Cost Concepts for Accounting Analysis

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I NEED A DESCRIPTION OF YOUR PROJECT AND ITS PROJECTED COST.
THAT'S IMPOSSIBLE.
www.dilbert.com scottadams@aol.com
THE PROJECT UNCERTAINTY PRINCIPLE SAYS THAT IF YOU UNDERSTAND A PROJECT, YOU WON'T KNOW ITS COST, AND VICE VERSA.
8/4/03 © 2003 United Feature Syndicate, Inc.
YOU JUST MADE THAT UP.
THAT DOESN'T MAKE IT WRONG.

Who are we?

Defense Resources Management Institute (DRMI)

- Sponsored by Secretary of Defense
  - Department of Defense (DoD) Instruction 5010.35
- Established in 1965 at the Naval Postgraduate School (NPS)
  - Dr. Charles Hitch, OSD comptroller under SecDef McNamara, used NPS faculty to teach analytical and business approaches to make the best use of defense resources

Course Goals

- To develop a broad-based analytical framework for defense decision makers
  - emphasizing the economic and efficient allocation of scarce defense resources to competing mission areas.
- To provide an environment for the comparative exchange of ideas related to the management of national security

What do we teach?

Resident Courses:

- **General**
  - International Defense Management Course (IDMC)—10 weeks; 2 per year
  - **Defense Resources Management Course (DRMC)—4 weeks; 4 per year**
  - Senior International Defense Management Course (SIDMC)—4 weeks; once per year
- **Specific**
  - Multi-Criteria Decision Making—2 weeks
  - Introduction to Budget Concepts—8 days
  - Risk Management—2 weeks
  - Performance Management & Budgeting—1 week
  - Human Capital RM—2 weeks

Non-Resident Events:

- Mobile Courses—1-2 weeks
- Workshops—3-5 days
- Seminars—3-5 days

- Tailored to country's specific needs
- Conducted in appropriate language
- Opportunity to quickly build a large cohort

More information

- **Target audience**:
  - Military E-7 and above; 0-3 and above
  - Civilian GS-9 and above
- **NO** tuition charged for DoD military and civilians
- Sending agency responsible for travel and per diem **(Army Centrally Funded FY19)**
- **Website: http://my.nps.edu/web/drmi**

Cost Questions

- Cost concepts are integral to resource management and decision making because they provide the information and ***basis for making those decisions***


FLAMMABLE
0
NO SMOKING

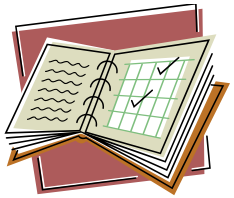
Learning Objectives

- Identify different types of costs and their relevance
- Understand Cost Analysis
  - Calculate life-cycle cost
  - Understand net present value and its use in defense cost analysis
- Time Value of money
- Cost Accounting
- Cost Estimating techniques

Key Decision Criteria

Will it do the job?

When can we get it?



How much will it cost?

What can go wrong?

What is Cost?

- The real physical resources consumed
- The money equivalent of the real physical resources used.
- The value of benefits foregone in the alternative use of resources.

Cost is a measure of the *consequences* of a decision

Cost Questions

- What would it cost if…? (P)
- What will it cost and when? (P)
- How much is it actually costing? (BE)
- How much did it cost? (E)

Why Analyze Costs?

- To compare alternatives
- To prepare budget
- To achieve economy and efficiency

A Variety of Costs…

- Relevant costs and irrelevant costs
- Past costs and future costs
- Fixed costs and variable costs
- Recurring costs and non-recurring costs
- External costs and internal costs
- Opportunity cost

Relevant vs. Irrelevant

- Relevant costs—Costs that are contingent upon a specific choice or decision under consideration.
- Irrelevant costs—Any cost that will be incurred regardless of the decision at hand.

Holiday trip example

A friend with a large SUV invites you and three other friends on a holiday trip so all five of you can share the transportation costs. The “round trip” journey is 500 miles. How much should each of you pay for the trip?

Estimated annual cost

1. Depreciation	$2000
2. Interest on investment in car	740
3. License fee and taxes	1500
4. Parking ($20 per month)	240
5. Insurance	435
6. Gasoline ($.16 per mile)	1600
7. Oil/Lubrication	60
8. Tires (Replaced every 50,000 miles at a cost of $500)	100
9. Repairs and maintenance	400
Total annual cost	$7,075

Estimated cost of trip

Cost per mile = $7,075/10,000 = $.71

Cost of trip = $.71/mile x 500 miles = $355

Cost per person = $355/5 = $71

Estimated annual cost

~~1. Depreciation~~	~~$2000~~
~~2. Interest on investment in car~~	~~740~~
~~3. License fee and taxes~~	~~1500~~
~~4. Parking ($20 per month)~~	~~240~~
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7. Oil/Lubrication	60
8. Tires (Replaced every 50,000 miles at a cost of $500)	100
9. Repairs and maintenance	400
Total annual cost	$7,075

Incremental costs

Gasoline ($.16 x 500)	$80
Oil Lubrication ($60/10,000 x 500)	3
Tires ($100/10,000 x 500)	5
Repairs/Maintenance ($400/10,000 x 500)	20
Total Incremental Cost	$108

Re-estimated cost of trip

Cost per mile = $108/500 = $.216

Cost per person = $108/5 = $21.60

Check on Learning

Irrelevant costs are defined as:

a. The shoes I bought last week
(my husband, boyfriend will never know)

b. Any cost that will be incurred regardless of the decision at hand

c. My $500 round of golf tomorrow

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A Variety of Costs…

- Relevant costs and irrelevant costs
- Past (sunk) costs and future costs
- Fixed costs and variable costs
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- External costs and internal costs
- Opportunity cost

Past vs. Future costs

- Costs which have already occurred (past or sunk costs) are generally **irrelevant** in a cost analysis.
- Cost analysis should focus on costs which will be incurred in the future.

Example: Sunk Costs

- **Future Combat Systems.** A brigade of weapons systems, from tanks to drones and war-fighting software, all connected over an advanced wireless network. Its projected budget swelled to $159 billion. By the time Defense Secretary Robert Gates nixed the program in 2009, the Pentagon had already spent around $19 billion to develop it.
- **Expeditionary Fighting Vehicle.** This amphibious assault vehicle, envisioned as a tank that swims from sea to shore with 17 Marines on board, was canceled in 2011 after ballooning costs and poor performance. Its development costs notoriously ate up $3.3 billion.

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Fixed vs. Variable costs

- Variable costs are costs that tend to vary directly with the production rate
- Fixed costs are costs that are relatively independent of changes in the production rate.

Fixed vs. Variable costs

- 200 helicopters cost $400 million.
  - $200 million: Fixed cost--independent of number of helicopters ordered.
  - $200 million: Variable cost--$1 million per helicopter
- Assuming same fixed and variable costs, 100 helicopters would cost $300 million.

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One-Time vs. Recurring costs

- *One-time costs* are costs that are paid once in the product lifecycle.
  - Research and development
  - Acquisition
  - Disposal
- *Recurring costs* are costs that are paid repeatedly in most or all of the product lifecycle.
  - Operations and support

"The shampoo's getting cost prohibitive.
You're free to go."

Check on Learning

Recurring costs are defined as:

a. Two words – Starbucks Cappuccino

b. costs that are paid repeatedly in most or all of a product lifecycle.

c. Trips to Colorado Rockies games

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External vs. Internal

- **Internal Costs** are the costs that the buyer of a good or service pays the seller.
- **External Costs** (or externalities), in contrast, are the costs that people other than the buyer are forced to pay as a result of the transaction. (particular individuals or society at large).
- For example, the manufacturing cost of a car reflects the *internal cost*s for the manufacturer The polluted waters or polluted air also created as part of the process of producing the car is an *external cost* borne by those who are affected by the pollution The driver does not compensate for the environmental damage caused by using the car.

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Opportunity Costs

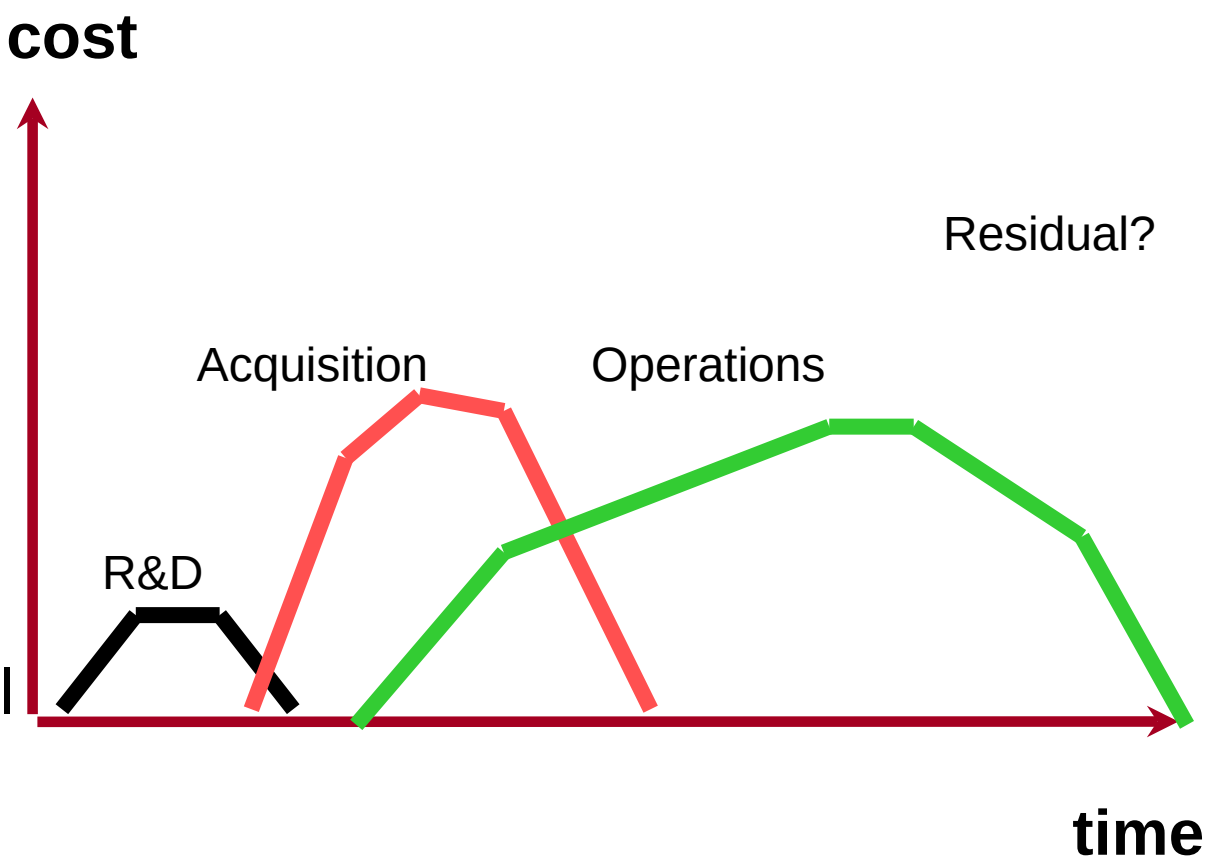
- value of the best alternative that was not chosen in order to pursue the current endeavor—i.e., what could have been accomplished with the resources expended in the undertaking. It represents opportunities forgone
- What I WOULD do if I DIDN’T do what I AM DOING

Cost Analysis

- A sequential process that involves the identification, measurement and evaluation of alternatives.
- Requires:
  - Understanding objectives and alternatives
  - Use of appropriate cost categories
  - Discrimination between relevant and irrelevant costs
  - **Emphasis on life cycle costs**

Lifecycle Costs

- Research and Development
- Adquisition
- Operating and Support
  - Manpower
  - Fuel
  - Parts
  - Other supplies
  - Services
- Disposal/Residual



A Simple Life-Cycle Cost Model

$$LCC = a + bx + cxy +/- d$$

a = one-time system costs (R&D)
b = one-time unit costs (Acquisition)
x = number of units
c = recurring (annual) operating costs
y = number of years operated
d = disposal costs (+) or residual value (-)

Life-Cycle Costs

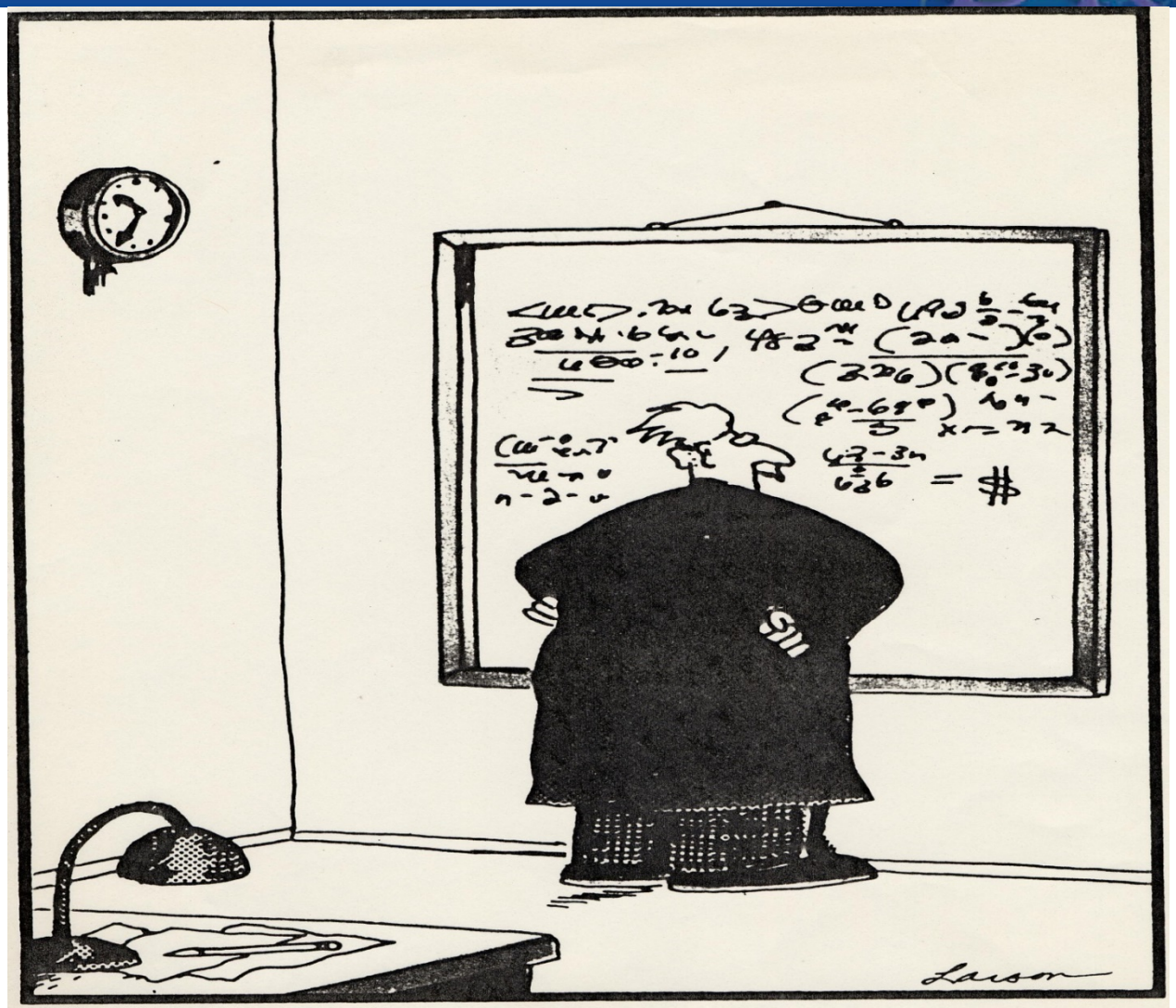
cost

How do you evaluate different alternative costs (or benefits) flows <u>over time</u> ??

The further out costs are slated to occur, the more uncertainty…..

time

Present Value Analysis



Einstein discovers that time is actually money.

A Matter of Time

You’ve won *195 MILLION* dollars!

Lump sum now or equal payments over 25 years?

A Matter of Time

- Pay me later…
  - $7.8 million/year for 25 years = $195 million
- Pay me NOW!
  - ~$115,000,000* – (assuming 5% discount rate)
- Difference: $80 million!!!

*$7.8 million per year for 25 years, starting 1 Jun 15 ~=$114,998,000

$$PV_{\text{Ordinary Annuity}} = C * \left[\frac{1-(1+i)^{-n}}{i}\right]$$

Discount Rates

- Inflation
- Risk
- Opportunity Costs

Nominal

Nominal Discount Rate includes your expectation about inflation (current prices)

How can we evaluate alternatives with different cash flows over time?

Present Value Analysis

- Facilitates comparison of projects with different cash flows over time.
- Allows comparison of a particular program to the “expected next-best use” of funds -- the **opportunity cost** of resource allocation
- Analytical tool, not a decision rule

Future Value

The value which a sum today will accumulate to in the future given a specified compound rate **(r = 10%)**

P	F_1	F_2	F_3	F_4	F_5	
$1000	$1100	$1210	$1331	$1464	$1611	
0	1	2	3	4	5	time

F_3 = $1210 (1+.10) = $1000 (1+.10)(1+.10)(1+.10) = $1000 $(1+.10)^3$ = **$1331**

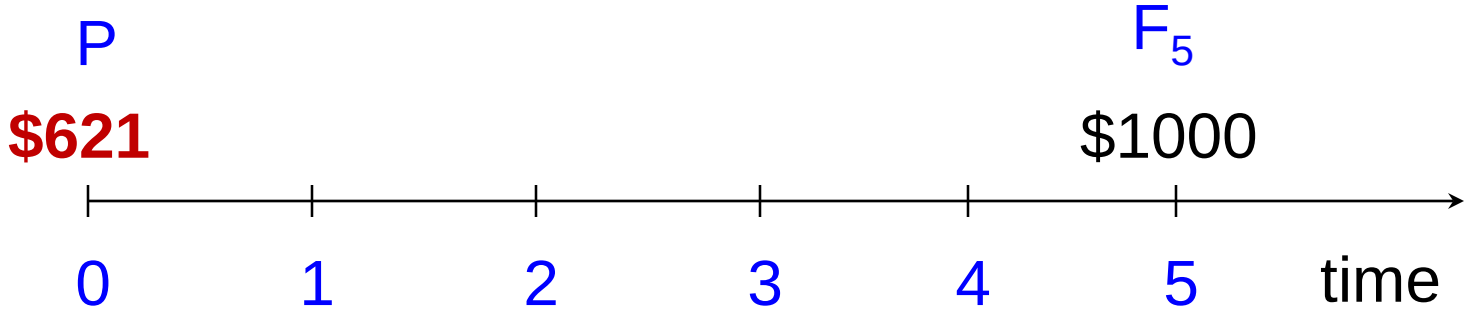
$$F_n = P(1+r)^n$$

compound factor

Present Value

The value of expected future cash flows discounted back to the present at a specified discount rate

(r = 10%)



$$P = F_{n} * \frac{1}{(1+r)^{n}}$$

discount factor

Discount Factor Tables

	Discount Rate (r)							
n	2%	4%	5%	7%	10%	15%	20%	25%
1	0.9804	0.9615	0.9524	0.9346	0.9091	0.8696	0.8333	0.8000
2	0.9612	0.9246	0.9070	0.8734	0.8264	0.7561	0.6944	0.6400
3	0.9423	0.8890	0.8638	0.8163	0.7513	0.6575	0.5787	0.5120
4	0.9238	0.8548	0.8227	0.7629	0.6830	0.5718	0.4823	0.4096
5	0.9057	0.8219	0.7835	0.7130	0.6209	0.4972	0.4019	0.3277
6	0.8880	0.7903	0.7462	0.6663	0.5645	0.4323	0.3349	0.2621
7	0.8706	0.7599	0.7107	0.6227	0.5132	0.3759	0.2791	0.2097
8	0.8535	0.7307	0.6768	0.5820	0.4665	0.3269	0.2326	0.1678
9	0.8368	0.7026	0.6446	0.5439	0.4241	0.2843	0.1938	0.1342
10	0.8203	0.6756	0.6139	0.5083	0.3855	0.2472	0.1615	0.1074
11	0.8043	0.6496	0.5847	0.4751	0.3505	0.2149	0.1346	0.0859
12	0.7885	0.6246	0.5568	0.4440	0.3186	0.1869	0.1122	0.0687
13	0.7730	0.6006	0.5303	0.4150	0.2897	0.1625	0.0935	0.0550
14	0.7579	0.5775	0.5051	0.3878	0.2633	0.1413	0.0779	0.0440
15	0.7430	0.5553	0.4810	0.3624	0.2394	0.1229	0.0649	0.0352
16	0.7284	0.5339	0.4581	0.3387	0.2176	0.1069	0.0541	0.0281
17	0.7142	0.5134	0.4363	0.3166	0.1978	0.0929	0.0451	0.0225
18	0.7002	0.4936	0.4155	0.2959	0.1799	0.0808	0.0376	0.0180
19	0.6864	0.4746	0.3957	0.2765	0.1635	0.0703	0.0313	0.0144
20	0.6730	0.4564	0.3769	0.2584	0.1486	0.0611	0.0261	0.0115
21	0.6598	0.4388	0.3589	0.2415	0.1351	0.0531	0.0217	0.0092
22	0.6468	0.4220	0.3418	0.2257	0.1228	0.0462	0.0181	0.0074
23	0.6342	0.4057	0.3256	0.2109	0.1117	0.0402	0.0151	0.0059
24	0.6217	0.3901	0.3101	0.1971	0.1015	0.0349	0.0126	0.0047
25	0.6095	0.3751	0.2953	0.1842	0.0923	0.0304	0.0105	0.0038
26	0.5976	0.3607	0.2812	0.1722	0.0839	0.0264	0.0087	0.0030
27	0.5859	0.3468	0.2678	0.1609	0.0763	0.0230	0.0073	0.0024
28	0.5744	0.3335	0.2551	0.1504	0.0693	0.0200	0.0061	0.0019
29	0.5631	0.3207	0.2429	0.1406	0.0630	0.0174	0.0051	0.0015
30	0.5521	0.3083	0.2314	0.1314	0.0573	0.0151	0.0042	0.0012

*** End of year discount factor = $(1+r)^{-n}$**

Example

SYSTEM A

Year	R&D	Procurement	O&M	Total
1	20			20
2	23			23
3	15	15		30
4		20	10	30
5		10	13	23
6			4	4
7			4	4
8			4	4
9			4	4
10			4	4
Total	58	45	43	146

SYSTEM B

Year	R&D	Procurement	O&M	Total
1	10			10
2	10			10
3	5	5		10
4		5	5	10
5		3	7	10
6			20	20
7			20	20
8			20	20
9			20	20
10			20	20
Total	25	13	112	150

PREFERENCE??

Example (7% mid-year)

System A

Year	R&D	Acq.	O&S	Total	Present Value
1	20			20	19.33
2	23			23	20.78
3	15	15		30	25.33
4		20	10	30	23.67
5		10	13	23	16.96
6			4	4	2.76
7			4	4	2.58
8			4	4	2.41
9			4	4	2.25
10			4	4	2.10
Total	58	45	43	146	118.18

Example (7% mid-year)

System B

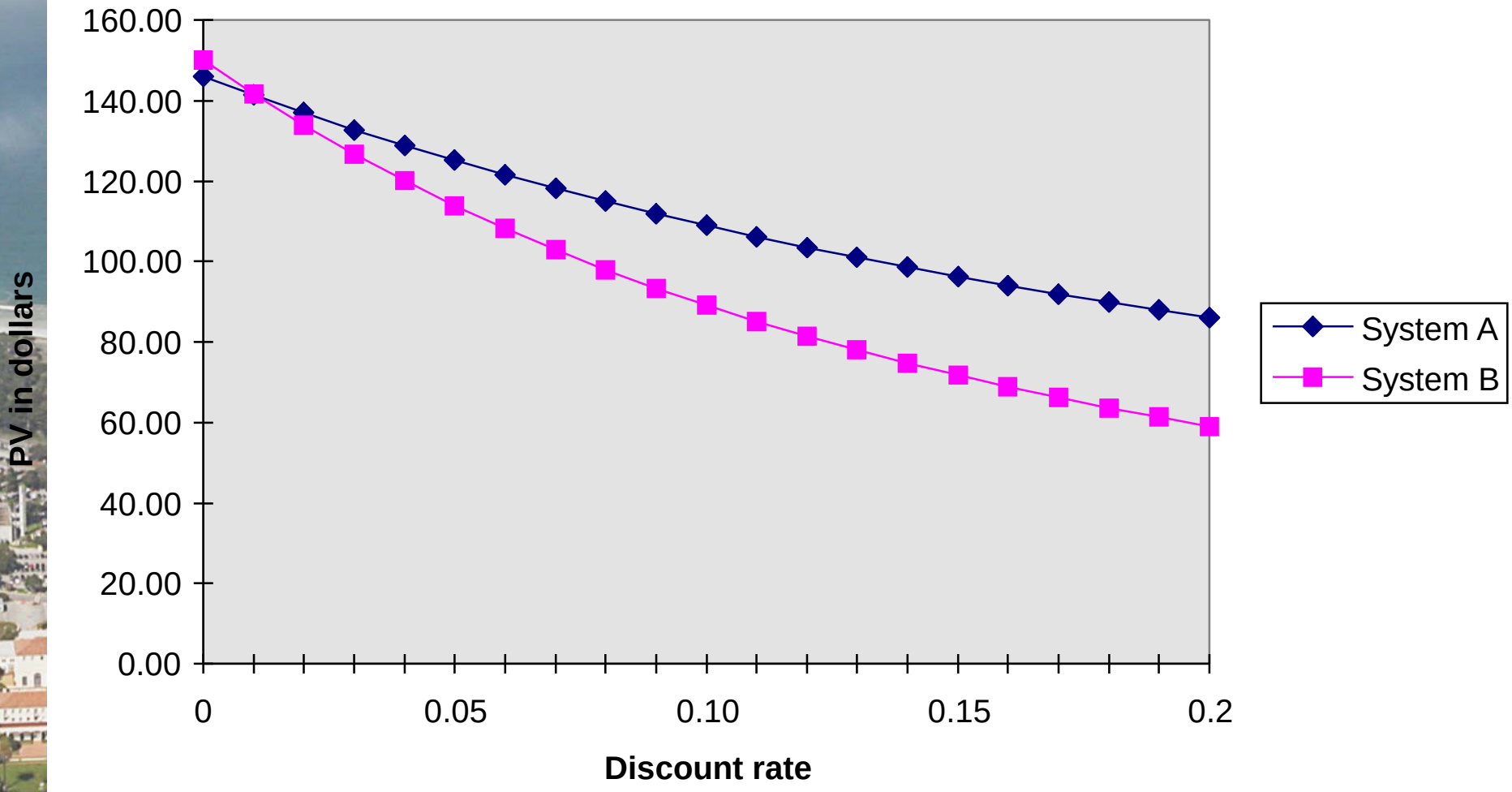
Year	R&D	Acq.	O&S	Total	Present Value
1	10			10	9.67
2	10			10	9.03
3	5	5		10	8.44
4		5	5	10	7.89
5		3	7	10	7.38
6			20	20	13.79
7			20	20	12.88
8			20	20	12.04
9			20	20	11.25
10			20	20	10.52
Total	25	13	112	150	102.89

Uncertainties and Future Costs

- How do we identify and measure all the possible forgone future benefits?
- What inflation rate will prevail?
- What discount rate should we use?
- How do we deal with uneven project lives?

Useful tool - sensitivity analysis

Present Values for Systems A & B



Nominal and Real Discount Rates: 2015

	Nominal	Real (no inflation premium)
• 3-year	1.7	0.1
• 5-year	2.2	0.4
• 7-year	2.5	0.7
• 10-year	2.8	0.9
• 20-year	3.1	1.2
• 30-year	3.4	1.4

<u>Nominal rates</u> often used in lease-purchase analysis; <u>Real rates</u> often used in cost-effectiveness analysis. Use linear interpolation for different project durations.

(OMB 94)

Ref: http://www.whitehouse.gov/omb/circulars_a094_a94_appx-c/

Applications of Cost Analysis

- Buy Now <u>or</u> Later?
- Buy Which One?
- Buy How Many?
- Buy New <u>or</u> Used?
- Buy <u>or</u> Lease?
- Insource <u>or</u> Outsource? (Privatization)
- Break-up <u>or</u> Consolidate Production? (Economies of Scale)
- Specialize <u>or</u> Diversify? (Multi-product organization: Economies of Scope)

Cost Accounting

"We are neither hunters nor gatherers.
We are accountants."

What is Accounting?

The system of recording and summarizing business and financial transactions and analyzing, verifying, and reporting the results*

*Webster's dictionary, 2015

Types of Accounting

- Financial Accounting
  - Preparation of financial statements for external users
- Managerial Accounting
  - Providing cost data for internal users

Financial vs. Managerial Accounting

	Financial	**Managerial**
Users	External	Internal
Rules	GAAP	SFFAS
Scope (detail)	Entire Org	Parts of Org
Frequency	Qtr/Annual	As needed
Orientation	Past	Future

Cost Accounting

A subset of managerial accounting dealing with relevant cost elements necessary for management analysis and decision making purposes.

Cost Accounting Uses

- Cost control
- Budgeting
- Performance measurement
- Determining reimbursements
- Setting fees and prices
- Program evaluations
- Economic choice decisions

Cost of Outputs

You have dinner with three friends at Bob's Big n' Juicy Steakhouse. You're really watching your great figure, so you have soup and salad for dinner and drink water. Your friends have T-bone steaks, a couple of bottles of the finest wine, and of course, decadent deserts. The bill is $325 plus tip and your friends suggest to split the bill equally among the four of you.

The Myth of the $600 Hammer

When contractors allocated their engineering expenses among the items on the project list - a bookkeeping exercise that had no effect on the price the Pentagon paid overall - they simply treated every item the same. So the hammer, originally $15, picked up the same amount of R&D overhead, $420, as each of the highly technical components.

Sydney J. Friedberg, Jr. National Journal, Dec 1998

Cost Classifications

- Direct cost. A cost that can be easily traced to an individual cost object.
  - Direct Materials
  - Direct Labor
- Indirect (overhead) cost. A cost that supports more than one cost object.

Determining Costs of Outputs

- Cost *accumulated* by “responsibility center”
  - A component of a unit or organization
  - Responsible for carrying out a mission, conducting a major activity, producing a product or providing services.
- Cost *allocated* to “cost objects”
  - The outputs of a responsibility center

Cost Accumulation

- Job Order
- Process Costing

Job Order Costing

- Costs are recorded for each product, batch or service separately
- Used for products, projects or assignments that differ in duration, complexity or resource requirements
  - Aircraft repair
  - Military Construction
  - Research Projects

Process Costing

- Costs are recorded by department or process
- Used for continuous flow production of homogeneous units
  - Immunizations
  - Aircraft Refueling
  - Parachute Assembly

Base Recycling Facility

A base Commander has decided to build a recycling facility. You are the civil engineer in charge of the project. How would you determine the cost of the facility?

Job Order

Base Recycling Facility

Suppose you are the manager of the new recycling facility and have been asked to determine the cost per ton of trash. How would you go about doing this?

Process

Cost Allocation

- Direct tracing
- Single-step allocation
- Activity-Based Costing

Direct Tracing

- Observing, counting and recording consumption of resources
- Most accurate
- Most expensive and difficult

Single-Step Allocation

- All indirect costs allocated to units based on a single cost driver (usually volume, direct labor hours, machine hours or direct materials)
- Least accurate
  - Often the allocation base (cost driver) has little relation to the consumption of resources
- Least expensive and easiest

The Boat Company

The Boat Company makes five boats and has $25,000 in overhead costs. Using single-step allocation, the overhead cost per boat would be $5,000 each.


SFMYC

Base Recycling Facility

Regular trash is taken directly to the dump while recyclable trash is processed at the facility (sorted and compacted).

How would you allocate the salaries of the personnel that sort the recyclable trash?

Direct Tracing

How about the salaries of the truck drivers?

Direct Tracing or Single Step

Base Recycling Facility

The facility manager is in charge of scheduling trash collection and supervising processing activities. How would you allocate his salary to each type of trash?

Single Step

Base Recycling Facility

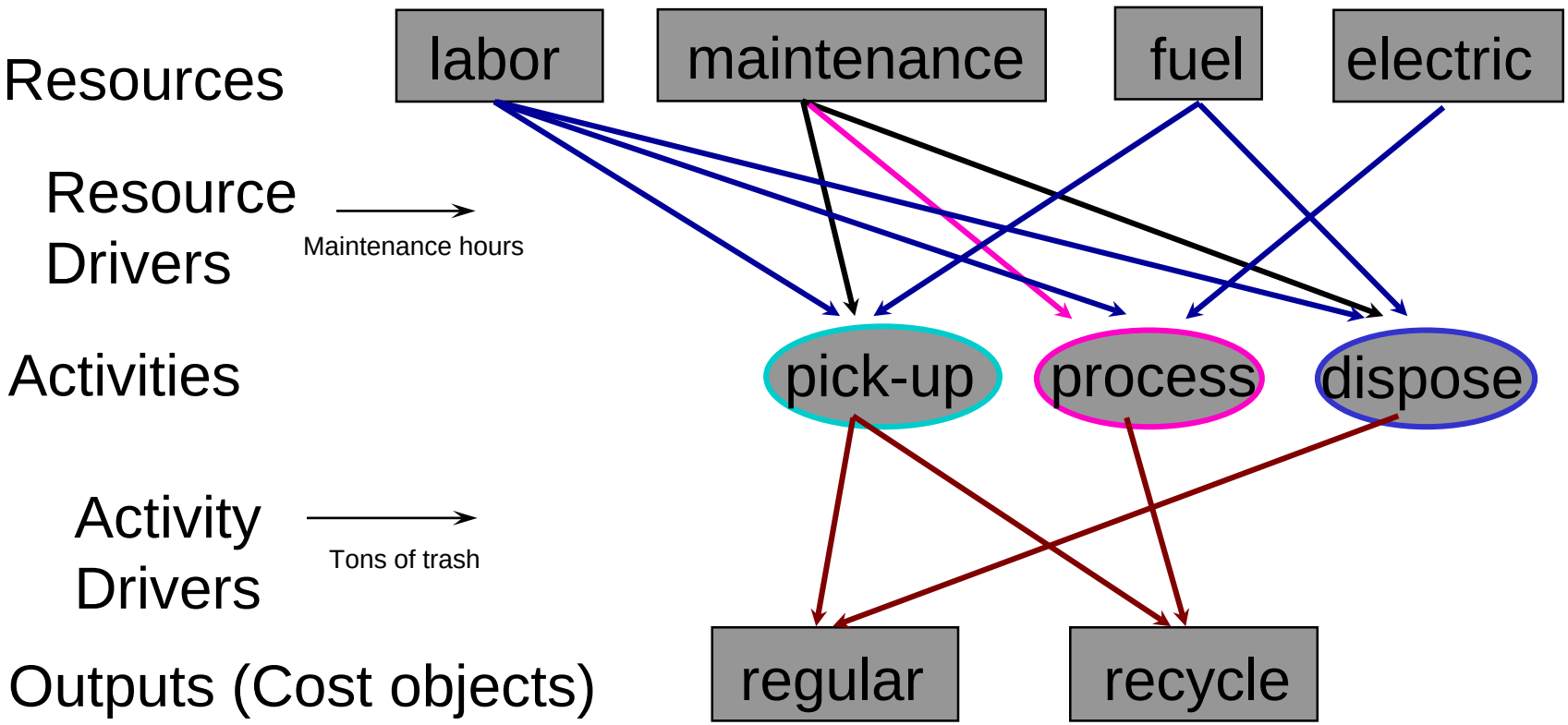
The base charges a fixed monthly fee to provide maintenance for the trucks and the compacting machine. How would you allocate the cost of maintenance?

Which activities consume maintenance?

Activity-Based Costing

- Traces cost of resources used to *activities* using *resource drivers*, then cost of activities to outputs or cost objects using *activity drivers*
- Minimizes cost distortion
- Requires more effort and expense
- Analyzes process and identifies inefficiencies

Activity-Based Costing



Base Recycling Facility

Suppose the base provides maintenance for the trucks and the compacting machine, but it's paid out of the *base* budget, not the recycling facility budget.

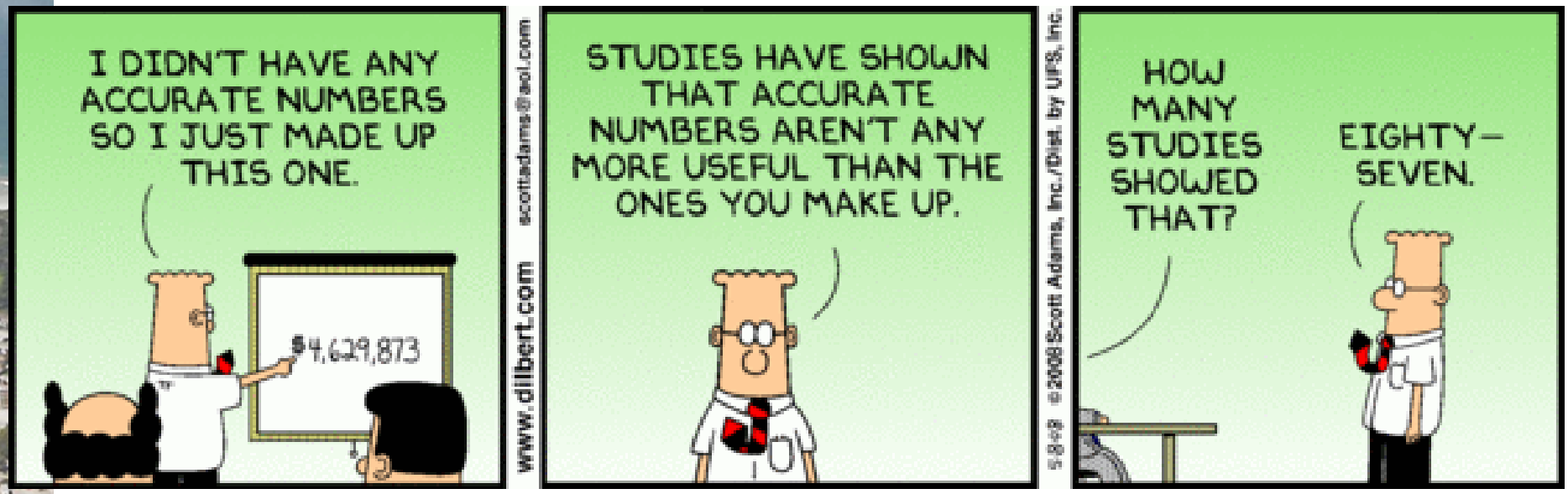
Is the maintenance free?

Should maintenance be included in the cost of recycling?

Base Recycling Facility

DoD built and paid for the recycling building two years ago (out of the Military Construction appropriation). The manager wants to calculate the average (unit) cost of recycling a ton of trash this year.

Should the cost of the building be included?


I DIDN'T HAVE ANY ACCURATE NUMBERS SO I JUST MADE UP THIS ONE.
$4,629,873
www.dilbert.com scottadams@aol.com
STUDIES HAVE SHOWN THAT ACCURATE NUMBERS AREN'T ANY MORE USEFUL THAN THE ONES YOU MAKE UP.
© 2008 Scott Adams, Inc./Dist. by UFS, Inc.
HOW MANY STUDIES SHOWED THAT?
EIGHTY-SEVEN.

Cost Estimating

An estimate
is a judgment, opinion, forecast, or prediction.

A cost estimate
therefore is a prediction of the likely future cost of a process, product, project, service, program, or system.

Cost Estimating Techniques

- Two basic approaches
  - Detailed ("Bottom-up") – Prices of sub-component costs, labor, etc.
  - Order-of-Magnitude (″Top-down″) A rough order of magnitude could look at what a similar project cost in the past. For example, projecting what a new computer system would cost for a multi-location business could be completed by multiplying what one location cost the last time the computers were upgraded times the number of locations.

Cost Estimating Techniques

- Methods used to support estimates
  - Direct assessment
  - Analogy/Component Ratio
  - Handbook/Catalog
  - Vendor quote
  - Actual Costs
  - Parametric

You have been informed that funds just became available for construction of an air operations center, but you need to provide a cost estimate within 24 hours so that funds can be obligated before the end of the FY.

Besides ensuring compliance with fiscal law, What to do??

Direct Assessment

- Subjective evaluation based on
  - Expertise
  - Study
- Estimate without details
  - Resources
  - Dollars

Analogy

Estimate the cost of a new system by multiplying the cost of a similar existing system by a weighting factor (or index) which captures the difference in a key system characteristic

$$\text{Cost}_{\text{New}} = \text{Cost}_{\text{Old}} \times \frac{\text{Characteristic}_{\text{New}}}{\text{Characteristic}_{\text{Old}}}$$

$\text{Cost}_{\text{New}} = \text{Cost}_{\text{Old}} \times \text{Index}$, where Index = a complexity multiplier

New Building Construction Cost

Cost of Existing Building	$2,000,000
Cost of New Building	$?
Ft^2 of Existing Building	10,000 Ft^2
Ft^2 of New Building	15,000 Ft^2

New Building Cost = $2M x 15,000/10,000
= $3,000,000

Analogy

- Advantage:
  - Can be simple, inexpensive, and quick
- Potential Problems:
  - Relies on judgment of functional experts
  - Ignores fixed costs
  - Ignores manufacturing technology changes
  - Failing to adjust for quantity/schedule differences between the existing and the new systems

Component Ratio (Factor)

- Similar to analogy
- Uses component costs (parts and/or processes) of old but similar systems to estimate the costs of similar components in new systems.
- Component costs of old systems are expressed as a percentage of total cost.

Fighter Aircraft O&S Costs

Managerial Question: What will be the annual O&S cost for a new fighter aircraft?

Given: Life Cycle Cost data for 20 old fighter aircraft reveal:

2% of LCC is R&D
18% of LCC is Acquisition
80% of LCC is O&S

Fighter Aircraft O&S Costs

We expect the R&D for the new fighter to be $10B
We plan to procure 1000 new aircraft
We plan to operate each aircraft for 25 years

O&S Estimate Calculation:

2% of LCC (R&D)	= $10B ➔ ($500B system LCC)	
18% of LCC (Acquisition)	= $90B	
Total O&S cost (system)	= 80% of $500B	= $400B
Total O&S cost (per a/c)	= $400B/1000	= $400M
Annual O&S cost (per a/c)	= $400M/25 years	= $16M

How would you estimate the cost of 100 computers required for the AF Pilot Training School?

Handbook/Catalog Pricing

- Advantages
  - Easy and inexpensive
  - Provides resource requirements as well as cost
  - Based on years of experience and data
  - Current market prices
- Potential Problems
  - Items don’t match requirements
  - Information is based on old technology

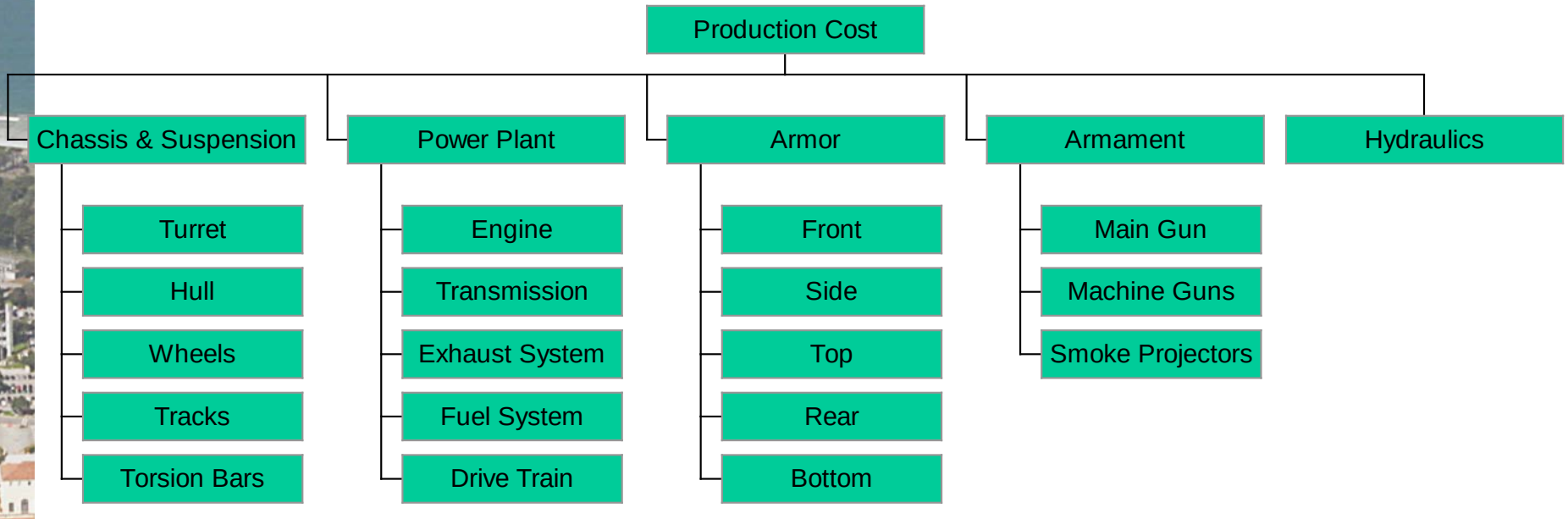
Vendor Quote

- Advantages
  - Efficient
  - Realistic
    - Use 3 or more bids to check
  - Reliable (firm)
- Disadvantages
  - Requires preparation of RFQ
  - Relies on vendor information

Resource Requirements

- Detailed description of system
  - WBS
- Complete list of resources required for each task
  - Direct
    - Documents
    - Materials
    - Labor
  - Indirect
  - Time
- Unit cost of each resource

New Tank Production Cost



New Tank Production Cost

Component/Subsystem	Cost Estimate
Chassis & Suspension	$250,000
Power Plant	430,000
Armor	640,000
Armament	360,000
Hydraulics	235,000
Electronics	430,000
Tools & Test Equipment	124,000
Integration & Assembly	73,000
Total:	**$2,542,000**

Resource Requirements

- Advantages
  - Very accurate, complete
  - Forces consideration of details
  - Basis for cost/schedule control
- Disadvantages
  - Requires detailed design
  - Labor and time intensive
  - Must change as design/use changes

Actual Costs

- Based on cost data from
  - Prototypes
  - Test and Evaluation
  - Limited production runs
  - Fielded units
- Extrapolates cost of future units based on actual cost of prior units
- Drawbacks
  - Built-in inefficiencies
  - Failure to normalize data

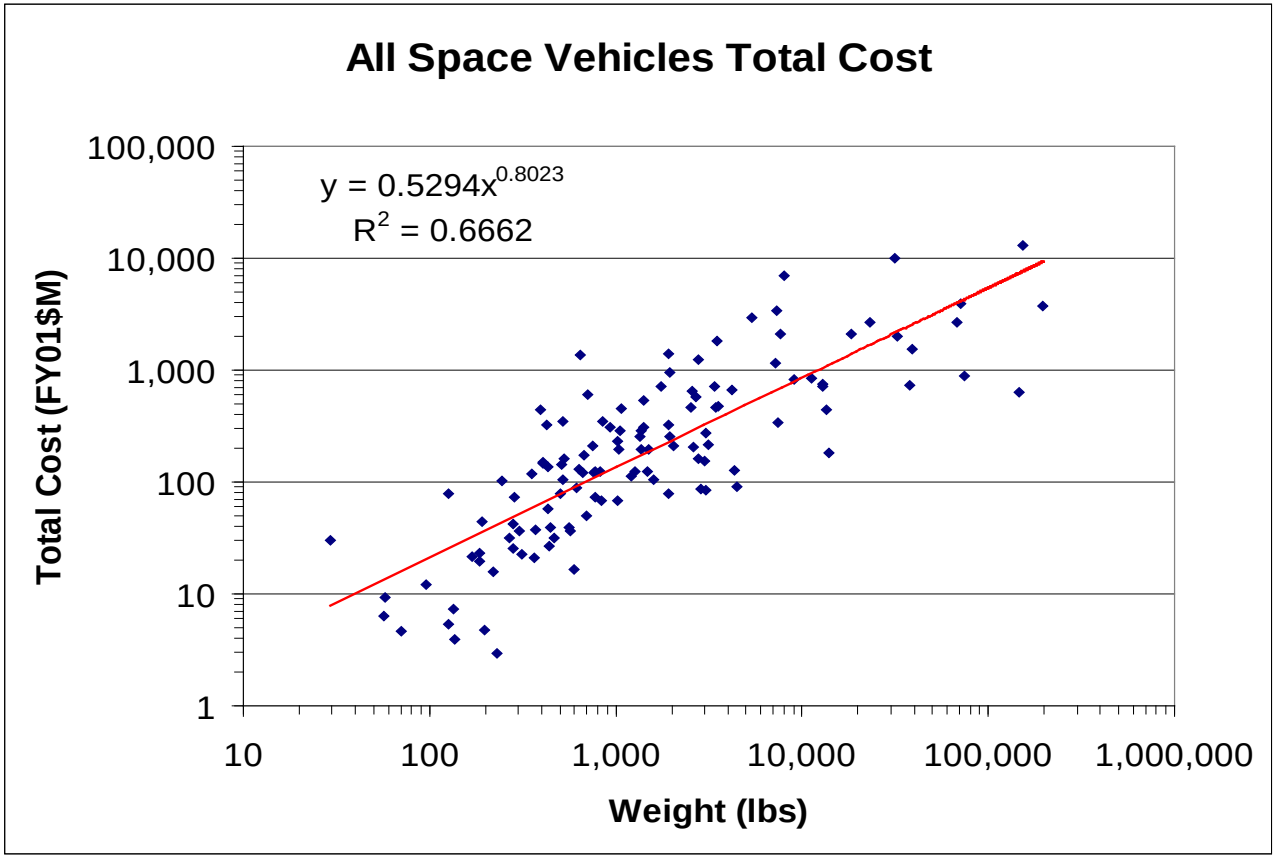
Parametric

- Uses regression analysis to develop a cost estimating relationship (CER) between one or more design or performance characteristics of the system and cost
- Validity of estimate is judged statistically
- Based on historical data
- Requires technical as well as cost data

Cost Estimating Relationship

- Gather and normalize data
- Select logical variables
- Test relationships
  - Scatter diagram
  - Correlation coefficient
- Fit a regression model
  - Evaluate quality of CER
- Test the model

Example – Space vehicles



Engineering Cost Office

Example: New Tank Production Cost

$$\text{Cost} = 72.0 + 24.0W + 9.9C + 0.5H$$

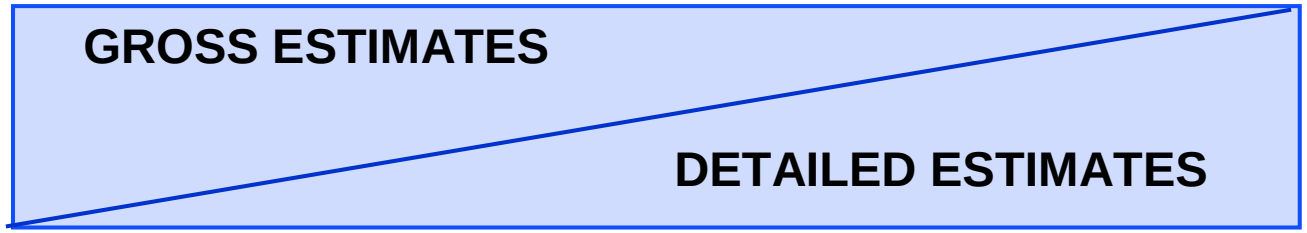
W = Weight of Tank in tons (65)
C = Caliber of main gun in mm (120)
H = Horsepower of engine (1500)

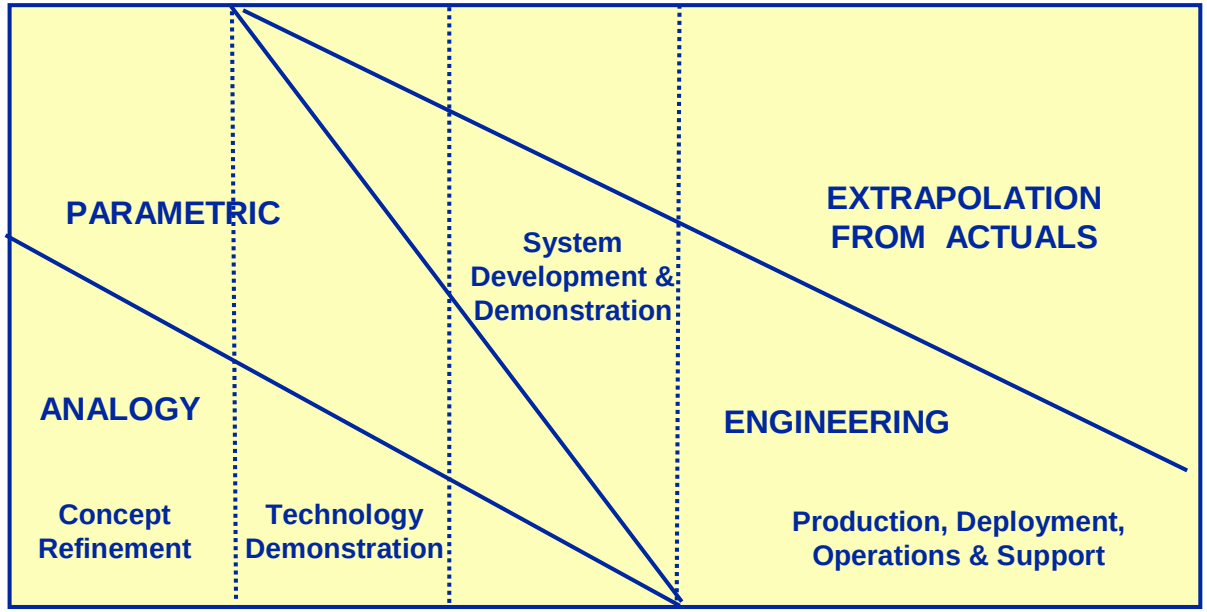
$$\text{Cost} = 72 + 24\,(65) + 9.9\,(120) + 0.5\,(1500) = \$3570$$

Cost Estimating Relationships

- Strengths
  - Provide quick estimate without knowing design and WBS details
  - Based on objective historical data
  - Validity can be tested statistically
  - Simplifies estimating
- Weaknesses
  - Data must be normalized
  - Can be too simplistic
  - No in-depth visibility to cost elements
  - No cost/schedule visibility

Cost-Estimating Techniques





Check on Learning

Cost estimating techniques are:

a. Honey, my new Harley was somewhere between $50 and $20,000

b. predictions of the likely future cost of a process, product, project, service, or system

c. Methods of determining bail for Justin Beiber and Lindsay Lohan

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Summary of Key Concepts

Understanding costs is essential for cost analysis, cost accounting and decision making:

- Relevant and irrelevant costs
- Fixed vs. variable costs
- One-time vs. recurring costs
- Lifecycle costs
- Cost profiles and present value analysis
- Cost accumulation and allocation