The Builders' Association
Serving the commercial construction industry in MO and KS since 1887

TOTAL COST OF OWNERSHIP

February 1, 2013

McKinstry
For The Life Of Your Building

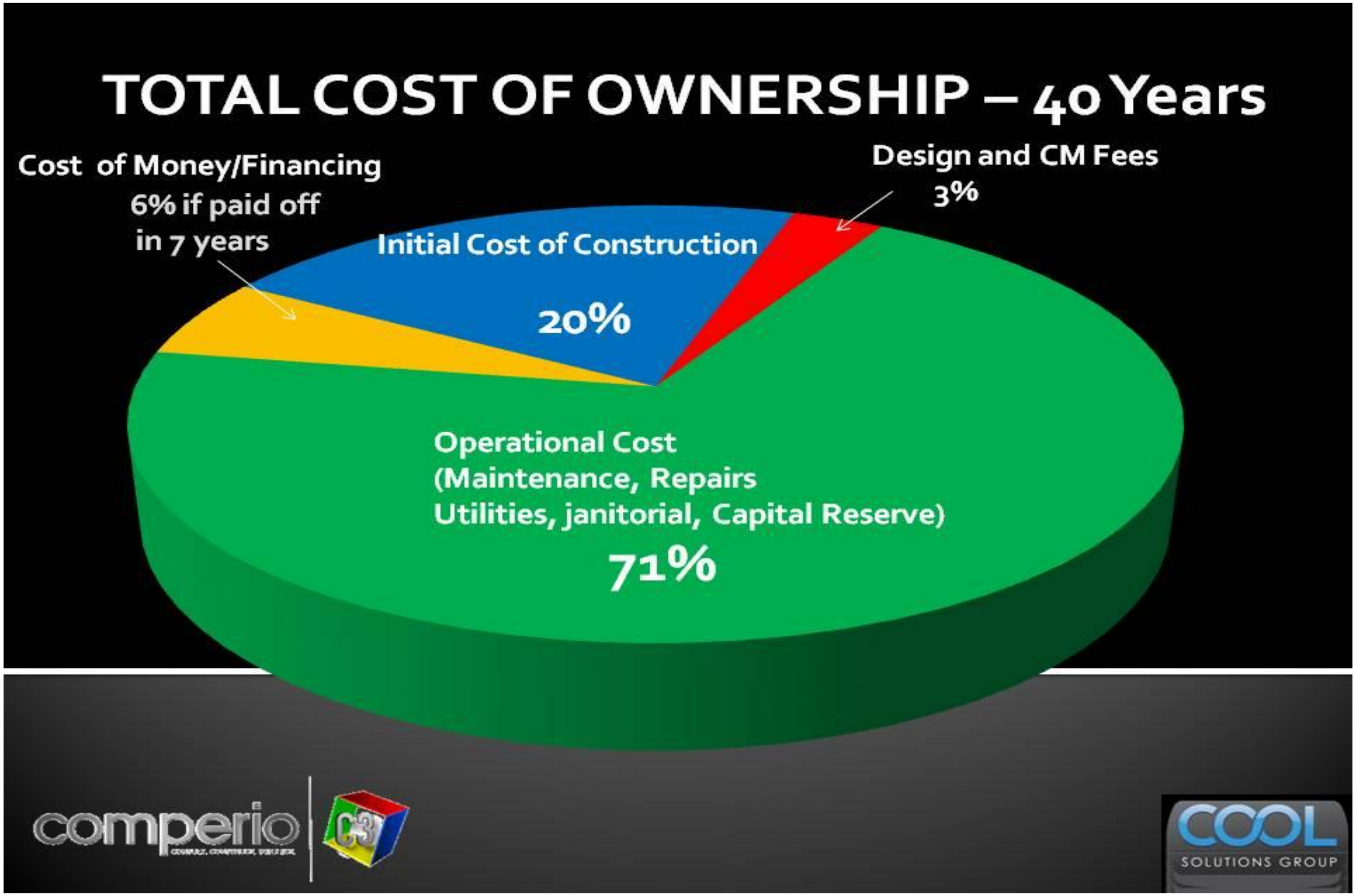
WHAT IS TCO?

- Total Cost of Ownership is the total cost of owning an asset over a period of time. In the real estate and construction industry this usually means the total cost of designing, constructing, operating, and maintaining a project throughout its useful life.
- For practical reasons, a typical lifespan is often used, such as 30 years or 50 years, depending on your organization and the type of facilities you own.
- For costs that are in future years, adjust upwards for inflation each year and then adjust downwards for the real value of money in that year compared to today's money.

WHY TCO?

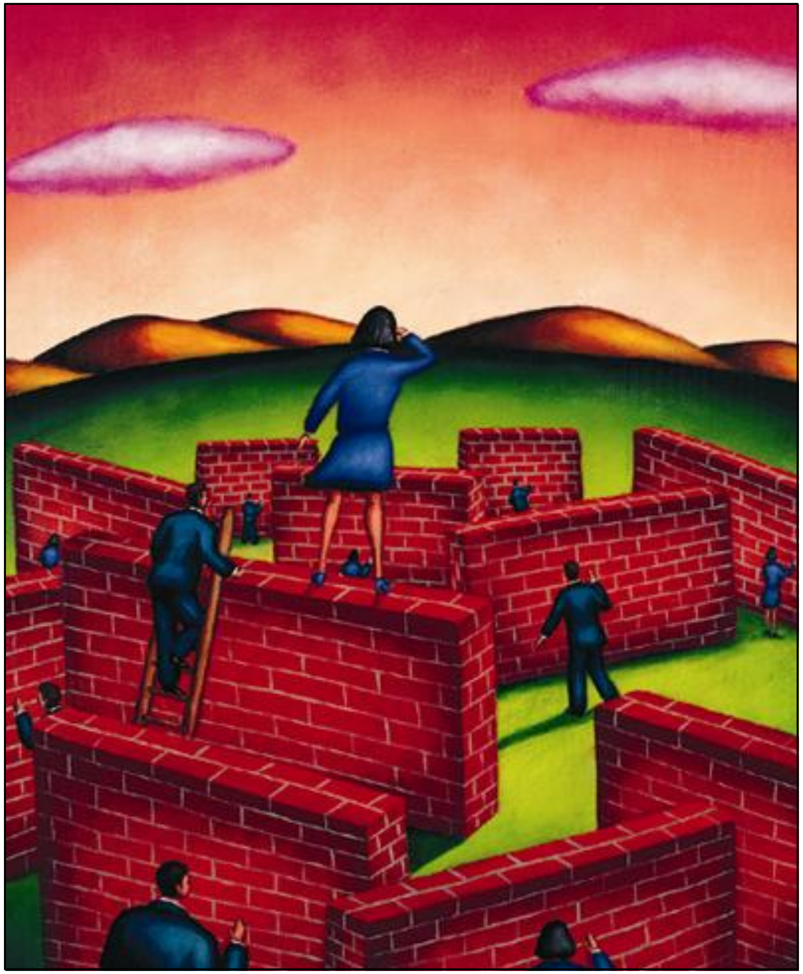
- Every owner wants a cost-effective building. But what does this mean? In many respects the interpretation is influenced by an individual's interests and objectives, and how they define "cost-effective".
  - •Is it the lowest first-cost structure that meets the program?
  - •Is it the design with the lowest operating and maintenance costs?
  - •Is it the building with the longest life span?
  - •Is it the facility in which users are most productive?
  - •Is it the building that offers the greatest return on investment?

COST SPECTRUM



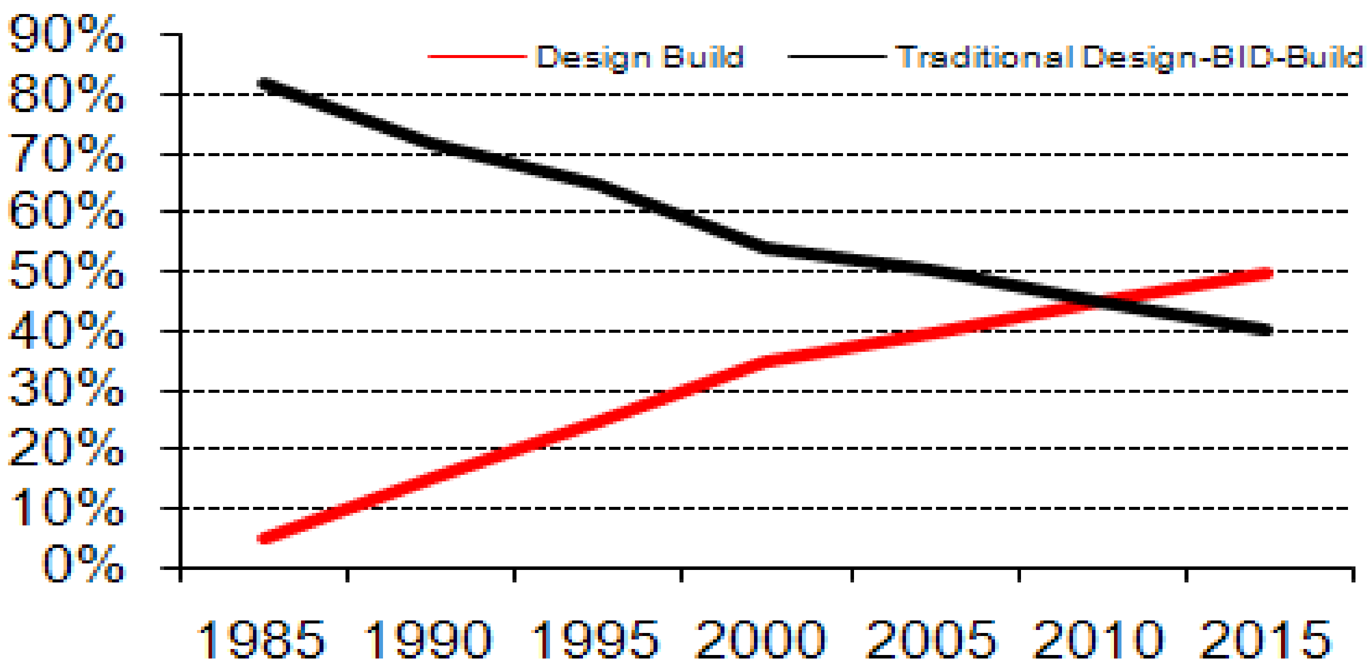
WHAT DOES TCO OFFER?

APPROACH PROJECTS FROM A FRESH VIEWPOINT



DESIGN BUILD FOR TCO

- The design build process is better suited for TCO in that the flexibility allows for interaction between all parties.



VARIATIONS ON A THEME

- P3
- DBOM
- DBOOM
- Guaranteed Savings (energy, operations cost)
- Shared Savings (energy, operations cost)

- ALL OF THESE ARE VARIATIONS ON PERFORMANCE BASED CONTRACTING

FULL SPECTRUM APPROACH

- For the TCO concept to be accurate, a ‘Full Spectrum’ approach must be taken. This includes addressing:
  - Design and Construction Considerations
  - Utility Consumption
  - Facility Operations Parameters
  - Replacement/Remodeling Costs
  - Commissioning
  - Value Engineering
  - Residual Value
  - Life Cycle Cost Analysis

Design and Construction Considerations

- The easiest way to reduce total costs is to build operating efficiency into the design and construction of the building using existing techniques, many of which are well developed but not always used.

- The caveat is that these techniques may extend the total project time, will introduce increased consulting/professional fees up-front and may result in design changes that increase initial costs. Build these techniques into the initial schedule and budget and then use the results, along with the related financial analysis, to justify increased construction costs that reduce ongoing costs.

UTILITY CONSUMPTION

- Operational expenses for energy, water, and other utilities are based on consumption, current rates, and price projections. Because energy, and to some extent water consumption, and building configuration and building envelope are interdependent, energy and water costs are usually assessed for the building as a whole rather than for individual building systems or components.

FACILITY OPERATIONS PARAMETERS

- Non-fuel operating costs, and maintenance and repair (OM&R) costs are often more difficult to estimate than other building expenditures. Operating schedules and standards of maintenance vary from building to building; there is great variation in these costs even for buildings of the same type and age. It is therefore especially important to use engineering judgment when estimating these costs.
- Involve an experienced FM team for analysis.

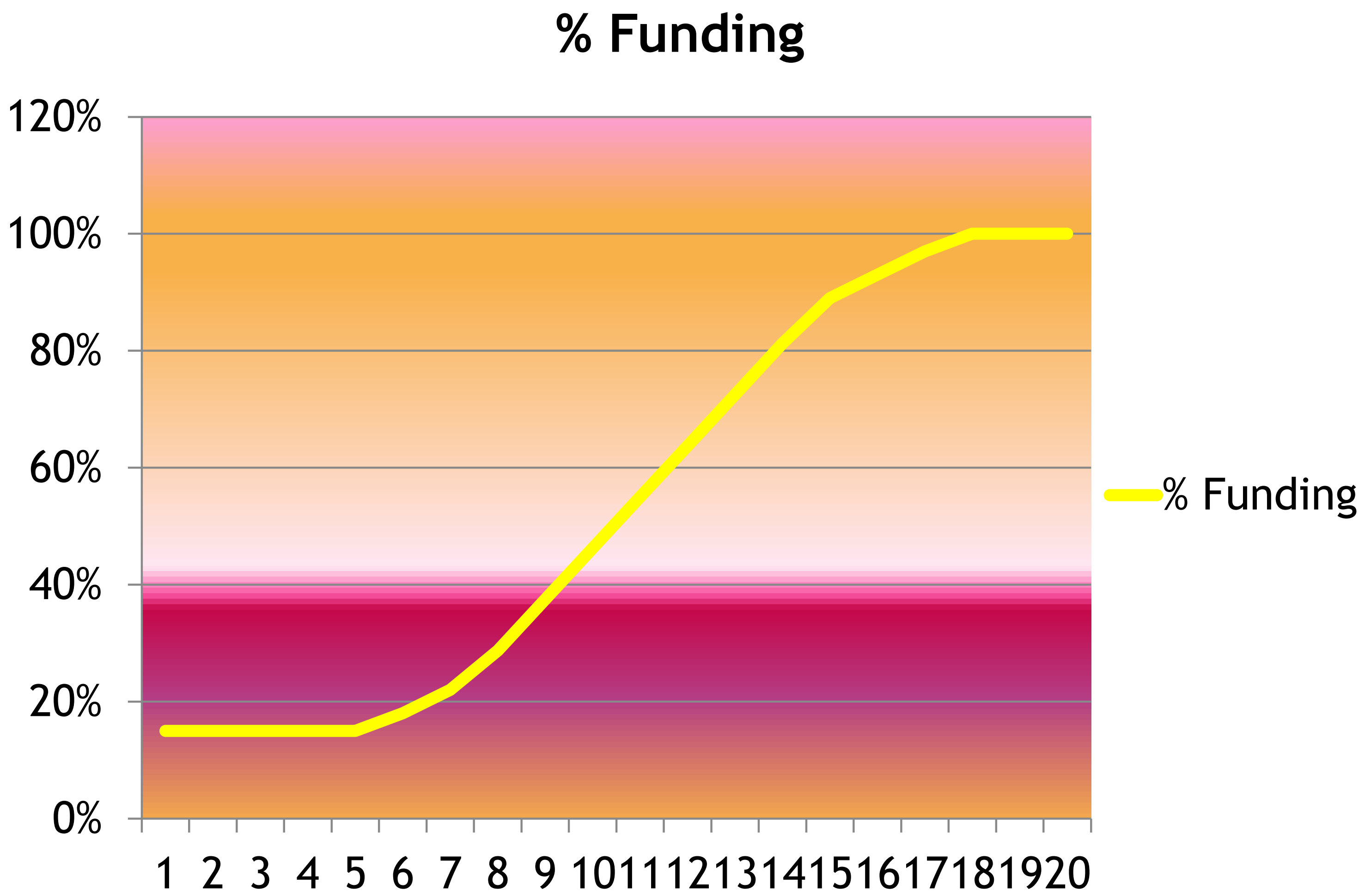
REPLACEMENT/REMODELING COSTS

- The number and timing of capital replacements of building systems depend on the estimated life of the system and the length of the study period. Use the same sources that provide cost estimates for initial investments to obtain estimates of replacement costs and expected useful lives. A good starting point for estimating future replacement costs is to use their cost as of the base date. The LCCA method will escalate base-year amounts to their future time of occurrence.

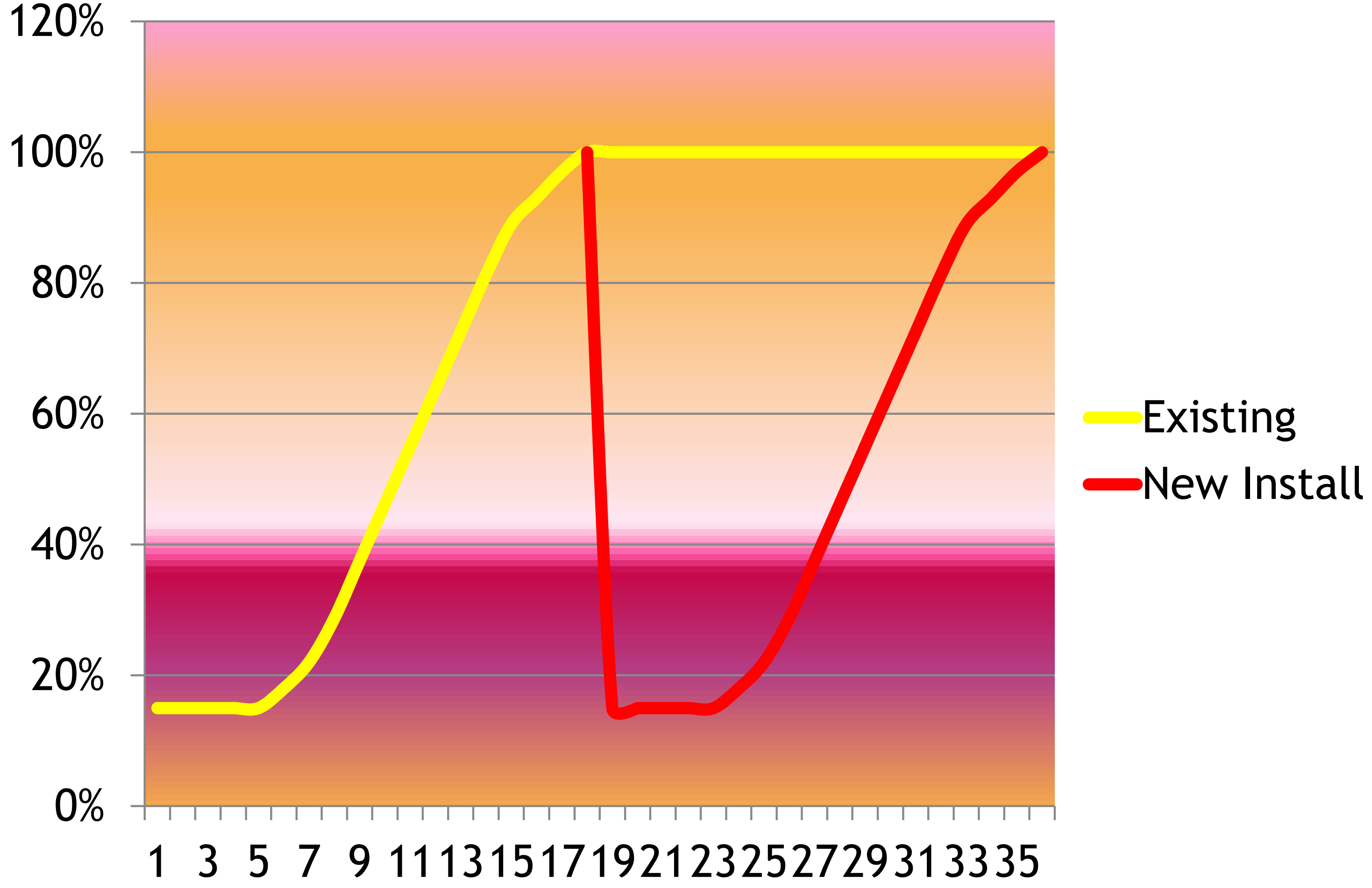
SAMPLE OF ASHREA LIFE RATINGS

Equipment	Yrs	Equipment	Yrs
Air conditioners		Air terminals	
Window unit	10	Diffusers, grilles, and	27
		registers	
Residential single or split	15	Induction and fan coil	20
package		units	
Commercial through-the	15	VAV and double-duct	20
wall		boxes	
Water-cooled package	15	Air washers	17
Heat Pumps		Ductwork	30
Residential air-to-air	15	Dampers	20
Commercial air-to-air	15	Fans	
Commercial water-to-air	19	Centrifugal	25
Roof-top air conditioners		Axial	20
Single-zone	15	Propeller	15
Multi-zone	15	Ventilating roof-mounted	20
Boilers, hot water (steam)	Coils		
Steel water-tube	24 (30)	DX, water, or steam	20
Steel fire-tube	25 (25)	Electric	15
Cast iron	35 (30)	Heat Exchanger	
Electric	15	Shell-and-tube	24
Burners	21	Reciprocating compressors	20
Furnaces		Packaged chillers	
Gas- or oil-fired	18	Reciprocating	20
Unit heaters		Centrifugal	23
Gas or electric	13	Absorption	23
Hot water or steam	20	Cooling towers	
Radiant Heaters		Galvanized metal	20
Electric	10	Wood	20
Hot water or steam	25	Ceramic	34

MAINTENANCE 'S CURVE



RESETTING THE 'S' CURVE



COMMISSIONING

- Even if the design reflects the best value in initial and total cost of ownership, the actual implementation of the design during construction needs to be validated against the design specifications. Payback on commissioning costs for energy alone is under five years. This has a huge impact on the total benefits over the life of the building.

- Commissioning is a quality assurance process that verifies that the systems installed during construction meet the original design criteria through testing and documentation. This process is conducted by third party commissioning consultants throughout the construction process.

- To get the best value from the commissioning process, the FM staff should be involved in the commissioning and receive training on the systems during the construction phase. Since the cost of operations is by far the largest part of the total cost of ownership, it is critical to give operational staff the knowledge they need to operate the facility efficiently in accordance with the design intent.

VALUE ENGINEERING

- This tool is closely related to Life Cycle Costing and they often work together. Unlike LCC, value engineering goes beyond purely financial analysis and assesses the design, including materials, equipment and functional requirements. The intent is to eliminate or modify elements of the design that are either not required to achieve the functional requirements or add unnecessary costs.

- Generally, value engineering will drive design and equipment selection alternatives. LCC will then analyze the total economic impact of those decisions.

RESIDUAL VALUE

- The residual value of a system (or component) is its remaining value at the end of the study period, or at the time it is replaced during the study period. Residual values can be based on value in place, resale value, salvage value, or scrap value, net of any selling, conversion, or disposal costs. As a rule of thumb, the residual value of a system with remaining useful life in place can be calculated by linearly prorating its initial costs. For example, for a system with an expected useful life of 15 years, which was installed 5 years before the end of the study period, the residual value would be approximately 2/3 (=(15-10)/15) of its initial cost.

LIFE CYCLE COST ANALYSIS

- The LCC analysis takes four key cost components into account to determine the lowest total cost of design alternatives. It's a well-established economic analysis that takes a component –by-component approach to the initial cost as well as maintenance, energy and replacement or renewal costs of the equipment over the life of the building. The analysis is rigorous, taking into account the time value of money and inflation to develop a net present value for the total cost of the components over their entire life cycle.

- This technique can be used for a design/build tender to achieve the lowest total costs rather than the lowest initial construction cost. By requiring LCC analysis by a third party as part of each submission and using the results as a basis for final selection, you can make the best financial decision.

FINANCIAL ANALYSIS HORIZONS

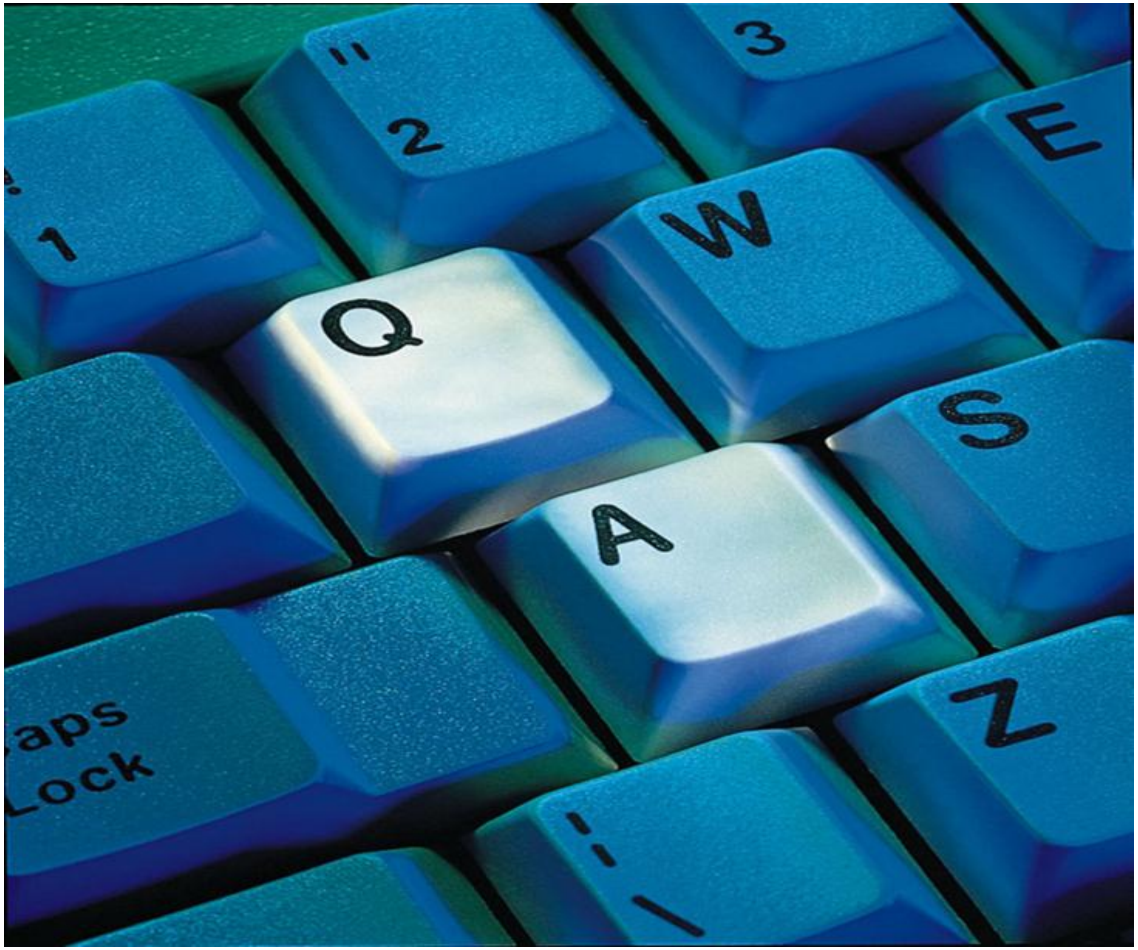
- After identifying all costs by year and amount and discounting them to present value, they are added to arrive at total life-cycle costs for each alternative:

- LCC = I + Repl − Res + U + OM&R + O

- LCC = Total LCC in present-value (PV) dollars of a given alternative
- I = PV investment costs (if incurred at base date, they need not be discounted)
- Repl = PV capital replacement costs
- Res = PV residual value (resale value, salvage value) less disposal costs
- U = PV of utility costs (energy, water, waste water, storm water, etc)
- OM&R = PV of non-fuel operating, maintenance and repair costs
- O = PV of other costs (e.g., contract costs for ESPCs or UESCs)

QUESTIONS ?

- Thank you for your time



MCKINSTRY

- Mark Gardner, PE, RLA, CEM, LEED AP, CDAT
- mgardner@mckinstry.com
- 913-232-6791