MSIAC
Munitions Safety Information Analysis Center

Supporting Munitions Safety

Munitions Safety in Operations and Design: Git ‘er Done

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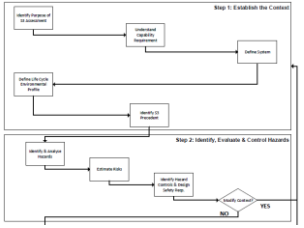
Outline

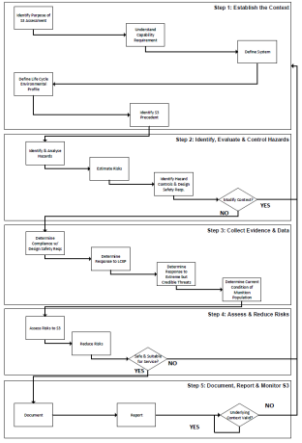
- AOP 15 & Design Safety Requirements
- Holistic Relationship between Performance, Service Life / Longevity, and Safety
- Vocabulary
- Design Process
- Codes, Standards, and Specifications
- Key Points

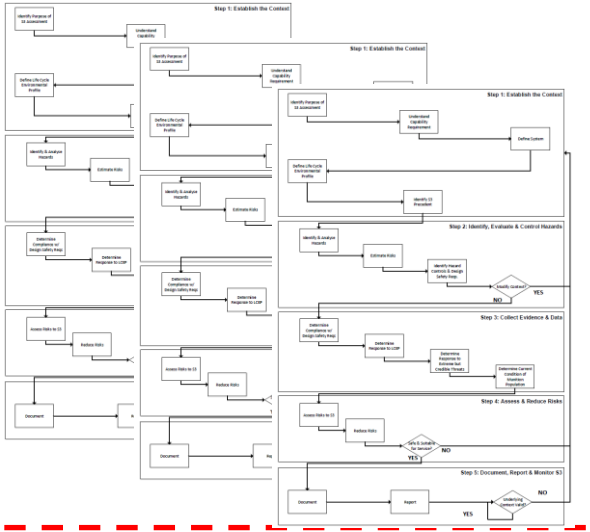
AOP-15 & Design Safety Requirements

- S3 assessment is an iterative process, which may inform design activities during concept / development phases of the life cycle

Pre Concept → Concept → Development → Production → Utilisation / Support → Retirement







Hazard identification, analysis & risk estimation may identify **controls which must be implemented within the design.**

How do we Reduce Risks?

- Dependent on the phase of the life cycle

Significant scope to influence design (or select pre-existing design solution)

Development:

- Inform design changes
- Modify capability requirement / MTDS / LCEP

Prior to Introduction to Service:

- PPE / admin. controls
- Define lifing / surveillance strategy

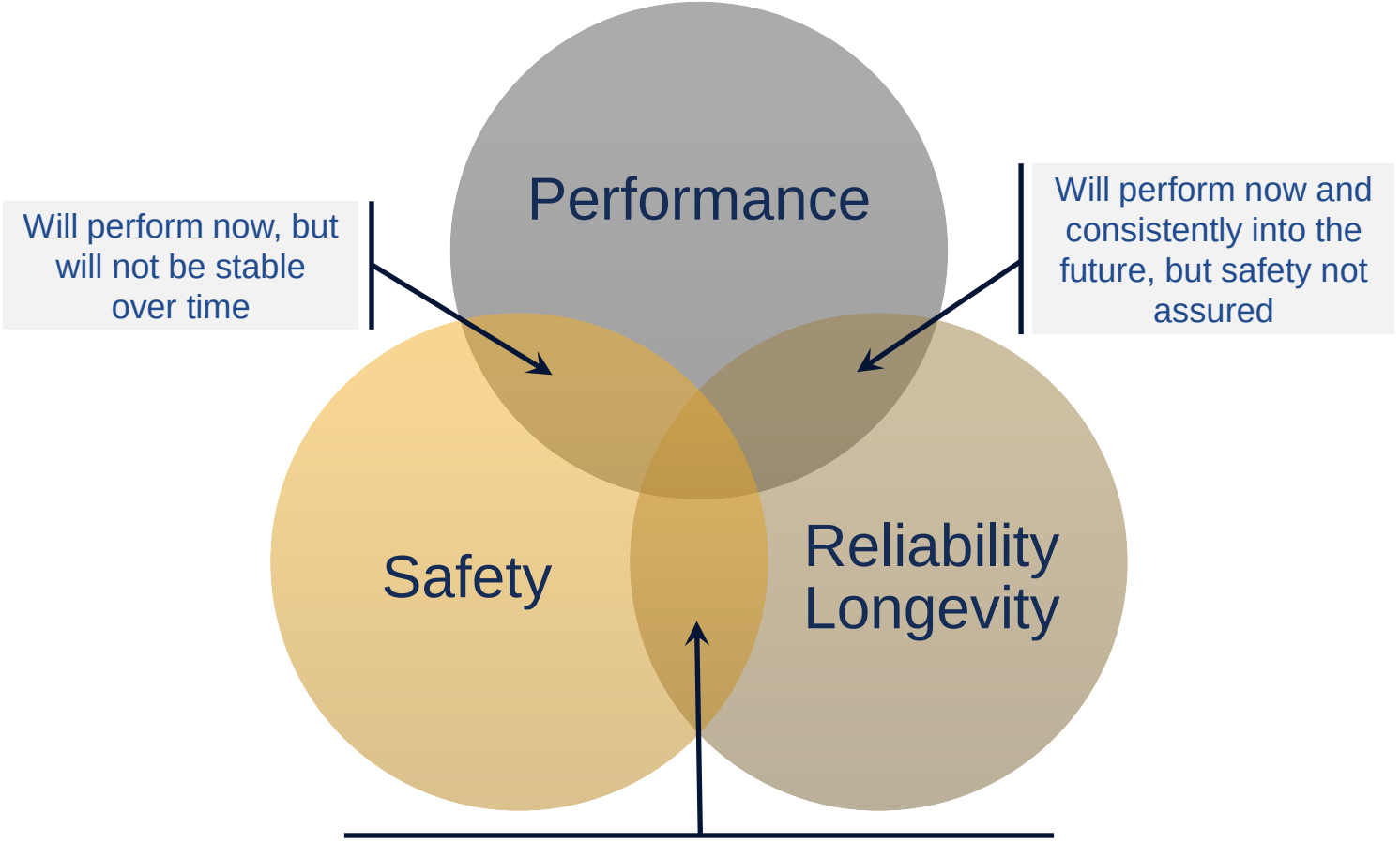
Introduce exposure or age limitations based on continued monitoring of condition of munition stockpile

How do we Reduce Risks?

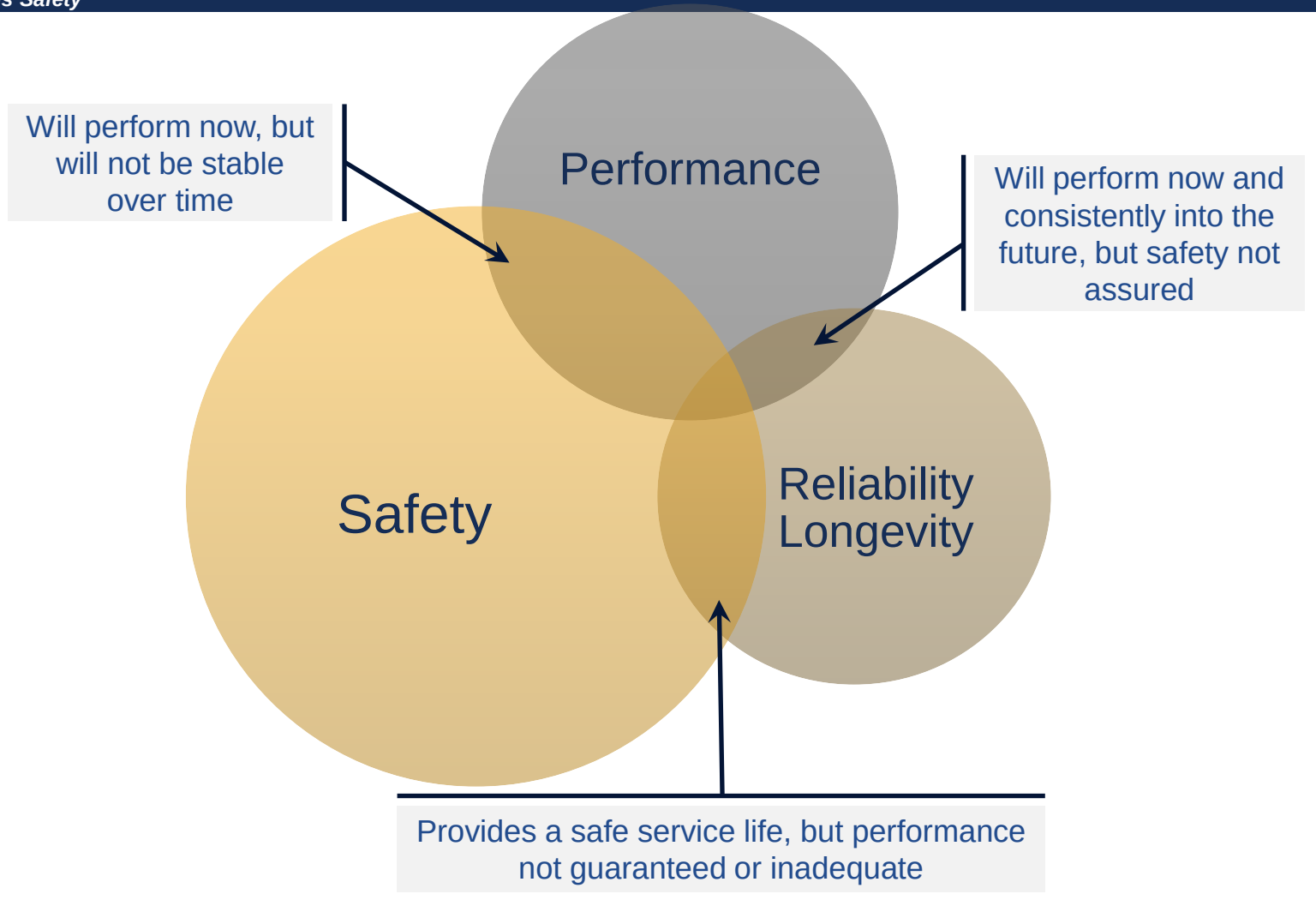
- Propagation of decisions during life

- Notification of Risk
  - What has changed and how does it affect safety in operations, lifing, logistics, disposal?
- Nature of the Consequences
  - What has changed and how does it affect possible outcomes?

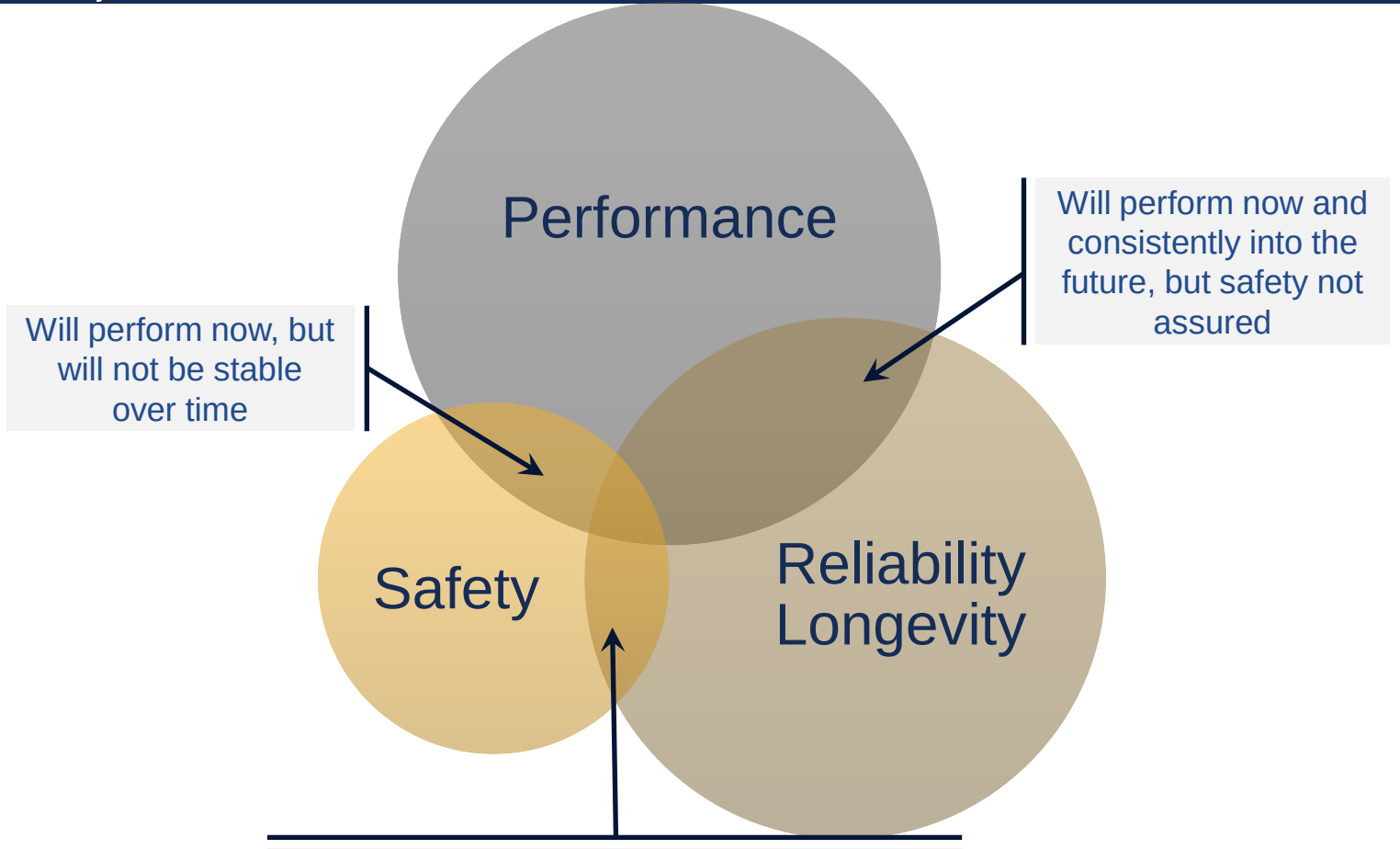
A Holistic Relationship



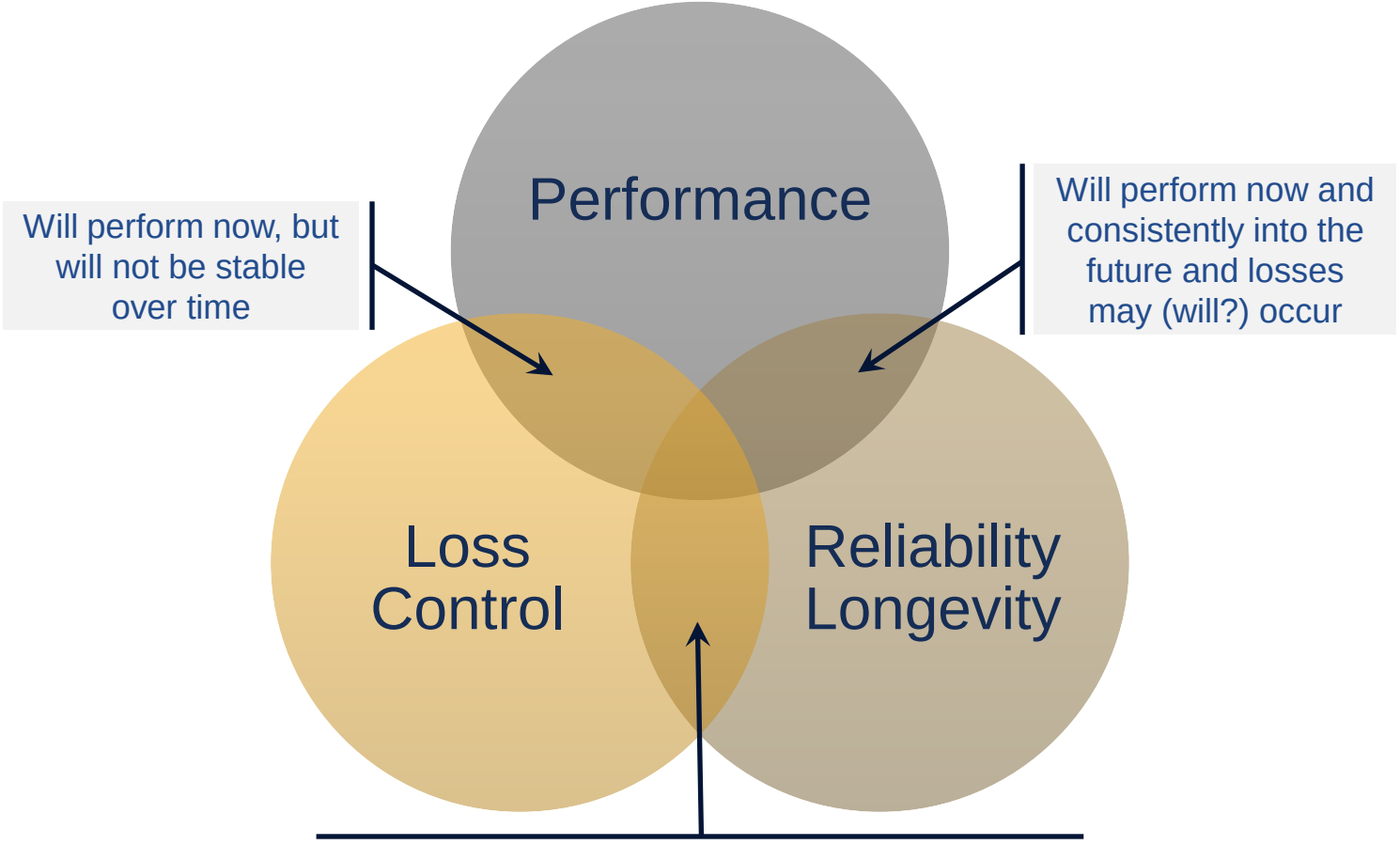
A Holistic Relationship: Procurement



A Holistic Relationship: User



A Working Relationship for Everyone



Performance & Safety

- Performance is inherently limited when potential losses* are considered
- Acceptable losses are bounded by:
  - Laws, codes of practice
  - Accepted levels of risk as embodied in contracts or standards
- Losses are a risk

  → A robust risk assessment / acceptance framework!

  BUT
- For munitions, need an appreciation of the design framework

*Losses in the context of loss control

Vocabulary

- Terms: design, design (safety) assessment, design (safety) requirements, design build standard ..
- How do these terms fit into the design process?
- What is design?

"A process to translate a military requirement into detailed information from which industry can manufacture and provide the item."

– *Adapted by K.M. Jaansalu from M. F. Ashby, "Materials Selection in Mechanical Design", pg. 1*

Aspects of Design

"Design establishes and defines solutions to and pertinent structures for problems not solved before, or new solutions to problems that have been solved in a different way."

– *G.E. Dieter "Engineering Design", pg. 1*

- The Four C's of Design:
  - Creativity – analyze and synthesize something that did not previously exist
  - Complexity – decisions on many variables and parameters
  - Choice – between many possible solutions at all levels, basic concepts to smallest details
  - Compromise – balancing multiple and conflicting requirements

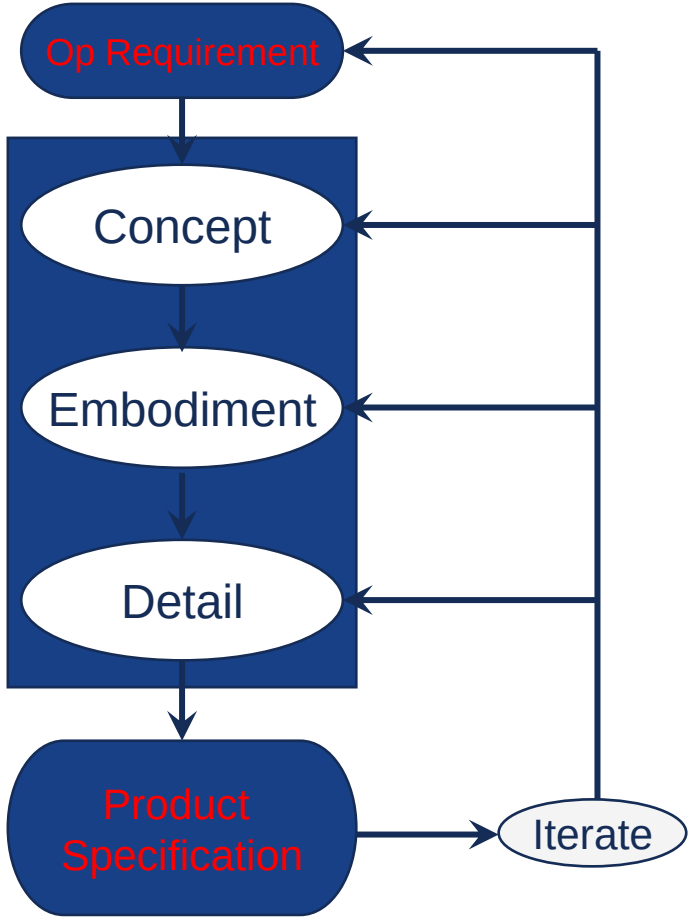
The Key for Industry

"..the real key to world-competitive products lies in high quality product design. .. What was once a fairly cut-and-dried engineering process has become one of the **cutting edges of engineering progress**." *- G.E Dieter, p 4, emphasis added.*

- Great example:

Design Process

- First, translate the requirements into:
  - Function - what does the component / item / system do?
  - Objective(s) – what aspect of performance is to be maximized or minimized?
  - Constraints – what essential conditions must be met? i.e. boundaries / limitations on how the design is realised, cost, IM
  - Free variables – what is allowed to be changed by the designer?
- There is no unique solution
- NATO AC/326 creates and promulgates standards that can be **constraints** for the design



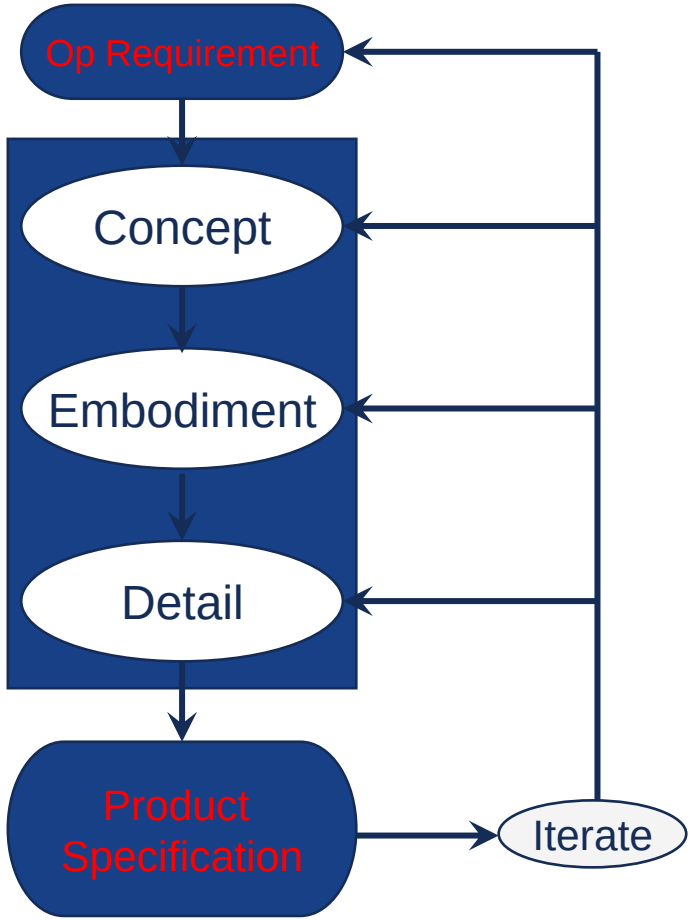
Adapted from Ashby, p 11.

Design Process

- Across this process are planning for:
  - Manufacturing
  - Distribution
  - Use (Human Factors)
  - Retirement & Disposal

- There are various standards associated with these activities which can be constraints

- NB - These three stages may be expanded for higher detail / additional activities



Discussion on Constraints

- Ashby makes a distinction between hard and soft constraints
  - Hard → legally binding or otherwise enforceable
  - Soft → negotiable, a trade-off with risk
- Negotiating soft constraints require risk identification, risk mitigation, and risk acceptance
- Who has the authority to accept any trade-offs of constraints with risk in design?
  - This is a normal part of the design process!
- In combat, all constraints MAY become negotiable, depending on circumstance and need
  - But laws relating to armed combat still apply

Codes, Standards, Specifications

- Codes are legislated documents to protect public and property and are enforced
  - communicates what to do, how to do it
  - For example: electrical code, building code, fire code
- Standards are an agreed upon set of procedures, criteria, dimensions, parts
  - address a general situation, not enforceable by themselves, usually embodied in another document such as contracts or codes
- Specifications – address a specific situation / material
  - F-34, RDX, NC,..

Codes, Standards, Specifications

- Use in design promotes:
  - Best practices, ensuring efficiency and safety
  - Compatibility and interchangeability
- Essentially, three general categories for standards
  - Performance – related to functioning, eg arming delay, plate penetration
  - Codes of practice – methods or analyses for repetitive design problems or characteristics of the solution, e.g. fuze design
  - Test methods – how performance is to be assessed, or a property is to be measured
- These categories are not mutually independent

Codes, Standards, Specifications

- Long established standards succeed in reducing risk
- Codes and standards reflect both a broad and deep understanding of the issues
- Current solutions become hard to displace
  - Standards can inhibit advancement!
  - Testing for qualification
  - Standard / specification applied to a different situation (code of practice challenges)
- Disruptive technology – e.g. loitering munitions
  - A re-visioning of standards considering intent and applicability
  - Asking the question “what is this (most) like”

Summarizing the Key Points

- Perspective is important
- Vocabulary is important
  - Performance, capability, function, objective, constraint
  - Respect the balance between performance and safety
- What is the objective in design?
- Constraints are embodied in standards, reflecting:
  - Performance characteristics, eg reliability
  - Codes of practice - common and accepted methods
  - Test methods to prove compliance

Questions?

(Technical information has been drawn from M.F. Ashby, Materials Selection in Mechanical Design, and G.E. Dieter, Engineering Design.)