the actual point of the project: to get the profitably performant asset.
3. How to get there

b. Projects abhor a vacuum. The PECO fills it.

The ecosystem is the arena where the construction action will occur, one that includes all of the variables that are external to the project.

The project ecosystem is summed up in one question: what could possibly go wrong?

**Kernel:** The physical constraints of the site. Geography, weather, natural calamities, water sources, pollution.

**Location:** The bottlenecks to and from the equipment’s final site location, including local kings.

**Whip:** The regulatory environment and its disregard for owner costs.

**Grease:** This layer is all about friction and its retarding effects on the execution of the project. Friction sources include construction strategies, recalcitrant stakeholders, and politics.

**Culture:** How things actually get done or not. It is a fractious layer, fraught with judgment and ignorance, and the one that screams the loudest for local representation within the owner’s project team.

**Chain:** Supply chain. What stuff can be bought from whom, where and when? What features of that stuff must be validated before reaching site?

**Bulwark:** Acts as sentry against incoming marauders. Held in place by a network of competitors ready to defend their stakes.
3. How to get there

c. The owner-vendor Framework

The framework sets out the “landscape” within which the work will be done.

- It prescribes the management schema, the SOE, the progress metrics and quantifies the Project Ecosystem.
- Defines the Construction, Operations and Supply Chain strategies
- Who submits what to whom, when.
- Records management strategy (digital vs paper).
- Digital infrastructure
- Interface management
- Audits and approvals

**SOE: Standard Operating Environment.** The complete set of standards, procedures, templates, document specifications (naming, numbering, style guide, colour schemes, etc.) and administrative methodologies that apply ubiquitously over the project’s lifecycle.

**Org Chart**

**Accountability matrix**

**Document management**

**Approval hierarchy**

**Execution Plan**

**Vendor oversight plan**
### 3. How to get there

#### c. The owner-vendor Framework

<table>
<thead>
<tr>
<th>Standard Operating Environment</th>
<th>Standard Operating Landscape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dictated by the Owner:</td>
<td>Dictated by the joint venture:</td>
</tr>
<tr>
<td>• Corporate standards, processed and procedures</td>
<td>• Common SOE</td>
</tr>
<tr>
<td>• Templates, forms and checklists</td>
<td>• Communications framework</td>
</tr>
<tr>
<td>• Document specifications (naming, numbering, style guide, colour schemes, etc.)</td>
<td>• Inter-party accounting and invoice processing</td>
</tr>
<tr>
<td>• Administrative methodologies</td>
<td>• Contract terms &amp; conditions</td>
</tr>
<tr>
<td>• Reporting requirements</td>
<td>• Engineering modelling and drafting standards</td>
</tr>
<tr>
<td>• Invoice submissions and payments</td>
<td>• Engineering and design software infrastructure</td>
</tr>
<tr>
<td>• Document management</td>
<td>• Work-sharing and sub-contracting</td>
</tr>
<tr>
<td>• Digital architecture</td>
<td>• Change management</td>
</tr>
<tr>
<td>• Policies and governance</td>
<td>• Compliance enforcement mechanics</td>
</tr>
<tr>
<td></td>
<td>• Mandatory software</td>
</tr>
</tbody>
</table>
3. How to get there

d. Design strategy

Design then bid then award then build.
3. How to get there

e. **Prescribe, not describe**

**To specify is to quantify**
All that counts must be measurable
Never assume – define everything. Avoid figures of speech (eg. XXX)
Provide list of acronyms and abbreviations – especially for regulatory terms
Templates, standards and presentation prescriptions (per SOE)

**The deal with Codes**
Quote rather than refer
• Bad: Tank’s anchor chairs designed in accordance with API 650 – 12th Edition.

Provide list of codes and standards with explicit references to pertinent articles.
• When dealing with foreign vendors, compile articles into an *Extract Summary*
3. How to get there

e. **Prescribe, not describe**

<table>
<thead>
<tr>
<th>BAD</th>
<th>GOOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>The project manager is responsible for satisfying all stakeholder interests</td>
<td>The project manager shall realize the profitably performant asset.</td>
</tr>
<tr>
<td>The quality assurance manager will ensure that the quality assurance policy is complied with.</td>
<td>The quality assurance manager shall enforce procedures X, Y and Z at the intervals specified therein.</td>
</tr>
<tr>
<td>The engineering manager shall endeavour to ensure the delivery of a quality drawing set.</td>
<td>The engineering manager shall, without exception, enforce the drawing verification and checking procedure XX, and maintain a record of the performance metrics derived from its application.</td>
</tr>
<tr>
<td>As the work progresses, every effort must be made to comply with the health and safety targets.</td>
<td>The Total Recordable Incident Frequency (TRIF) limit for the work shall be 2.33. Higher TRIF values shall trigger penalties defined in Clause X.X-9(a) of the contract.</td>
</tr>
</tbody>
</table>
3. How to get there

e. Prescribe, not describe

**W5H EXAMPLE: WEEKLY MEETING PROCEDURE**

**What:** Weekly progress meeting

**Why:** Required per article 5.2.1 of Annex A to the contract

- To review progress of team’s work over the past week
- To plan the work for the upcoming two weeks
- To communicate the findings to the Client
- To review last week’s meeting minutes

**When:** Every Tuesday, at 10:00, 90 minutes duration. On the following Wednesday, when Tuesday is a statutory holiday.

- Meeting minutes to be issued by noon the following day.
- Agenda published the day before to attendees via email by Project Administrator.

**Where:** Conference room 910B, Complex A.

- May be held at the Client’s office, when requested by latter.

**Who:** Project Manager chairs the meeting
- Engineering Manager, list.
- Project administrator records the minutes
- Meeting minutes approved by: SPECIFY
- Meeting minutes distributed to: SPECIFY

**How:** Reports reviewed to include man-hours, deliverables, change list, and cost accruals.

- Paper copies are prohibited. All reports viewed via projector.
- Webex to be set-up to enable callers to view simultaneously
- Minutes taking to be displayed live, on second screen
- Agenda to be published to attendees by Project Administrator
- Meeting minutes published using template XXX.YYY.123.
- Meeting minutes to be numbered in accordance with document management procedure XXX.UUU.12
3. How to get there

f. Construction strategy

Modules vs stick-build vs COTS

How will you build your project at site?

What are your constructability requirements?

How must the modules fit this construction strategy?

How will you address misalignments?

Logistics and transportation of modules
3. How to get there

g. Operating strategy

Low capital costs now = higher operating costs later

What are your operations and maintenance requirements

Module records, documentation and manuals

Materials, consumables and instrument sourcing

After-sale support from vendor

“Noppe, no airbags. But did I mention the heavy-duty seatbelts?”
3. How to get there

h. Vendor work package

The VWP is fundamentally a risk management tool. It minimizes risks by:

- Defining explicitly the specifications governing what the owner is buying.
- Defining explicitly and quantitatively the elements of the module to be built, by breaking down the module into installations, systems and components.
- Establishing precisely the rules of engagement and execution management between the owner and the vendor.
- Prescribing how the module will be accepted by the owner.

The effective VWP is prescriptive, precise and complete, to the extent that any capable vendor would be able to proceed with the work autonomously.
3. How to get there

h. Vendor work package

You get what you inspect, not what you expect

- The reviewer as subject matter expert (SME)
- What gets inspected, by whom, when
- When will you visit the shop – specify the visit deliverables
- Inspection records
- Quality assurance records

Shipping

- Preservation, containment, protection, pilferage
- Transportation plan is key
- Knowledge of PECO is essential
- Never assume that the past applies to the future
- You will never be big enough to overcome bureaucracy

Languages

- Use simplified English for master documents
- Translation as insurance policy
- ALWAYS issue directions through formal documentation
  - Letters, memoranda, project directives, change orders
  - Never do so via email, voicemails, verbal directions or spreadsheet lists.
3. How to get there

h. Vendor work package

Suggested Table of Contents

1. Module description
2. Execution management
   • Teams
   • Processes and procedures
   • Change management
   • Approvals and sign-offs
   • Standard Operating Environment
   • Interface management
3. Definitions and acronyms
4. Design and engineering
5. Code extract summary
6. Approved materials and vendors
7. Constraints
   • PECO
   • Construction strategy
   • Operations and maintenance
   • Shipping and transportation
   • Future logistics and supply chain
8. General work requirements
9. Work breakdown
   A. Instrumentation
      • Work items
      • Drawings & documents
      • Specifications and standards
      • Bill of materials
      • Quality records
   B. Electrical
   C. Mechanical
   D. Civil
   E. Process
   F. Architectural
   G. Etc.
10. Inspections and validation
11. Document management
12. Shipping
13. Site installation
Exercise three: adventures in contracting
4. Contract strategies

a. Four-part process

The fundamental point of going modular boils down to one thing: to get a profitably performant asset.

The greatest danger with any invitation to tender or request for proposal is to attempt to do everything in a single step. That is, to pre-qualify, assess, quantify, negotiate and award the work in a single effort. This approach only works for small procurement initiatives.

If your focus is on achieving project success - a commercially viable, constantly profitable operating plant – then the onus is entirely on the owner to help the Fabricator succeed. To succeed, you must proceed in incremental steps.

He who chooses the vendor owns the outcome.
4. Contract strategies

a. Four-part process

Part 1: Pre-qualifications. Identify which organizations (internal or external) possess the skills, expertise, experience, project mechanics and mechanisms to execute the intended contract work. Quantify what a vendor can and cannot do. Assess his experience with previous works before any ITT or RFP is released.

Part 2: Design specifications. Develop the theoretical design, which includes the schematics and associated specifications (including codes, standards, datasheets, performance calculations).

Part 3: Invitation to Tender. Prepare the bid package and solicit proposals from pre-qualified vendors. SCOPE OF WORK MUST BE BASED ON THE DESIGN SPECIFICATIONS. Stage 3 seeks to determine which bidder offers the owner the highest probability of fulfilling the contract. *Only way to equalize bids.*

Part 4: Award. Nominate the winner. Negotiate the contract. Initiate the work. Note that the initial work will focus on the defining the execution strategy jointly by the owners and the vendor’s PM team.
4. Contract strategies

b. Accountability matrix

Give up the traditional squad check process.

Adopt the direct accountability model.

• Accountability is assigned for each deliverable.
• Accountability is assigned to one individual, not to a group (otherwise, accountability is diffused and unaccountable).
• This person is the deliverable owner.
• The owner performs a first check of the deliverable and either returns it to the vendor with annotations, or submits it to an internal review.
• The owner convenes a review (attended by invitation only, sent by the owner).
• The review is done in one or more meetings, during which all comments, annotations and changes must be approved by the group of attendees and formalized by the owner via a single copy markup.
• The markups are sent back to the vendor via document control.
• Upon receipt of the revised deliverable, the owner alone checks the conformance of this revision with the changes requested.

This process eliminates dabbling, meddling and endless revision cycles.
4. Contract strategies

c. Inspection and acceptance

You get what you inspect, not what you expect

Schedule of inspections and audits
- What gets inspected when, by whom
- Records required – translation requirements
- Final acceptance test requirements
- MTRs, quality tracking, shipping records
- Shop certificates

Materiel sourcing
- Approved vendors and parts
- Shop certificates
- Quality assurance certification
- Archiving original documentation

Logistics and transportation
- Shipping plan (especially permit register)
- Import/export paperwork
- Regulatory paperwork
- What’s required before shipping (records, FAT, fit-up, assembly instructions)
- Translating transit records
- The importance of being transportation earnest
5. Execution

a. Information sharing

**Kick-off meeting.** The kick-off meeting aligns owner and fabricator from a single baseline of information that establishes the work.

- Framework presentation
- HO & SO
- SOE
- Change management and conflict resolution
- Digital infrastructure and cloud strategy
- PECO presentation

**Contract review session.**

- Scope of work review, chaired by Owner
- Review of CWP, codes and standards
- Contract page-turning meeting (high level team representatives)

**Progress control session.**
5. Execution

b. Mobilization

Execution plans.
• Mobilize the fabricator’s project management team.
• Develop the plans mandated by the contract. Approval by owner.
• Activate interface management team.

SOE Roll-out
• Review of owner-imposed templates and standards.
• Implementation of digital infrastructure

Document management system
• System and procedure roll-out
• Version management and translation
• Stamping and authentication

Dry runs
• Document transmittal
• Digital infrastructure connectivity
• Test invoice submission
• Test progress report submission
• Teleconference set-up
5. Execution

c. Initiation

Full team mobilization by vendor

Meetings and tele-conferences (and the importance of minutes)

Visits (of Vendor, of Owner)

The criticality of first reviews

Schedule ownership

Enforce the terms of the contract on yourself, the owner.
5. Execution

d. Interface management

Starting position: Errors will happen and changes will be incurred. Interface management has nothing to do with error prevention and change mitigation. Its purpose is to fully control the impact of a convergence issue in order to obviate surprises and unintended consequences.

Elements
1. Capture
2. Resolution
3. Escalation
4. Management of change (MOC)
5. Dissemination, and
6. Transparency.

Interface management shuns the blame game in favour of full disclosure
5. Execution

d. Interface management

Documentation:
• Never publish formal decisions by emails, meeting minutes, spreadsheets, etc.
• Rely instead on formal mechanisms.

Formal mechanisms of decisions:
• *Formal letters* for management or business relationship issues between project partners. Letters are also suited to commercial and legal matters between partners and external entities.

• *Memoranda* are the equivalent of letters for internal matters communicated within a partner’s organization or project team. They are the default medium for publishing decisions, arising out of meetings to participants.

• *Project directives* are suitable for decisions arising out of the execution of the work by any functional discipline or partner’s scope of work.

• *Change orders* are utilized to communicate a decision that affects asset compliance or asset performance.
5. Execution

It’s a spreadsheet world after all

Exercise four: paper pains
5. Execution

e. Digital framework

Document management
- Formal processes and procedures required
- Uniformity of application
- Use of robust, commercially available software
- Technical writing group

Database instead of Excel
- Form generator for reports
- Use for live changing lists (risk register, action items, decision records, change order tracking), field reports, progress reports, expense reports, etc.
- Will completely eliminate the problems associated with multiple versions and wrong templates.

Math vs Excel
- See associated example from anchor chair calculations IAW API 650
- Dreaded errors from copy-and-paste actions
- Uniformity of units in calculations
- Auditable calculations

Digital markup software
6. Long distance relationships

a. What we have here is a failure to communicate

Going global entails global challenges.

There is more to cost than price.

The concept of distance “delays” in communication
• The most effective and reliable pathway between a sender and a receiver is the direct link. That is, two individuals who deal with each other in person, in the same language, in the same environment and time zone, and with a common basis of understanding of the information transacted.
• Moving radially out by one layer (or node) magnifies the potential for information degradation.

The distance delays are, from least to worst:
• Presence (in person, via teleconference, via phone, via text, via letter, via intermediary);
• Language (shared spoken, shared written, verbally translated, formally translated);
• Environment (same team, same organization, same location, same business culture, same time zone); and
• Knowledge (topic, mandate, workload, project history, business imperatives).

The consequence of delays is to create a requirement to add more staff to the team to counter their deleterious effects and lubricate, if you will, the flow of information.
6. Long distance relationships

b. Clash of empires

Cultures matter

Language and numbers
- Not everyone speaks English
- Not everyone who speaks English understand English
- English is the language of mathematics – in rare places. Metrics rule.
- Always translate formal documentation (from which contract interpretations will be made

Sleepless in Seattle
- Night and day! That’s what time zones are.
- Team burnout
- Hidden costs of travel

The dollar inequality
- A dollar of productivity is not the same everywhere
- Hidden costs of oversight
- Random costs of overseas fabricators

NEVER EVER EVER EVER ASSUME!
The amount of information required by a successful modular project vastly exceeds the contractual documentation. You must take the time to educate each other (owner and vendor) before mobilizing the teams.

Design first – in order to quantifiy prescriptively the VWP and scope of work

If you include design in the fabrication contract, you increase your risks to budget and schedule.

All is specified, none is required or suggested. Achieving such a level of completeness requires diligence and patience from the owner.

Understand the ecosystem in which your project will unfold.

Never assume. Prescribe, explain, specify, enforce.

Beware lower-than-required costs. They will cost you more in the long run.
8. Encore

a. The event catalog

**Event chronology.** There will be times during a project when it is necessary to track down a sequence of events that led to the making of a particular decision. This can be a time-consuming endeavour often plagued by findings bereft of documentation. Sorting through the mass of emails, meeting minutes and people’s recollections can be daunting.

The sequence of events leading up to a decision is essential to an understanding of the minutia of execution from which the *post mortem* review is conducted (discussed below).

The master schedule is not suitable for this task.

**Event catalog.** The *event catalog* is constructed from the master schedule, with the activities from the schedule tagged by the colour-coded circles, in the left pane of the page, under the “Plan” column.

Events associated with activities are captured in real time. An event can be a published record (a project decision, change order, etc.), an impromptu meeting, an email, and any other instance that triggers the publication of the record.

Especially useful during construction, when field problems occur and get resolved on the spot, without necessarily flowing through the formal project management channels because of time constraints.