Keynote Panel – Differing Perspectives – Technical Requirements
Technical Requirements – A Designer’s Perspective

Richard Houseman MSc, PEng, PMP
Context

- This perspective contains the views and opinions of the author only.
- They represent a perspective based on experience both within the Canadian Forces and within the private sector on technical requirements for ship design whether for acquisition or in-service of naval ships.
Outline

• “Good” Technical Requirements

• Existing Design
  o “As Is”
  o Modified

• New Design
  o Design Process and Requirements
  o Concept to Contract Design

• Conclusions
Good Requirements
(back to basics)

• Feasible – both technically and legally, and within cost and schedule
• Clear – unambiguous, without vague terms
• Complete – expresses a coherent idea
• Consistent – without conflict amongst requirements
• Verifiable – assessable to determine whether met
• Traceable – identifiable with a tracked history
• Design Independent – does not pre-determine a solution
Existing Design

- Aka “Parent Craft” or either Military or Commercial Off The Shelf (MOTS/COTS).
- Procurement process used where the design is not unique and proven requirements meet operator’s requirements.
- Requirements must be identical to “as built” and proven ship.
- Operators must accept “as is” unless feasible and funded alterations are acceptable with parent designer and involve builder.
- Government obtains design licence and assumes risk for key performance requirements but shipyard has obligations for risk it controls – weight management, equipment selection
- Shipyard assumes risk for production, particularizes production package to suit own infrastructure and processes.
- At outset who is responsible for what requirement must be clearly defined.
- Requirements must be managed with original designer/gov’t/shipbuilder (designer continuity – shipyard involvement)
Modified Existing Design

- Oxymoron?
- “Requirements” are the proven “as built” package (assumes package maintained up to date together with requirements)
- Owner’s desire to minimize technical risk but invariably there are requirement changes that re-introduce risk and transfer responsibility
- Requirements change causes a “ripple effect” ranging from changes in performance to changes to technical data package
- Changes to requirements and requirements creep rapidly erode any perceived benefits of this procurement approach
- When requirements change, critical to assess feasibility of change with original designer and involve the shipbuilder. Develop detailed specifications.
New Design Requirements

Typically in response to unique requirements or at owner’s discretion

Input:
• Statement of Capability Deficiency
• Statement of Requirements (customer)
• Concept of Employment
• Concept of Operations

Statement of Technical Requirement:
• Ship specifications
• Standards
  • Unique customer requirements
  • IMO regulations
  • Classification Society
  • Customer standards
  • Others (ISO, IEEE, etc.)
Concept to Contract Design

• Concept and preliminary designs with subsequent options and sensitivity analysis are the means to ensure requirements validity
• Requirement validation needs to be conducted early together with requirements management and tracking
• Design processes identify requirements feasibility and affordability (all requirements cost), which are design drivers and cost drivers, and where conflicts exist amongst requirements
• The owner has an obligation to ensure that requirements are sufficiently mature, have been verified and are “good requirements” before entering into any contract
• The contractor also has obligations to verify requirements before proposing/accepting work
• Dialogue between customer and bidders/contractor key
• There are no shortcuts to the design process, including time and resources, in the development of “good” requirements
Conclusions

- Requirements must be “good” requirements: Feasible, Clear, Complete, Consistent, Verifiable, Traceable and Design Independent.

- Different procurement processes present their own unique challenges to ensuring good requirements

- Specifications when under pressure leak

- Good requirements are fundamental to the success of any ship acquisition program
Questions?
Mari-Tech 2012
Differing Perspectives – Technical Requirements
April 10, 2012
Content of the Presentation

• Approach
• Process of creating technical requirements
• Example
Approach

• Be a “smart customer” by exploring, conceptualizing and validating requirements to ensure that we know what we want and realize what we are asking for.

• By creating an “in-house” design, Coast Guard will be an informed customer and become the best possible client for industry.
Create Technical Requirements

• All requirements for new vessels were/will be derived from the missions with which the vessel will be tasked.
• Using scenarios derived from the missions and a series of stakeholder engagements, other governmental department consultations, operational and science working groups indicative requirements are generated.
• These requirements are/will be combined into a single document the Indicative Requirements Document (IRD).
• The IRD was/can be validated and became the Baseline Requirements Document (BRD)
  – The BRD is very similar to the Statement of Operational Requirements (SOR)
To start, most requirements have been a mixture of:

- **Requirement:** The actual base requirement derived from and linkable to the mission of the vessel. The kernel of the base requirement was almost always included and just needs to be extracted.

- **Vision:** An indication of how the requirement might be met in the future on the vessel. The vision is good information and is retained but as additional information to the requirement.

- **Guidance:** An indication of how the requirement is currently being met and should be met in the future. The guidance is good information and is retained but as additional information to the requirement.

- **Partial Solution:** A singular solution based upon experience and knowledge set with sufficient support to determine if solution is the only one, or even correct one. The partial solution usually forms part of the guidance for a requirement.
Validate Technical Requirements

• A “Valid” requirement meets the following criteria:
  – Necessary
  – Technically Feasible
  – Affordable (relative)
  – Non-conflicting
  – Clear
  – Concise
  – Verifiable
• The Baseline Requirements Document (BDR) is then expanded from the user (operational and program) requirements to the technical requirements that will be required to enter into the Contract Design process.

• The technical requirements are captured in the Design Instructions and Guidance (DI&G).
  – The DI&G is like the TSOR (Technical Statement of Requirements)

• The DI&G is generated by writing design reports as well as creating an in-house Concept Design to provide context for all of the design reports.
• **CCG Development Report**
  – Corner stone of Coast Guard concept design work
  – An engineering report that expands the operational or baseline requirements into the technical requirements.

• **Cumulative output of all the Design Reports is the DI&G and an “in-house” Concept Design.**
1. **Interaction with Project Stakeholders:**

   a. Identifying program and user requirements;
   b. Evaluating technical feasibility;
   c. Investigating potential technical solutions; and
   d. Developing technical requirements.

2. **Interaction With Designer:**

   To identify potential solutions for program specific equipment, including developing equipment and working space arrangements to ensure that program missions and user requirements can be achieved.

3. **Interaction with Industry:**

   To identify candidate equipment to meet user requirements within vessel design constraints.
Conceptual Coring Deployment System (STX and CCG)

- Piston Corer
- Coring Cradle
- Core Handler
- Secondary Crane Wire
Oceanographic Winch Pull versus Depth (Piston Corer Recovery)

- Static Total Mass Force (N)
- Actual Force (N)
- Actual Force and Vessel Motion (N)
- Max Force (N)
- Estimated Winch Pull Available OOSV (N)

Coring Boom
Main Crane
Secondary Crane
Oceanographic (Coring) Winch
A-Frame
Coring Davits
Coring Cradle
Core Handler

Reference: OOSV Equipment images courtesy of Rapp Hydema
ConocoPhillips, COP, as a major international oil company has a capital budget of ~$13.5 billion/annum.

COP is in a “continuous acquisition” mode for ships and floating units, built in N. America and internationally.

Critical importance doing the initial project work to know that we are “designing and building the right ship before we design and build the ship right.”
Submerged Turret Loading Tanker

World’s first Submerged Turret Loading Tanker Purpose-built to Service Heidrun Field In North Sea

• Diesel Electric fully dynamic position ship
• Submerged Turret recovered and connected to load from platform
• No lost production due to tanker down-time
• Budget ~$125 mm
Polar Endeavor Class

Five (5) off - 1 million bbl modern Jones Act tankers for Alaska trade
- Design for harsh environment operations
- Double-hulled
- Highly redundant propulsion and steering systems
- Two independent machinery rooms
- Twin engines – propellers - rudders with bow thruster
- Integrated bridge and engine controls
- State of the art navigation equipment
- Total budget $982mm
Qatargas LNG ships

Ten (10) large LNG carriers – 4 different designs

- 7 – 215,000 m³ ships
- 3 – 266,000 m³ ships
- 3 ships at DSME, 3 at HHI and 4 at SHI
- Ships fitted with GTT membrane cargo containment systems
- Twin slow speed diesels/propellers/rudders
- On board reliquefaction plant to handle BOG
- Total AFE ~$2.6 billion

Note: this was part of an overall procurement of over 50 such ships
Varandey Icebreaking Tankers

- Three (3) icebreaking tankers
  - 70,000 tdwt capacity
  - Built in Samsung HI, Geoje shipyard
  - Break 1.7m ice continuously
  - Diesel Electric Medium speed diesel prime movers
  - 2 x 10MW Tractor Azipod propulsion
  - First ship delivered in 2008 all 3 ships in service 2009/10
  - Budget ~$450MM for all 3 ships
Arctic Tanker Construction – SHI, Korea
Keel-laying - ~3000 ton Mega-block Lift

Note:
Keel laying to Launch – 9 weeks
# Icebreaking Tanker Project Schedule

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start of Project</td>
<td>4-Jan-05</td>
</tr>
<tr>
<td>Concept Defined &amp; Technical Requirements Developed</td>
<td>5-Mar-05</td>
</tr>
<tr>
<td>Specifications prepared; Shipyard and Shipowner bids issued, reviewed and analyzed; contract negotiated with Shipyard and long term charter negotiated with Shipowner</td>
<td>21-Oct-05</td>
</tr>
<tr>
<td>Shipyard and Ship Owner Contracts Signed</td>
<td>29-Oct-05</td>
</tr>
<tr>
<td>Steel Cutting</td>
<td>2-Nov-06</td>
</tr>
<tr>
<td>Keel Laying</td>
<td>17-Apr-07</td>
</tr>
<tr>
<td>Launching</td>
<td>23-Jun-07</td>
</tr>
<tr>
<td>Delivery</td>
<td>31-Dec-07</td>
</tr>
</tbody>
</table>
Varandey Ice-Management Vessels

- One escort icebreaker plus one icebreaking supply boat
- Ice breaking capability – 1.5m
- Built by Keppel O&M in Singapore
- Ships delivered early 2008
- Ships provide ice management and supply roles at Varandey loading terminal in Pechora Sea, (they do not escort tankers).
- AFE ~$200MM total for both vessels
Information and Outcomes

- Many challenges with project definition and management as we usually working in partnership with others, with multiple regulatory regimes, often with significant political risk and with less than perfect mission requirements and marine is usually only part of the project (i.e. not stand-alone).
- Each of these project has had a fairly high degree of innovation and first-in-class technology
- No change orders on any of these projects
- All the vessels described on the previous slides have performed well in service
- All projects were completed with less than 2% over-run from contract price (fixed)
- All the Asian-built ships were delivered on schedule (or early)
FPSOs in Asia-Pacific

• Yoke moored FPSO in Bohai Bay, China
  • COP has constructed a second unit in Shanghai – Pudong, which has had topside fitted in Singapore before returning to China for site installation in May 2009

• Purpose design and built unit for service in East Timor.
  • Built in Samsung Heavy Industries in Korea
  • Both Tandem and Side-by-Side offtake systems
  • Releasable turret mooring allows disconnect for typhoons
Procurement Strategy for Specialized Project Ships (such as Arctic Tankers)

1. CoP develops Ship requirements
2. CoP contacts Shipyard #1
3. CoP contacts Shipyard #2
4. CoP contacts Shipyard #3
5. CoP selects Shipyard
6. CoP selects Owner A
7. CoP selects Owner B
8. CoP selects Owner C
9. CoP develops Charter Requirements
10. CoP contacts Owner
11. CoP & Owner Negotiate Charter Party
12. CoP & Shipyard Develop Design
13. Shipyard Develops Costs & Schedules
14. CoP & Shipyard Negotiate Contract
15. CoP Project Charterer

CONTRACTUAL ENVELOPE
CoP Capital Projects Management System
Project Development Process

Expense Funding  Capital Funding

eAFE  AFF  AFD  FID AFE

1 SELECT PROJECT & ID
2A BUSINESS
PROBLEM FRAMED?
2B ALTERNATIVE
SELECTED?
3 AGREE
BUSINESS
CASE?
4 APPROVE
PROJECT?

PORTFOLIO
IDENTIFY & SCREEN OPPORTUNITY
FRAME
PROBLEM
SELECT ALTERNATIVE
FINALIZE PLANS
OBTAIN
APPROVAL

Requirements Development

EXECUTE & CONTROL PROJECT
MANAGE OVER TO OPS & CLOSE
VALIDATE PROJECT BENEFITS

INTERIM DELIVERABLES
ACHIEVED?
BUSINESS CASE
COMPLETED?
BENEFITS
CAPTURED?

Funding Gates

REQUIREMENTS
FINALIZED
Developing Requirements

• Do not over-specify - Leave room for alternative approaches and creative solutions.
• Use existing standards where appropriate, but be aware when they are not.
• Do not use a parent ship design unless you want the same ship with its benefits and challenges.
• Incorporate best practices and lessons learned (means that one must have captured these from previous projects and have them available)
• Unless you are dealing with a “very plain vanilla” ship do not rely on Class.
• Requirements must be a balance of Performance, Technical, Economic, Schedule, Life Cycle and CapEx Cost, Quality, Regulatory, and Environmental issues and they must be progressed in an integrated way.
• Keep project team small, include key individuals from operating business unit and from HQ Project Development.
• Use the most knowledgeable, most capable people on the project team – process is important but people are more important.
• Move fast and stay as flexible.
Important Attributes

• Continuous Evolution – Learn from Past Projects
• Attaining and Maintaining Smart/Informed Customer status
• Risk reduction in program implementation through focused Technology Development efforts
• Maintain close relationship with Shipbuilders, Ship-owners/operators and Vendors.
Developing Requirements

• Developing Requirements is the epitome of the naval architect’s professional activities.
• Developing requirements well, ensures that one will have the right ships designed and built.
• Unfortunately most professional training is based on designing and building ships right, rather than on designing and building the right ships.