Preliminary and Contract Design

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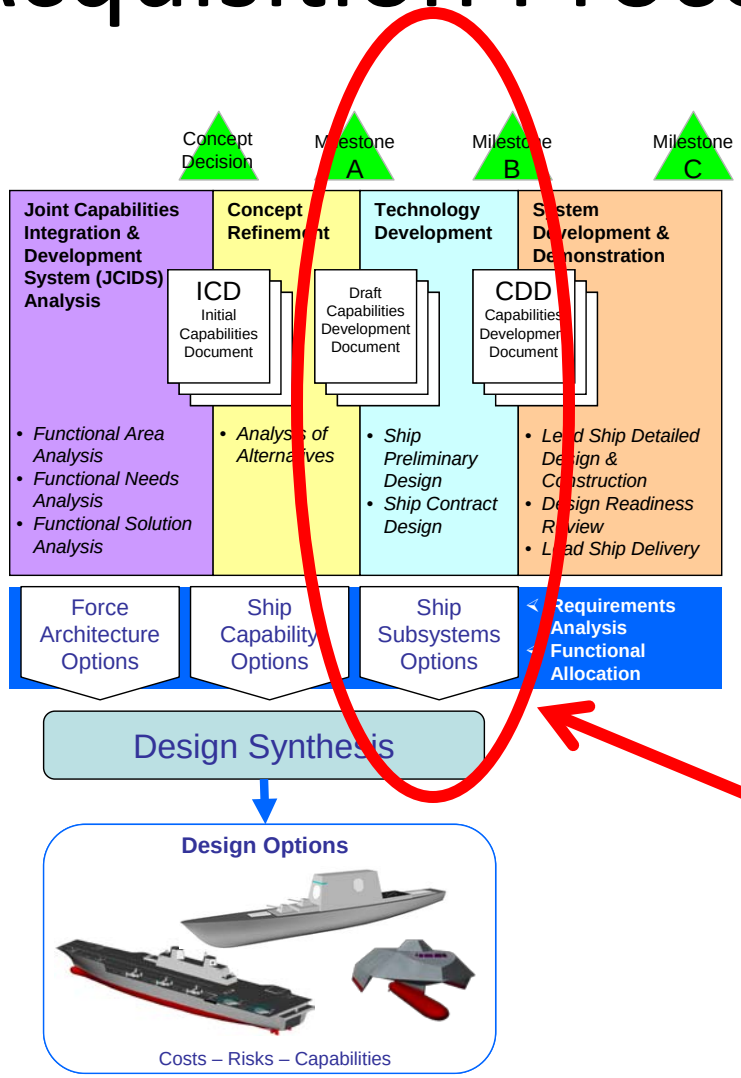
Agenda

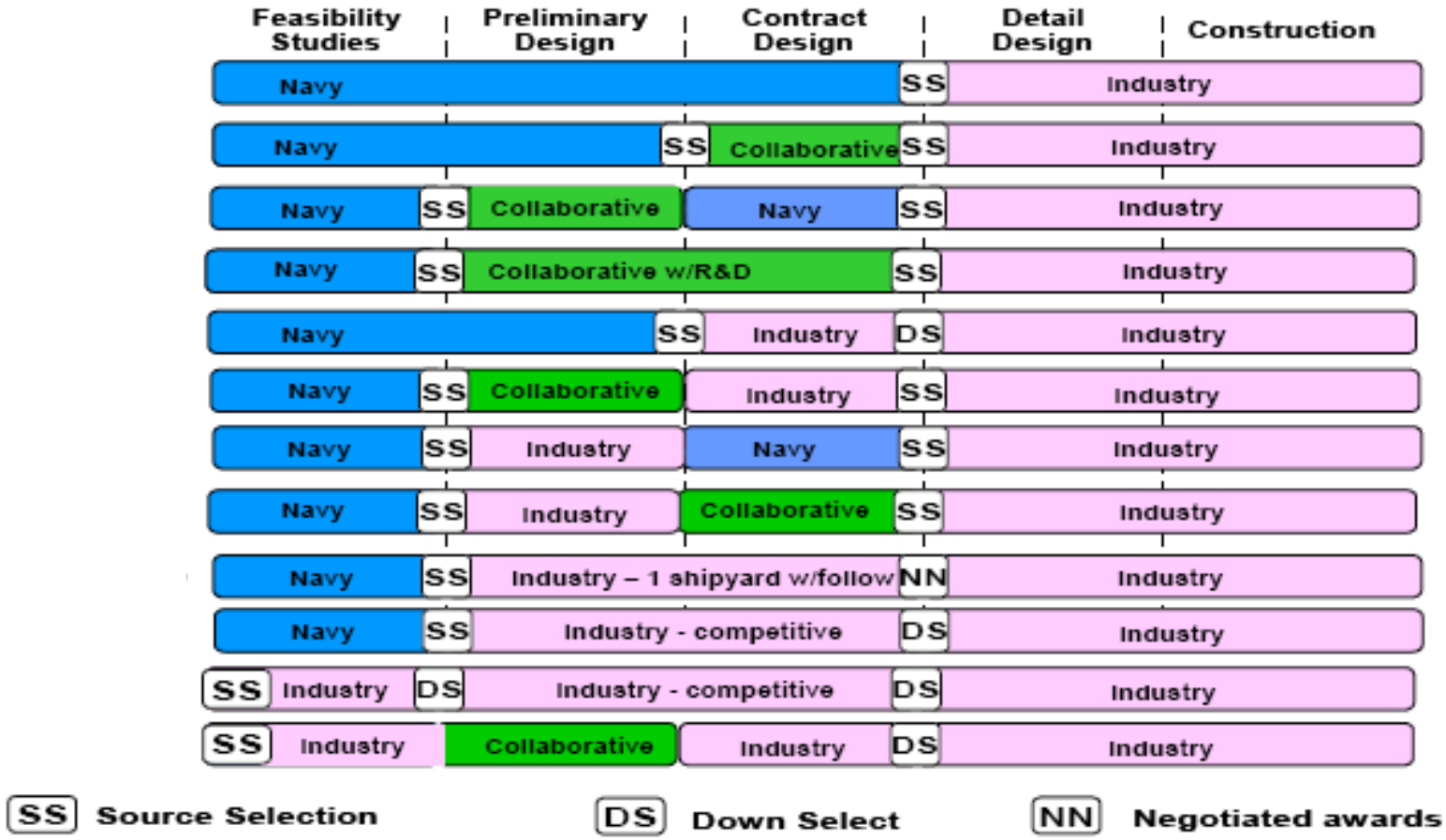
- Introduction
- Requirements
- Contract Package
- Risk and Opportunities
- Design Activities
- Conclusion

Acquisition Process



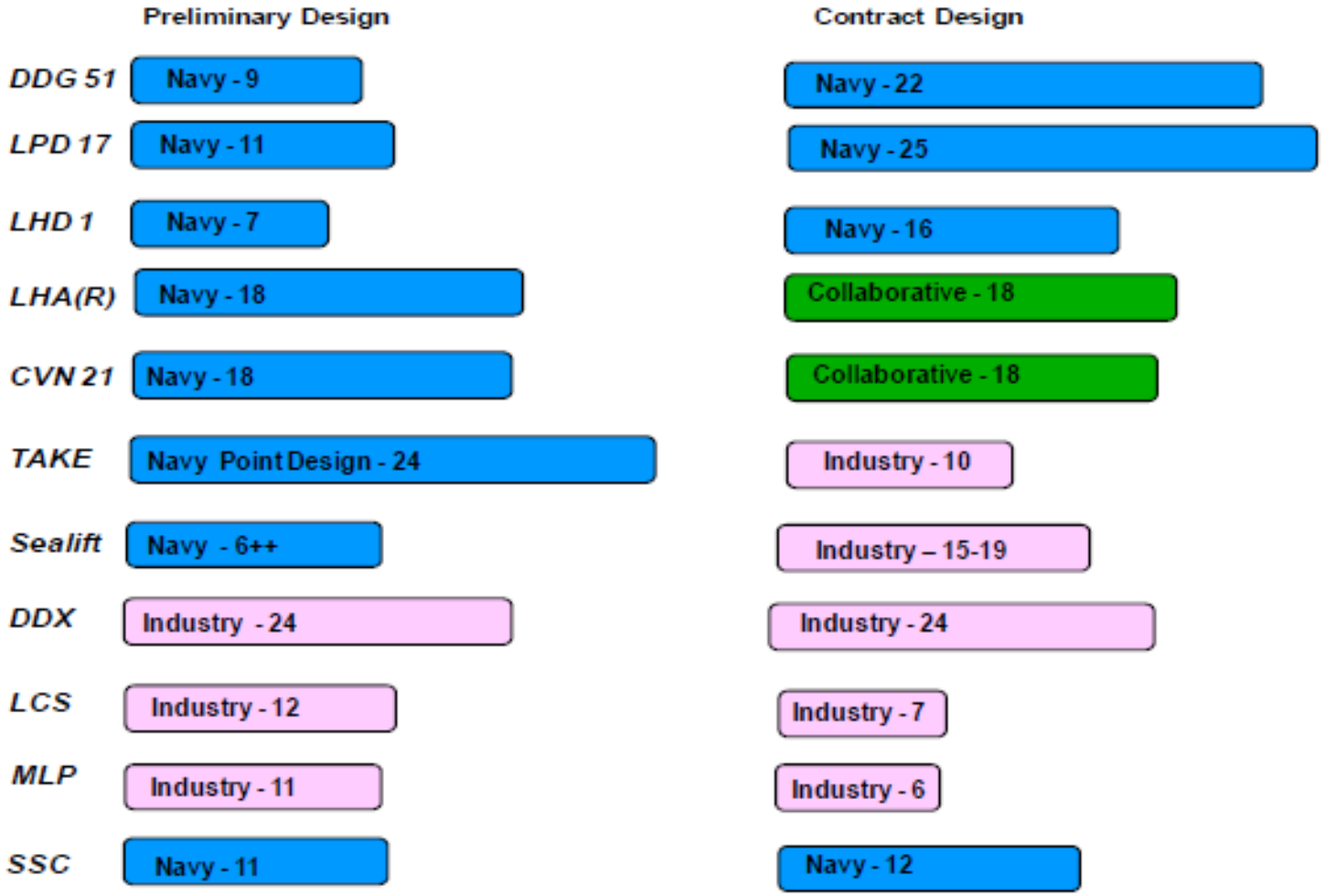
Preliminary and Contract Design

Notional Acquisition Strategies

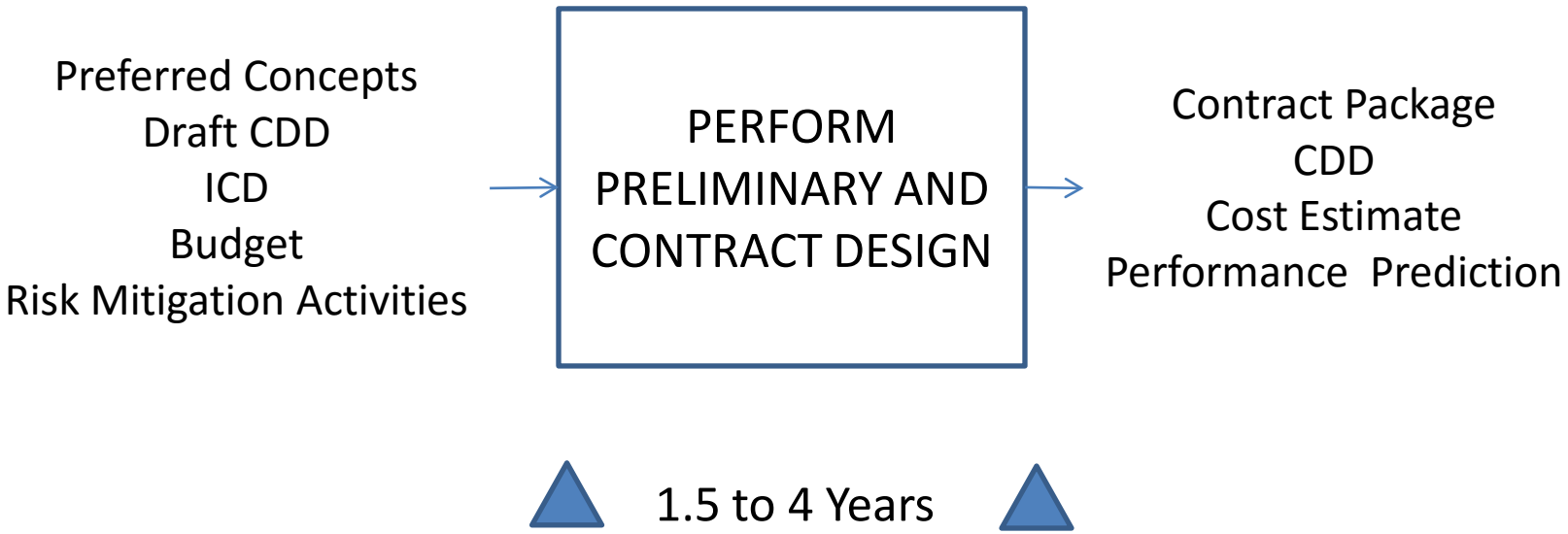


Enable Option for Navy Led or Collaborative PD / CD

Historic Duration of PD - CD (months)

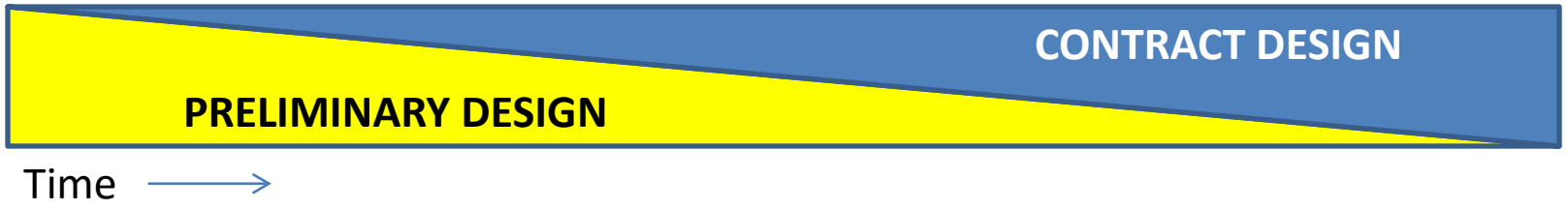


PD – CD: Simplified



Preliminary Design vs Contract Design

- Preliminary Design (~100 man-years)
  - Further reduce the design space from Concept Exploration via more extensive product definition and analysis
  - Refine CDD requirements
  - Develop derived requirements
  - Mature technology / Reduce risk
    - Typically the schedule driver
  - Mature cost estimates
- Contract Design (~200 man-years)
  - Mature design
  - Translate design and Ship System Specification into a Shipbuilding Specification
  - Contribute to development of remainder of Contract Package.

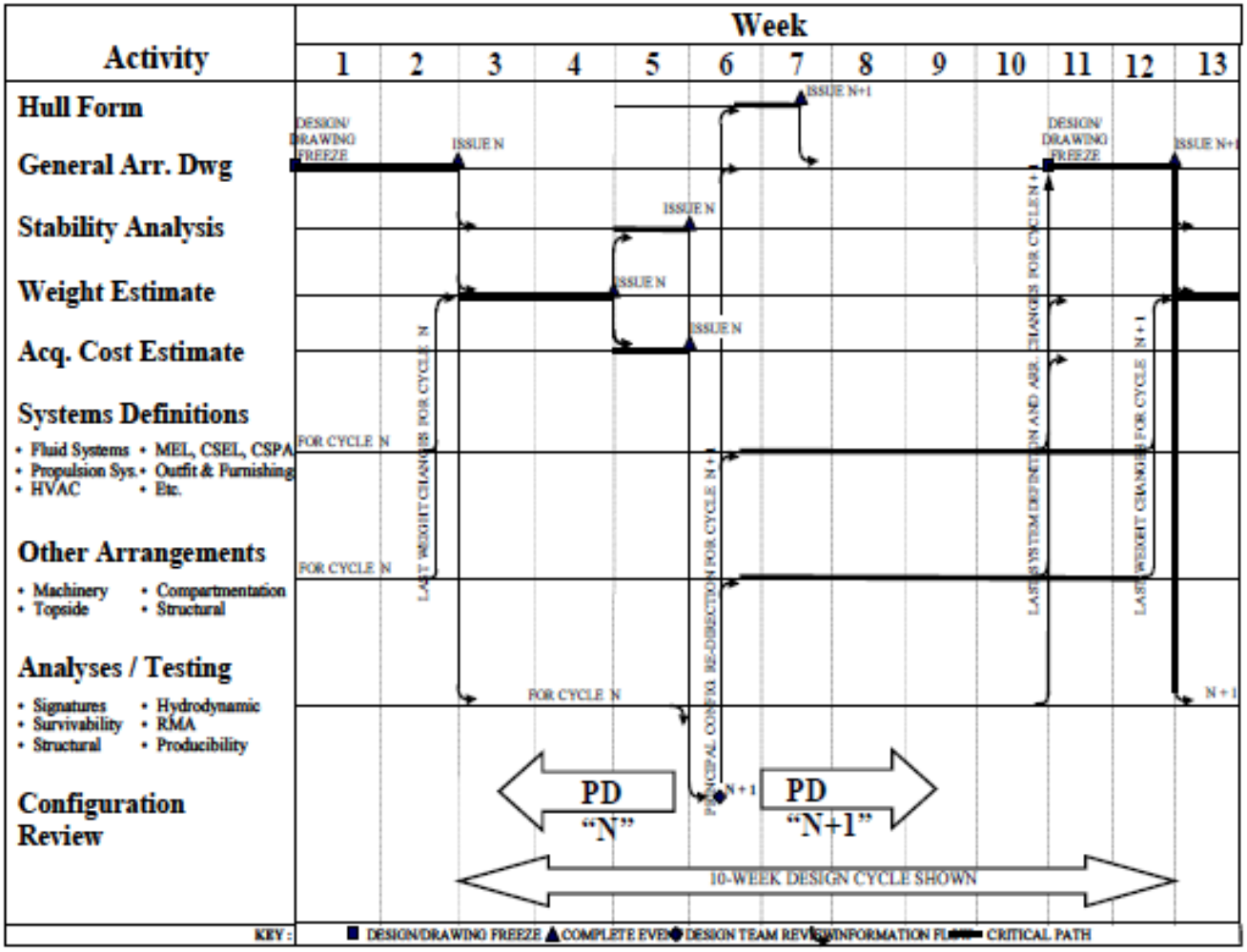


Design Iteration

- Design Iteration reduces design process complexity, from Nam P. Suh:
  - "For a system to operate stably for a long time, functional periodicity must exist in the system or must be built into the system"
  - Addresses Combinatorial Complexity in the design process:

    The accuracy or properties of the system change with time – either due to internal or external reasons such that the system can no longer reliably achieve its objectives.
- In PD and CD, design iterations are typically on the order of 10-13 weeks.

Design Iteration (Example)



Requirements

Requirements

- ICD and preliminary CDD exist at beginning of PD.
- Some CDD requirements may not initially be known.
- Some CDD requirements may require study to determine appropriate values.
- Some CDD requirements may be relaxed once cost impact is fully understood.
- New CDD requirements may become apparent as the Projected Operational Environment (POE) evolves.

Recommend conducting a Requirements Risk Review

Requirements Risk Review

- Categorize each CDD requirement
  - Certain
    - Requirement known and unlikely to change
  - Mid term uncertain
    - Requirement currently unknown or likely to change
    - Value expected to be defined within 1 year after MS A
  - Far Term uncertain
    - Requirement currently unknown or likely to change
    - Value expected to be defined before MS B
  - Modernization
    - Requirement currently unknown or likely to change over service life
- For all but “certain” requirements:
  - Develop a range for each requirement (not a threshold and objective)
  - Identify work necessary to determine the requirement
  - Develop a modularity / flexibility / modernization strategy to enable an affordable and timely response to fixing / changing the requirement

Contract Design Package

Contract Design Package

- Initially, as part of the Request for Proposal (RFP), describes what the Government wants the shipbuilder to do and deliver.
- Establishes a scope of work to enable negotiations between the Government and shipbuilder on the cost/price of the contract.
  - Contract Design Package may change as a result of negotiations.
- Note that once the shipbuilder is under contract, any change to the scope requires a contract modification.

Uniform Contract Format FAR 15.204

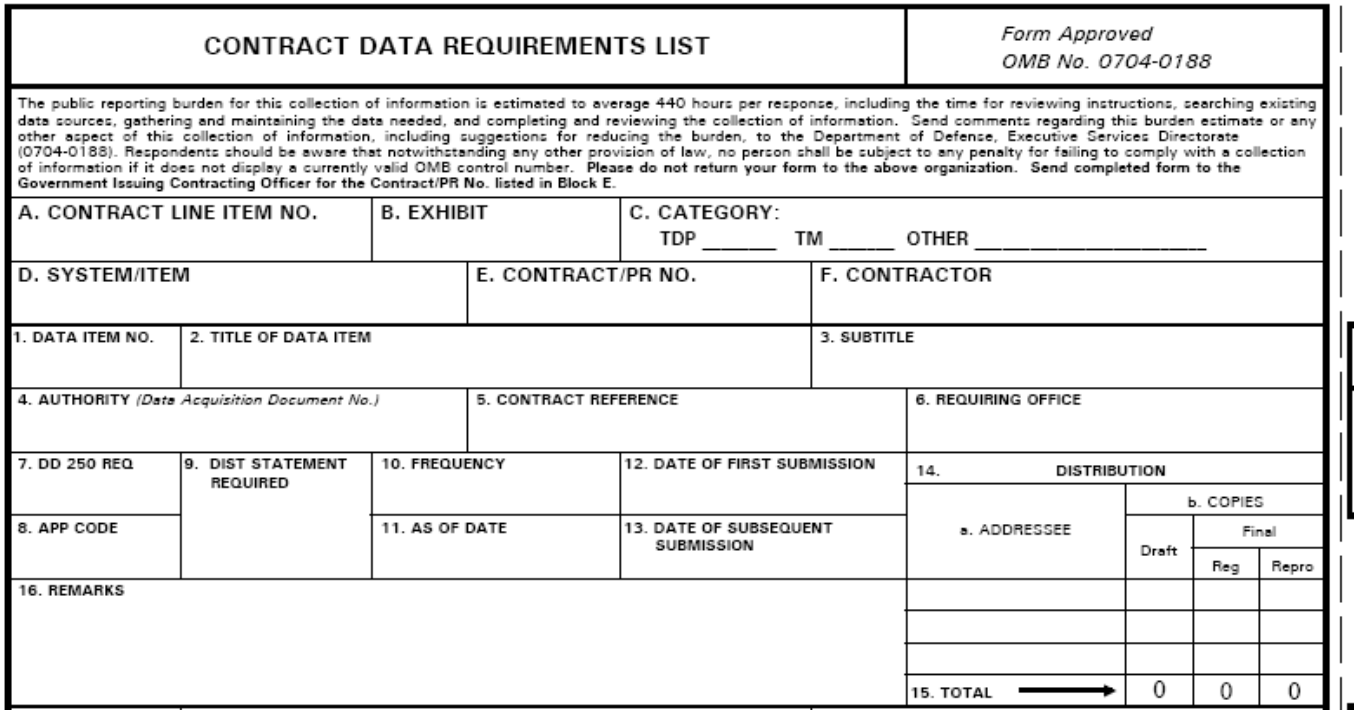
- **Part I The Schedule**
  - A Solicitation/Contract Form
  - B Supplies or Services & Prices or Costs
  - **C Specification/SOW/SOO/ORD**
  - D Packaging & Marking
  - E Inspection & Acceptance
  - F Deliveries or Performance
  - G Contract Administration Data
  - H Special Contract Requirements
- **Part II Contract Clauses**
  - I Contract Clauses
- **Part III List of Documents, Exhibits, & Other Attachments**
  - **J List of Attachments**
- **Part IV Representations & Instructions**
  - K Representations, Certifications, & Other Statements
  - L Instructions, Conditions, & Notices to Offerors or Quoters
  - M Evaluation Factors for Award

Typical J Attachments

1. **Ship Specifications**
2. **Contract Data Requirements List**
3. **Schedule A – Government Furnished Equipment**
4. Schedule B – Technical Services
5. **Schedule C – Government Furnished Information**
6. Technical Manual Contract Requirements
7. SOW for Provisioning Technical Documentation (PTD)
8. Configuration Status Accounting (CSA) Requirements Statement (CSR)
9. Contractor Cost Data Reporting Plan
10. R Supply File Formats
11. C4ISR Integration Plan
12. ..
13. Standardization Program Plan
14. Contract Security Classification Specification
15. Financial Accounting Data Sheet(s)
16. Small Business Subcontracting Plan
17. Ship Weight Factors
18. ...
19. Factors for Determining Loads
20. NAVSEA 4280, Unit Price Analysis
21. NAVSEA 4280-2, Summary
22. …
23. Mission Critical CFE
24. Contract Options

J2 Contract Data Requirements List

- Data Requirements specified using the standard DD Form 1423
- “Paper Based”



CONTRACT DATA REQUIREMENTS LIST

Form Approved
OMB No. 0704-0188

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A. CONTRACT LINE ITEM NO.	B. EXHIBIT	C. CATEGORY: TDP _____ TM _____ OTHER _____
D. SYSTEM/ITEM	E. CONTRACT/PR NO.	F. CONTRACTOR

1. DATA ITEM NO.	2. TITLE OF DATA ITEM	3. SUBTITLE
4. AUTHORITY *(Data Acquisition Document No.)*	5. CONTRACT REFERENCE	6. REQUIRING OFFICE

7. DD 250 REQ	9. DIST STATEMENT REQUIRED	10. FREQUENCY	12. DATE OF FIRST SUBMISSION	14. DISTRIBUTION			
				a. ADDRESSEE	b. COPIES		
8. APP CODE		11. AS OF DATE	13. DATE OF SUBSEQUENT SUBMISSION		Draft	Final	
						Reg	Repro
16. REMARKS							
				15. TOTAL →	0	0	0

J3 GFE LIST

- List of all Government Furnished Equipment
- Generally Provides the nomenclature name of the GFE and the date that it will be provided to the Contractor
- List does not
  - Provide detailed description of the GFE
  - Indicate what the GFE is to be used for

J5 GFI LIST

- List of Government Furnished Information
- Generally Provides a list of the documents / data and the date the Government will provide a contractor
- Does not indicate
  - Contents of the GFI
  - What the GFI is to be used for

Statement of Work vs Shipbuilding Specification

- Statement of Work (SOW) describes activities that the shipbuilder must do.
- Shipbuilding Specification describes the properties of the end product.
  - Usually includes test requirements
  - Can specify design methods

The lead for SOW development is typically the Program Office
The lead for Shipbuilding Specification development is typically the Ship Design Manager

Shipbuilding Specification

- Specification Sections
  - Organized by SWBS
    - 000 General Guidance and Administration
    - 100 Hull Structure
    - 200 Propulsion Plant
    - 300 Electrical Plant
    - 400 Command and Surveillance
    - 500 Auxiliary Systems
    - 600 Outfit and Furnishings
    - 700 Armament
  - Naval Combatant Design Specification provides standard clauses
- Project Peculiar Documents (PPD)
  - Typically component specifications or standards for ship unique cases
- Contract Drawings
  - Sometimes specified for guidance only

Shipbuilding Specification Considerations

- Requirements are different from design
  - Infinitely many designs can meet a specific set of requirements
  - Shipbuilding specifications that are too restrictive can result in higher costs by ruling out less expensive configurations
  - Shipbuilding specifications that are not restrictive enough can result in expensive engineering changes and rework
- How does one specify a design space?
  - Any configuration in the design space would be acceptable to the Navy
- How do you relate testing and analyses to validate a design to the validity of the design space defined by the specification?
- How does one analyze and test a shipbuilding specification to ensure it describes a design space acceptable to the Navy and is not too restrictive?
- How does one ensure the analyses, tests, and trials specified for detail design and construction will, at minimum cost, validate that the delivered product will meet requirements?
- What is the best way to trace specifications to requirements (of all types)
  - CDD
  - Law
  - Regulations
  - Policy

Impact of Acquisition Strategy

- Competition
  - Desire a larger design space to enable shipyards to submit bids that are optimized to their production processes and facilities.
- Sole-Source
  - Desire a smaller design space because it enables optimization to occur during PD/CD and it facilitates a better definition of the scope of work: less uncertainty.

Shipbuilding Specification vs Ship System Specification

- Shipbuilding Specification
  - Governs design activity during Detail Design and Construction.
- Ship System Specification
  - Governs design activity during Preliminary and Contract Design
  - Evolving description of the design space

Configuration Management

- Tracking the evolving Ship System Specification and Shipbuilding Specification is challenging
- Need to ensure self-consistency
- Need to ensure completeness
- Need traceability
- Need to ensure changes are properly vetted
- Need to ensure alignment with Technical Authorities.

Risk and Opportunities

Risk Definitions

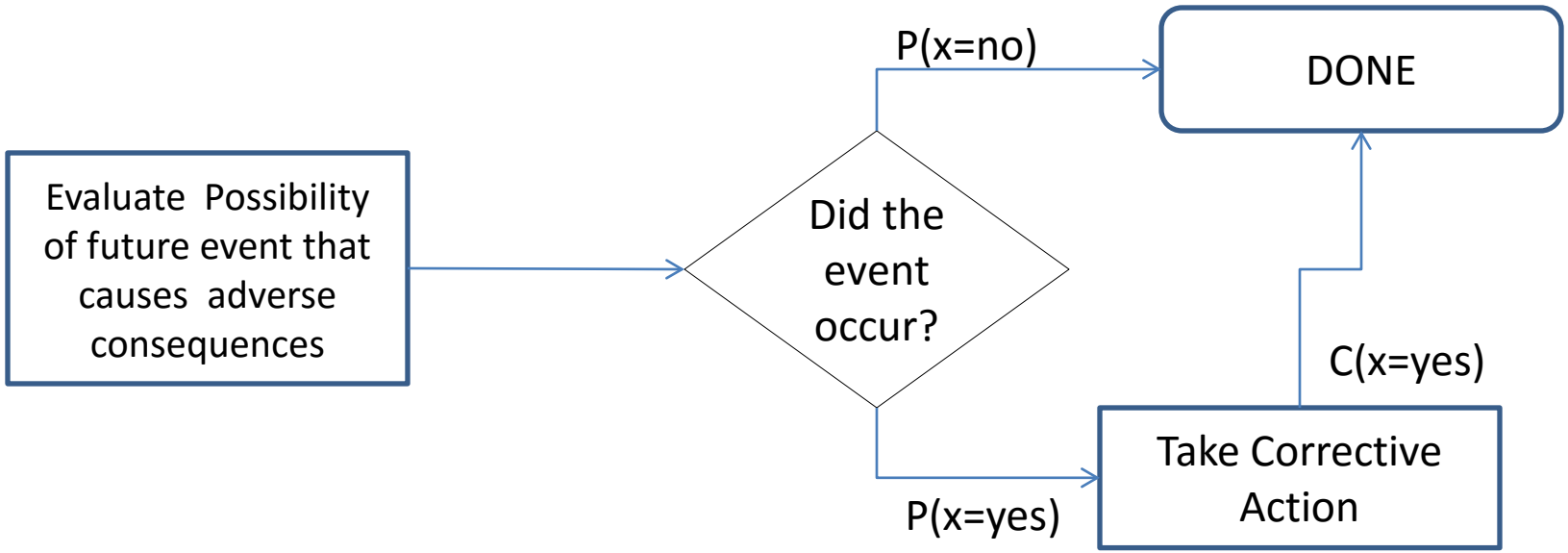
- Key DoD and Navy issuances define it as follows:
  - "Risk is a measure of future uncertainties in achieving program performance goals and objectives within defined cost, schedule, and performance constraints.“
    - Risk Management Guide for DoD Acquisition (2006)
  - "Risk is the potential for mishaps or other adverse variation in the cost, schedule or performance of a program or its products.“
    - " The Naval SYSCOM Risk Management Policy (2008)
- Common elements of these definitions include
  - Potential future event that if prevented would also prevent a potential consequence from occurring. Any future event will include:
    - A likelihood of occurrence
    - A consequence on a program if it occurs
  - Cost, Schedule and Performance parameters, which allow risks to be considered in relation to their impact on different program areas

Introduction to Risk Management, NAVSEA 05, Nov 30, 2011

Risk Insights

- Elements of the risk should include
  - Definition of the risk event (If it happens, it's a problem)
  - When the risk event occurs
  - The operational consequences of the risk event
  - The corrective action that is planned be taken should the risk event occur at the time specified
  - The cost of the corrective action
- The expected value of the risk is the probability that the risk event occurs multiplied by the cost of the corrective action
  - This is a real cost to the program and should be reflected in the cost estimate
- Much of Preliminary Design is about understanding, mitigating, and reducing risk before they become problems requiring corrective action.

Risk Activity Diagram



NOW

Expected Cost of Risk is
P(x=yes)C(x=yes)

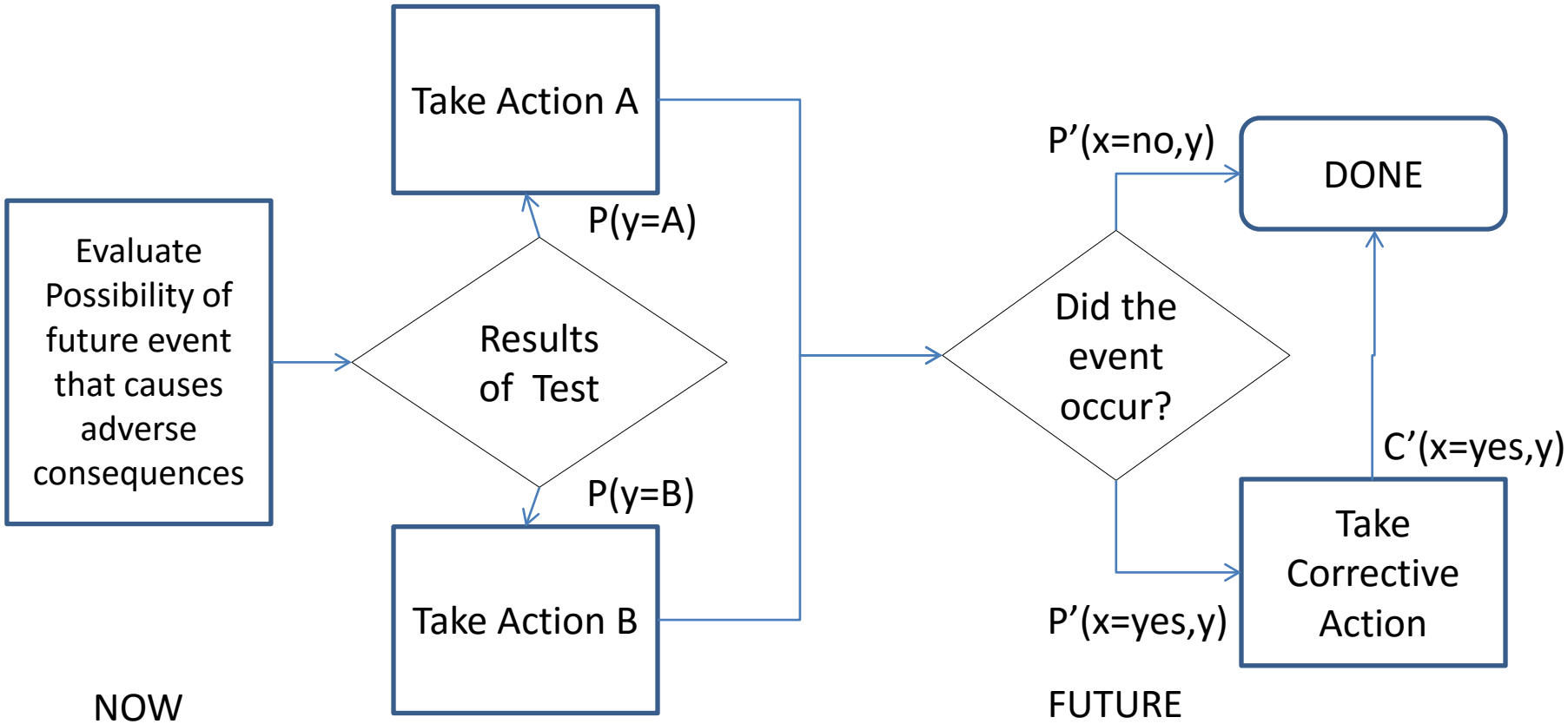
FUTURE

Cost of Risk is
Either $0 or C(x=yes)

Risk Mitigation

- A Risk Mitigation Activity is an investment prior to the "future event" consisting of potentially two parts:
  - A "test" or "analysis" to improve the assessment of the probability of the future event
  - A set of actions to reduce the probability of the future event, or the cost of corrective action in response to the future event, based on the results of the test
    - Each outcome of the test is associated with an action
    - One possible action is the "Null" Action.
- The expected value of the cost of the risk and risk mitigation should be less than the expected value of the cost of the risk if no mitigation is performed.

Risk Mitigation Diagram



NOW

Expected Cost of Risk is

$C(test) + P(y=A)C(y=A) + P(x=yes|y=A)C'(x=yes,y=A)$
$+ P(y=B)C(y=B) + P(x=yes|y=B)C'(x=yes,y=B)$

FUTURE

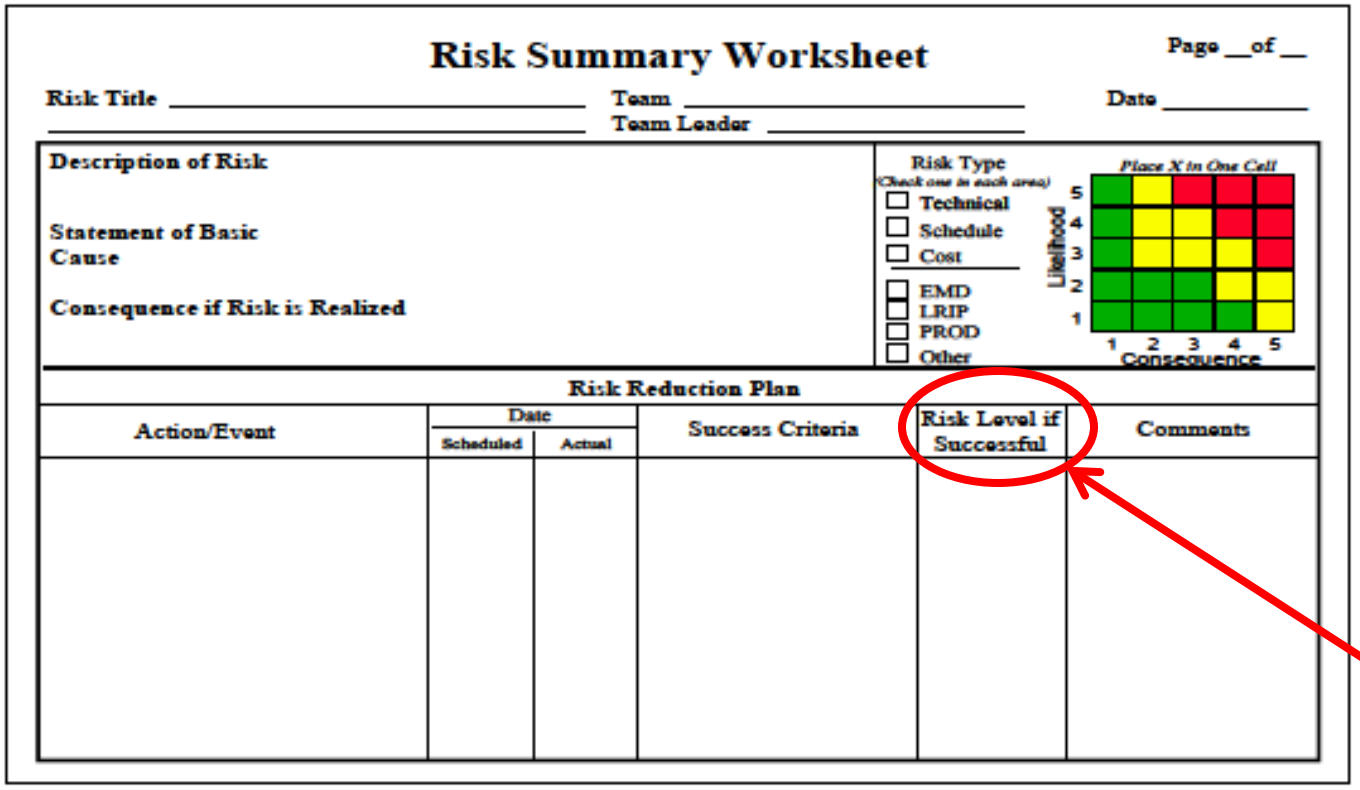
Cost of Risk is

($0 or $C'(x=yes,y)$) + $C(test)$ +
($C(y=A)$ or $C(y=B)$)

Risk Mitigation Insights

- Risk Mitigation consisting of “Test” alone
  - Increases expected value of risk prior to the test by the cost of the test
  - May either increase or decrease expected value of risk after the test
- Risk Mitigation consisting of a Mitigation Action without a test
  - Cost effective if the expected value of the risk decreases when the mitigation action is incorporated into the plan.
  - May want to consider this just “normal planned work” instead of a risk mitigation activity.

Typical Risk Form



Risk Summary Worksheet

Page __of __

Risk Title _____ Team _____ Date _____

Team Leader _____

Description of Risk

Statement of Basic Cause

Consequence if Risk is Realized

Risk Type
(Check one in each area)
- ☐ Technical
- ☐ Schedule
- ☐ Cost
- ☐ EMD
- ☐ LRIP
- ☐ PROD
- ☐ Other

Place X in One Cell

Likelihood 5 4 3 2 1

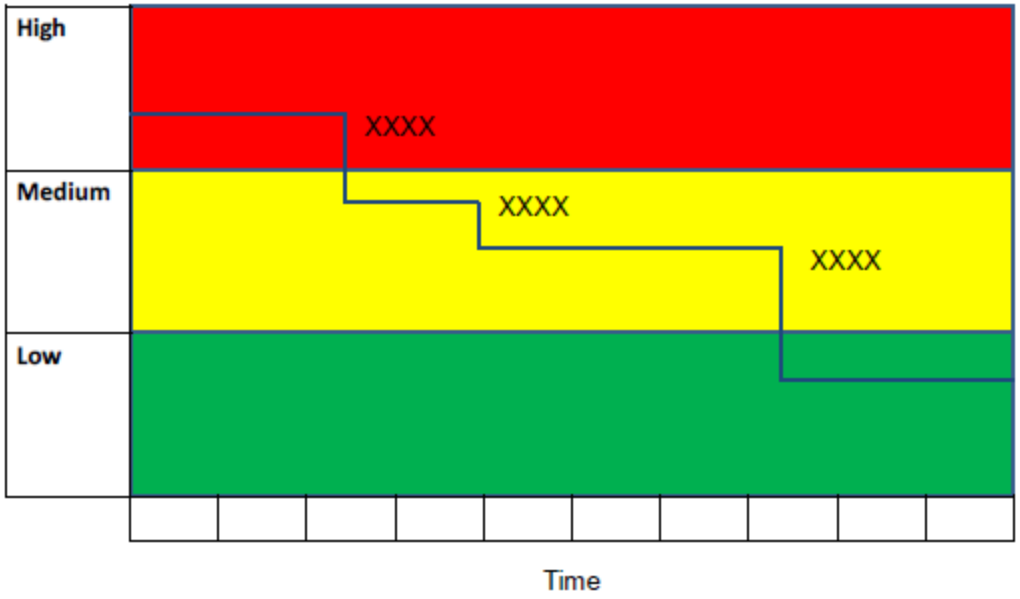
1 2 3 4 5 Consequence

Risk Reduction Plan

Action/Event	Date Scheduled	Date Actual	Success Criteria	Risk Level if Successful	Comments

What if unsuccessful?

Risk Waterfall Chart



- Typically Success Oriented
- Typically does not differentiate between tests and design changes
- Provides no insight on required activities based on results of tests

Opportunities

- Analogous to risks – but with favorable outcomes
- Goal should be to incorporate features now into the design to take advantage in the future of an opportunity if the expected value of the cost of the ship decreases if the feature is incorporated.
  - Use proven solutions as a baseline ….
  - Incorporate options for incorporating developmental solutions should testing prove viability.
- Real options analysis may prove useful.

Design Activities

Preliminary Design Activities

- Establish principal characteristics of the design
- Select major equipment
- Establish Functional Baseline
  - Conduct System Functional Review (SFR)
- Conduct Trade-studies
- Execute Risk Mitigation Plans
- Assess feasibility and performance
- Estimate Cost
- Support CDD development and approval
- Develop and Maintain the Ship System Specification
- Develop Design Certification Matrix
- Develop Preliminary Design Report
- Track design metrics (for example: design margin consumption)

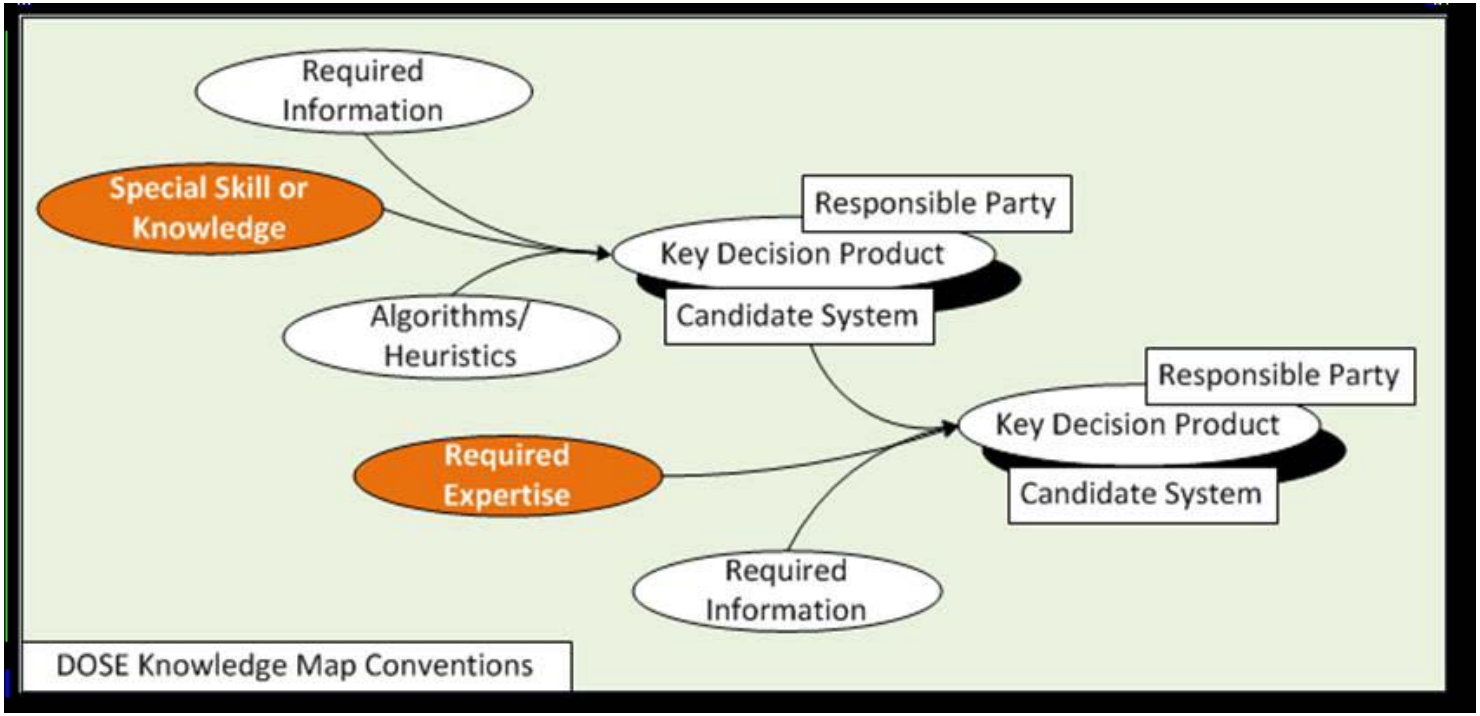
Contract Design Activities

- Develop the Contract Design Package
- Establish the Allocated Baseline
  - Conduct Preliminary Design Review
- Complete Risk Mitigation Activities for risks impacting the Contract Design Package
- Modify the design to deal with problems
- Modify the design to take advantage of opportunities
- Assess Feasibility and Performance

Design Process Considerations

- The specification that everyone likes technically is probably not affordable
  - Need capability to understand impact of relaxing specification requirements
- The order of design decisions is important
  - Need tools to guide the SDM in scheduling studies and making decisions

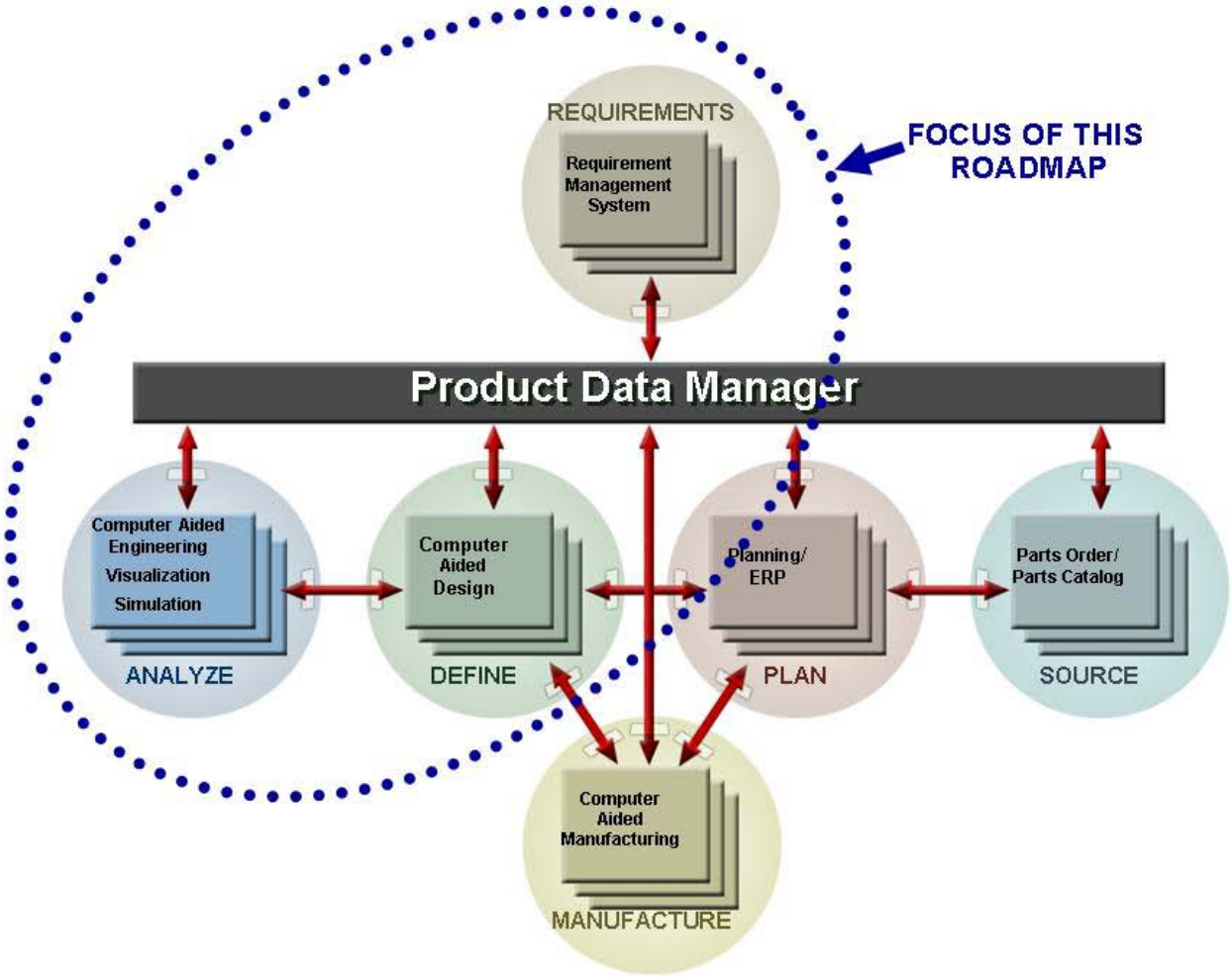
Decision Oriented Systems Engineering



- View design process as an evolution of knowledge punctuated by key decisions
- Define a network of key decisions supported by quality information and human judgment
- Map key decisions and information development to schedule

Design Tools

What do we mean by Design Tools?



What do we need from Design Tools?

- Pre-Milestone A:

  Characterize costs and risks for potential ship requirement sets

- Preliminary and Contract Design:

  System level functional design and total ship integration

PD - CD Tools

- Ultimate output is de-risked design & specifications
- Many people involved (hundreds for complex combatant)
- Many tools, run by many subject matter experts
- Major challenge is integrating efforts from many disciplines into coherent design that affordably meets requirements at acceptable risk level
- Some PD-CD tool examples:
  - Integrated Hydrodynamic Design Environment (IHDE)
  - Navy Enhanced Sierra Mechanics (NESM) – Shock/Damage
  - Finite Element Modeling (Structures)
  - Various topside electromagnetic integration tools

PD – CD Tool Challenges

- Enabling set-based design approach
  - Give individual system experts maximum flexibility to design for affordability without premature constraints
  - Delay overall ship configuration decisions until integrator understands impacts to all systems
- Validated data to support tools
  - Component libraries
  - Component models
  - Reliability and Maintainability data
  - Workload requirements
- Design practices and criteria for new technology
  - Ship systems
  - Design and analysis methods
  - Design methods
- Workforce experience
  - How does one get 10,000 hours of relevant experience?

Conclusion

- The ultimate product of PD-CD is a contract design package
- Other products needed to support acquisition
- Should concentrate on Risk Management and generating quality information / knowledge to inform design decisions

References

- S9800-AC-MAN-010 Ship Design Manager (SDM) and Systems Integration Manager (SIM) Manual
- MIL-HDBK-245 Handbook for Preparation of Statement of Work
- MIL-STD-961 Defense and Program-Unique Specifications Format and Content

Backup

Typical Design Phase Deliverables

	Exploratory Design and Force Architecture	Pre-AoA	AoA	Pre-Preliminary	Preliminary (Functional Baseline)	Contract (Allocated Baseline)	Detail (Product Baseline)
General Management	Study Guide, Annual Report, Design Phase Report including Design History, Draft Next Phase EMP	Design Phase EMP, Study Guide(s), Schedule, Budget, Annual Execution Agreement, Annual Report, Design Phase Report including Design History, Draft Next Phase EMP	Design Phase EMP, Study Guide(s), Schedule, Budget, Annual Execution Agreement, Annual Report, Design Phase Report including Design History, Draft Next Phase EMP	Design Phase EMP, Study Guide(s), Schedule, Budget, Annual Execution Agreement, Annual Report, Design Phase Report including Design History, Draft Next Phase EMP	Design Phase EMP, Study Guide(s), Schedule, Budget, Annual Execution Agreement, Annual Report, Design Phase Report including Design History, Draft Next Phase EMP	Design Phase EMP, Study Guide(s), Schedule, Budget, Annual Execution Agreement, Annual Report, Design Phase Report including Design History, Draft Next Phase EMP	Design Phase EMP, Study Guide(s), Schedule, Budget, Annual Execution Agreement, Annual Report, Design Phase Report including Design History, Draft Next Phase EMP, Shipbuilder SEMP, Shipbuilder Drawing Schedule, Ship Drawing Index, Shipbuilder Progress Reports, Monitoring of Shipbuilder Progress
Design Tools	Inputs to EMP on planned use of design tools	Inputs to EMP on planned use of design tools	Inputs to EMP and SEP on planned use of design tools	Inputs to EMP and SEP on planned use of design tools	Inputs to EMP and SEP on planned use of design tools	Inputs to EMP and SEP on planned use of design tools	Inputs to EMP and SEP on planned use of design tools
Modeling and Simulation	Inputs to EMP on planned use of Modeling and Simulation; development of Modeling and Simulation planning documentation including VV&A as needed	Inputs to EMP, on planned use of Modeling and Simulation; development of Modeling and Simulation planning documentation including VV&A as needed	Inputs to EMP, SEP and Test Planning on planned use of Modeling and Simulation; development of Modeling and Simulation planning documentation including VV&A as needed	Inputs to EMP, SEP, and Test Planning on planned use of Modeling and Simulation; development of Modeling and Simulation planning documentation including VV&A as needed	Inputs to EMP, SEP, and Test Planning on planned use of Modeling and Simulation; development of Modeling and Simulation planning documentation including VV&A as needed	Inputs to EMP, SEP, and Test Planning on planned use of Modeling and Simulation; development of Modeling and Simulation planning documentation including VV&A as needed	Inputs to EMP, SEP, and Test Planning on planned use of Modeling and Simulation; development of Modeling and Simulation planning documentation including VV&A as needed

Typical Design Phase Deliverables (cont)

	Exploratory Design and Force Architecture	Pre-AoA	AoA	Pre-Preliminary	Preliminary (Functional Baseline)	Contract (Allocated Baseline)	Detail (Product Baseline)
Risk Management	Risk identification, assessment, mitigation planning as required to support design	Risk identification, assessment, mitigation planning as required to support design	Risk identification, assessment, mitigation planning as required to support design; Start to develop, Risk Management Plan and Risk Register.	Execute Risk Management Plan. Maintain Risk Register.	Execute Risk Management Plan. Maintain Risk Register.	Execute Risk Management Plan. Maintain Risk Register.	Execute Risk Management Plan. Maintain Risk Register. Monitor Shipbuilder Risk Management Program.
Technology Assessment and Development	Technology assessment and planning as required to support design	Technology assessment as required to support design, Gate 1 and AoA planning	Technology assessment as required to support design, AoA and Gate 2	Technology assessment and development as required to support design and Gates	Technology assessment and development as required to support design and Gates	Technology assessment and development as required to support design, Gates and Milestone B	Technology assessment and development as required to support design and Gates
Manufacturing Readiness Assessment	Manufacturing readiness assessment and planning as required to support design	Manufacturing readiness assessment as required to support design, Gate 1 and AoA planning	Manufacturing readiness assessment as required to support design, AoA and Gate 2	Manufacturing readiness assessment and development as required to support Gates and design	Manufacturing readiness assessment and development as required to support Gates and design	Manufacturing readiness assessment and development as required to support design, Gates and Milestone B	Manufacturing readiness assessment and development as required to support design and Gates
Mission Scenarios, Threat Sets, CONOPS and Design Reference Mission		Develop mission scenarios, Threat Sets, CONOPS and Design Reference Mission	Updates as required	Updates as required			
Regulatory Body Compliance	Define initial approach and document in EMP	Define initial approach and document in EMP	Define initial approach and document in EMP and SEP	- Ship Specification inputs as required - ABS (for T-ships as applicable) and other reviews of the Design	- Ship Specification inputs as required - ABS (for T-ships as applicable) and other reviews of the Design	- Ship Specification inputs as required - ABS (for T-ships as applicable) and other reviews of the Design	ABS (for T-ships as applicable) and other regulatory reviews of the Design and Inspections

Typical Design Phase Deliverables (cont)

	Exploratory Design and Force Architecture	Pre-AoA	AoA	Pre-Preliminary	Preliminary (Functional Baseline)	Contract (Allocated Baseline)	Detail (Product Baseline)
Cost Forms and Cost Estimate	Cost Forms to support SEA 05C ROM level cost estimates	Cost Forms to support SEA 05C ROM level cost estimates	Cost Forms to support SEA 05C ROM level cost estimates	Cost Forms to support SEA 05C budget level cost estimates	Cost Forms to support SEA 05C budget level cost estimates	Cost Forms to support SEA 05C budget level cost estimates	- Cost Forms to support SEA 05C budget level cost estimates - Shipbuilder cost reporting
SDS				Develop plan for Gate 3 and complete following CDD approval for Gate 4	Complete following CDD approval for Gate 4		
Ship Specification				- Specification Management Plan - May start and even complete and approve Specification depending on Acquisition Strategy	May start and even complete and approve Specification depending on Acquisition Strategy	Complete and approve Specification	- Possible change from approved System Specification to an approved Shipbuilding Specification - Engineering Change Proposals - Waivers and Deviations
Data Requirements				DRL inputs as required for contracting	DRL inputs as required for contracting	DRL inputs as required for contracting	Review of DRL deliverables
Ship Product Model (SPM)	Define initial approach and document in EMP	Define initial approach and document in EMP	Define initial approach and document in EMP and SEP	- Initial SPM and SPM development plan	Update	Update	Shipbuilder SPM

Prepare for Detail Design and Construction

Enable successful Detail Design & Construction

- Ensure scope of work is clearly understood by Government (SUPSHIP et al.) and Shipbuilder
- For areas with significant remaining risk, have a fallback plan
  - Ensure the fallback plan is implementable in an affordable way
  - Ensure funds available to cover risks
- Understand impact of Contract Type: (Cost vs Fixed Price)
- Understand the impact of incentives
- Avoid causes for future claims

Cost vs Fixed Price

- Fixed Price contracts
  - Provide acceptable deliverables in accordance with the contract
  - Fee can be fixed or incentivized
- Cost type contract
  - Make a good faith effort to meet the Government's needs within the estimated costs in the Contract.
  - Fee can be fixed or incentivized

Major Causes for Claims

- Bidding too low – Loss of fee
- Faulty or inadequate design
- Construction problems
- Delay and Disruption
- Problems with Subcontractors
- Weather
- Strikes
- Schedule Slippage
- Late / Faulty GFE / GFI
- Combat Systems Integration Problems
- Software Problems
- Accidents (Fire / Flooding)
- Testing Problems / Delays

RADM William C. Wyatt, USN (RET)
Shipbuilding Contracts – Changes, Claims, and Claims Avoidance
24 April 2008

Avoiding Claims

- Limit changes after award
- No constructive Changes
- Timely Gov GFE / GFI
- Accurate warranted drawings & data
- Timely and fair progress system and payments
- Timely adjudication of changes (no backlogs)
- Deal with delay and disruption even if it can not be accurately measured

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Avoiding Claims continued...

- Demand only what contract calls for
- Do not "go around" prime contractor to his subs
- Insure equity exists in all contractor dealings
- Contractor deserves a fair profit for performance
- Keep arms length relationships with contractors (standard of conduct)

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