How Cost Arises – How We Can Reduce Cost

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Introduction

- This paper is heavily based upon the content of the NASA Design For Competitive Advantage web site that I authored from 1994-1998
  - Substantially republished at http://valuemanagement.us/dfcaadmin/dfca/

- This presentation will
  - illustrate how cost arises
  - suggest various means of reducing cost
  - provide resources for those who desire to further this research

What Creates Cost?

- The typical accounting cost measures are
  - Labor
  - Material
- But
  - Labor
  - Material
    - Labor
    - Material
      - Labor
      - Material
        - » ...
  - Until we reach
    - Labor
    - Land rights
- Cost is almost totally created by people doing something

Perspective

- Cost arises from doing something
  - It is a fundamental measure of the effort expended to do something
  - The cost is determined by
    - The complexity of doing something
    - The way we do something
    - How many times we do something that way
  - To reduce the cost of something we must change the way we do something

Terminology

- Work breakdown structure
  - A tree of items to be purchased
- Function
  - What a system must do in the form [verb, noun]
- Activity
  - The effort required for a system to do what it must do in the form (verbphrase, nounphrase)
- Process
  - A network of activities that does something (verbphrase, nounphrase)
- Architecture
  - What physically does what a system must do

How Cost Arises

- (genopersist, system)
  - (conceptualize, system)
  - (evaluate, system)
  - (design, system)
  - (prototype, system)
  - (test, system)
  - (produce, system)
  - (deploy, system)
  - (operate, system)
  - (support, system)
  - (evolve, system)
  - (dispose, system)
  - (manage, system)
- (design, (genopersist, system))
  - (design, (conceptualize, system))
  - (design, (evaluate, system))
  - (design, (design, system))
  - (design, (prototype, system))
  - (design, (test, system))
  - (design, (produce, system))
  - (design, (deploy, system))
  - (design, (operate, system))
  - (design, (support, system))
  - (design, (evolve, system))
  - (design, (dispose, system))
  - (design, (manage, system))

•Cost arises from the genopersistation of the system

✓Forget management reviews – think sand chart (continuous cost flows)

•The way the project organization defines how it will genopersist the system is a substantial cost driver – design for X

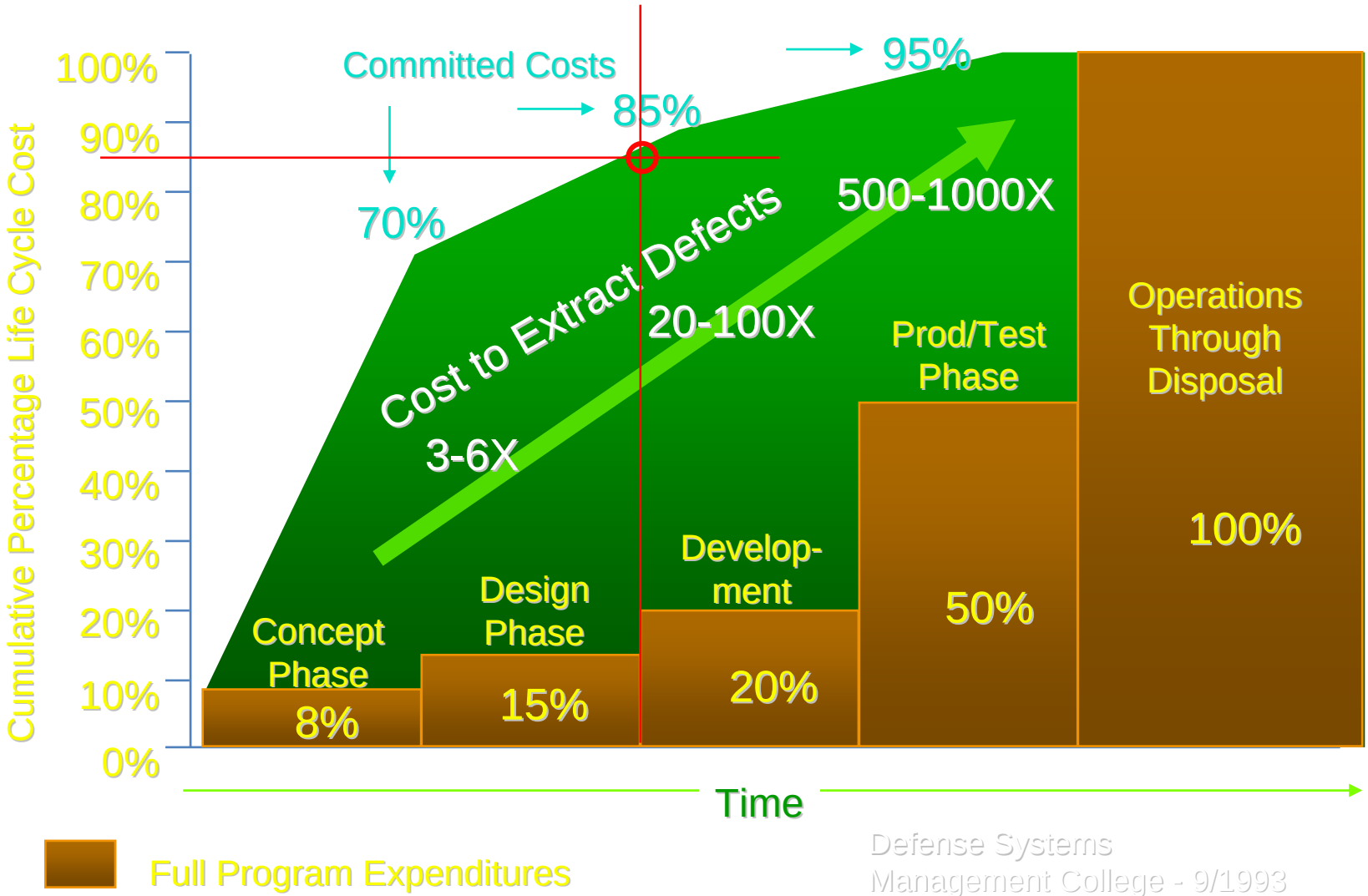
•The work breakdown structure

✓Is an after-the-genopersistation accounting view of purchasing an item

✓Has no relation to how cost arises

How Many Times We Do Something

- One definition of quality is that the entity does what is supposed to do the first time and every time thereafter
- If that is not the case, effort must be expended to approach quality as defined above
- Failures during the genopersistation process create rework
- The lowest cost case is when the genopersistation process is perfect, no rework is required, and cost is substantially reduced - but people are not perfect
- In my 65 or so cost estimates for NASA, the system that was delivered was not the system I estimated – change is the norm and each change requires rework



By the time system level design is complete, 85% of the costs have been committed and the cost to extract defects goes up exponentially

Systems Involved With the System

- The system [the entity]
- The system to bring forth, operate, sustain, and dispose of the entity
  - The developing organization
  - The operations organization
  - The sustainment organization, and
  - The disposal organization
- The system to bring forth, operate, sustain, and dispose of the system to bring forth, sustain, and dispose of the entity
  - the organizations that define how the system will be developed, operated, sustained, and disposed of

Systems Involved With the System

- The system [the entity]
  - It is here that we account for the cost to purchase the entity and its subsystems in the form of the work breakdown structure
- The system to bring forth, operate, sustain, and dispose of the entity
  - It is here that cost arises from the activities to bring forth, operate, sustain, and dispose of the entity
  - It is here that activity based costing accounts the cost in the manner in which the cost arises
- The system to bring forth, operate, sustain and dispose of the system to bring forth, operate, sustain and dispose of the entity
  - It is here that the doing of the bringing forth, operating, sustaining, and disposing of the entity is defined
  - It is here that the level of the cost to bring forth, operate, sustain, and dispose of the entity is defined

The Complexity of Doing Something

- Complexity is a measure of how difficult it is to do something
- The complexity depends on
  - What the something must do
  - How the something does what the something must do
  - The architecture of the something
  - The technology of the something
- The complexity of the system to develop, operate, sustain, and dispose of the entity drives cost as much or more than the complexity of the entity

The Way We Do Something

- The way something is done applies to
  - The system [the entity]
  - The system to bring forth, deploy, operate, sustain, and dispose of the entity {the project}
  - The system to bring forth, deploy, operate, sustain, and dispose of the system to bring forth, deploy, operate, sustain, and dispose of the entity {the contractor}
  - The system to bring forth, deploy, operate, sustain, and dispose of the system to bring forth, deploy, operate, sustain, and dispose of the system to bring forth, deploy, operate, sustain, and dispose of the entity {the contractee}

Conceptualize System

- Who are the
  - Customers
  - Stakeholders
- What do they desire
  - Quality Characteristics {Quality Function Deployment {QFD}}
- What must the system do to fill the desires
  - Functions [verb,noun] {System Engineering, Value Engineering, Extended QFD}
- How will we know if the system fills the desires
  - Requirements [verb,noun,measure] {Systems Engineering, Value Engineering}
- How will we group the things the system will do
  - Functional Architecture {Systems Engineering, Value Engineering, Extended QFD}
- What will the physical implementation be
  - Physical Architecture {Systems Engineering, Value Engineering}
- Potential parameters for estimating cost(conceptualize, system)
  - Complexity
    - Number of customers
    - Number of stakeholders
    - Number of functions
    - Number of requirements
  - Difficulty
    - Technology readiness level
  - Size
    - Physical size

The Genopersistation of Conceptualize System

- (Genopersist, (Conceptualize, System))
  - (Conceptualize, (Conceptualize, System))
  - (Evaluate, (Conceptualize, System))
  - (Market, (Conceptualize, System))
  - (Design, (Conceptualize, System))
  - (Prototype, (Conceptualize, System))
  - (Test, (Conceptualize, System))
  - (Produce, (Conceptualize, System))
  - (Deploy, (Conceptualize, System))
  - (Operate, (Conceptualize, System))
  - (Support, (Conceptualize, System))
  - (Evolve, (Conceptualize, System))
  - (Dispose, (Conceptualize, System))
  - (Manage, (Conceptualize, System))

The Cost Estimating Communities View of Managing The Cost of a System

- Cost as An Independent Variable
  - A vague mathematical perspective with no perception of how that can be done
- Design to Cost
  - A vague perspective that somehow the design process can be used to reduce cost
- Design for Cost
  - A perspective that the author provided in various papers and the NASA Design for Competitive Advantage web site
  - Methods of reducing cost have been provided

Design For X

- Design for
  - (Conceptualize, System) Conceptualizeability
  - (Evaluate, System) Evaluability
  - (Market, System) Marketability
  - (Design, System) Designability
  - (Prototype, System) Prototypeability
  - (Test, System) Testability
  - (Produce, System) Produceability, Manufacture
  - (Deploy, System) Deployability
  - (Operate, System) Operability
  - (Support, System) Supportability
  - (Evolve, System) Evolveability
  - (Retire, System) Retireability
  - (Manage, System) Manageability
  - System Cost Engineering Affordability, Target Costing, Value
  - Initial Operating Capability Scheduling

Value Engineering Process

- Gather information
  - Who is doing it?
  - What could it do?
  - What must it not do?
- Measure
  - What are the alternate ways of meeting requirements?
  - What else can perform the desired function?
- Analyze
  - What must be done?
  - What does it cost?
- Generate
  - What else will do the job?
- Evaluate
  - Which Ideas are the best?
- Develop and expand ideas
  - What are the impacts?
  - What is the cost?
  - What is the performance?
- Present ideas
  - Sell alternatives

Quality Engineering

- Something has good quality if it does what it is supposed to do the first time and every time thereafter
- Quality engineering is the process of ensuring that an object has good quality
- The cost of unquality arises because an object does not have good quality
- An example of the cost of unquality
  - The shuttle has a structural flaw that requires it to slow down during launch as it passes max G
  - This flaw is very sensitive to payload location within the bay
  - Each time a payload is changed for a flight, many reevaluations occur to ensure safety
  - Each payload change creates additional operations cost

Six Sigma and Lean

- Six Sigma
  - is a business management strategy
  - seeks to improve the quality of process outputs by identifying and removing the causes of defects (errors) and minimizing variability in manufacturing and business processes
  - was heavily inspired by six preceding decades of quality improvement methodologies such as quality control, TQM, and Zero Defects, based on the work of pioneers such as Shewhart, Deming, Juran, Ishikawa, Mijuno, Taguchi and others
- Lean
  - Is a production practice that considers the expenditure of resources for any goal other than the creation of value for the end customer to be wasteful, and thus a target for elimination
  - Was derived from the Toyota Production System
  - Is centered on preserving value with less work
  - Advocates
    - increasing efficiency
    - decreasing waste
    - using empirical methods to decide what matters, rather than uncritically accepting pre-existing ideas
  - Is being extended to many forms of human endeavor
- Lean Six Sigma
  - The simultaneous use of lean and six sigma technologies

Target Costing

- Target costing is a business system used by firms
- It is defined as a cost management tool for reducing the overall cost of a product over its entire life-cycle with the help of production, engineering, research and design
- The target cost is the maximum amount of cost that can be incurred on a product and with it the firm can still earn the required profit margin from that product at a particular selling price
- It involves setting a target cost by subtracting a desired profit margin from a competitive market price
- It has four basic steps
  - Define the product
  - Set the price and cost targets
  - ***Achieve the cost targets***
  - Maintain competitive costs
- It uses tools such as quality function deployment, value engineering, quality engineering, and lean to achieve target costs

Who Should be Responsible for System Cost?

- Accountant – yes!
  - Establish and provide a ***parametric process based cost data base***
- Engineer – yes!
  - Design subsystems ***for*** cost
- Project manager – yes!
  - Manage cost
- Systems engineer – yes!
  - Design the system ***for*** cost
  - Oversee and report cost
- ***Parametric*** cost analyst – yes!
  - Provide cost guidance
- Project designer – **yesssssss!**
  - Design the genopersistation of the system ***for*** cost – design ***for*** X

Recommended Resources

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