



The Total Cost of Ownership

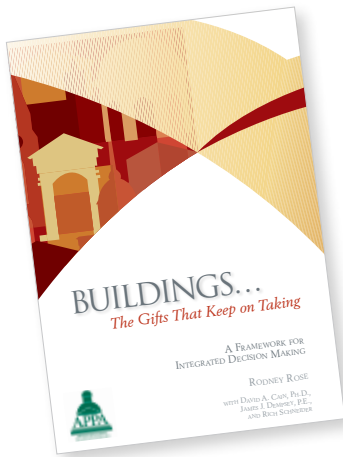
More than 10 years ago APPA introduced the concepts of total cost of ownership (TCO) to the educational facilities community. A major CFaR research project on TCO and asset management and investment, conducted by Doug Christensen, then of Brigham Young University, resulted in the landmark 2007 publication *Buildings...The Gifts That Keep on Taking*.

But much more has been occurring on the TCO front, which gives us the opportunity to present this section of mini-features on the definition and purpose of TCO, how great leaders can benefit from incorporating TCO concepts into their management of the built environment, and an update on the exciting work being done by APPA's new Total Cost of Ownership Work Group. Authors Doug Christensen, Ana Thiemer, Deke Smith, and John Bernhards provide an valuable introduction to the topic of total cost of ownership. Read on!

—Steve Glazner, Editor

WHAT IS TCO? WHY TCO?

By Douglas K. Christensen, APPA Fellow



At the APPA annual conference in Hawaii in 2006—jointly produced by APPA, the National Association of College and University Business Officers, and the Society for College and University Planning—a presentation was made on campus investment and the concept of total cost of ownership (TCO). The research, conducted under the auspices of APPA’s Center for Facilities Research (CFaR), resulted in the landmark 2007 APPA publication, *Buildings...The Gifts That Keep on Taking: A Framework for Integrated Decision Making*.

The original research focused on the question, “How do groups outside educational facilities deal with deferred maintenance/capital renewal?” From the research two major outcomes emerged. The first was a TCO model. APPA defines total cost of ownership as a strategic asset management practice that considers all costs of operations and maintenance in addition to the acquisition or first costs of design and construction. “TCO, therefore, includes the total of the present value of all direct, indirect, recurring, and nonrecurring costs incurred or estimated to be incurred in the design, development, production, operation, maintenance, and renewal of a facility, structure, or asset over its anticipated life span.” TCO is a financial management strategy that accounts for the complete life-cycle (cradle-to-grave) measurement and management of a physical asset’s useful life.

This model represented the best practices within the campus facilities profession in dealing with asset management. This model made it possible for nonprofit organizations to deal with deferred maintenance/capital renewal using current accounting principles.

THE STRATEGIC INVESTMENT PYRAMID

The second major result of the research was to create and define a Strategic Investment Pyramid.

In a process used to determine and assure proper capital investment, the elements of the Strategic Investment Pyramid started with a baseline understanding of the integrated decision-making framework. Standalone decision making for long-term capital investments did not work in general. Life-cycle considerations could, in most cases, be a guide to good decision making. The first level in the pyramid is answering the following strategic questions.

Figure 1: Strategic Investment Pyramid

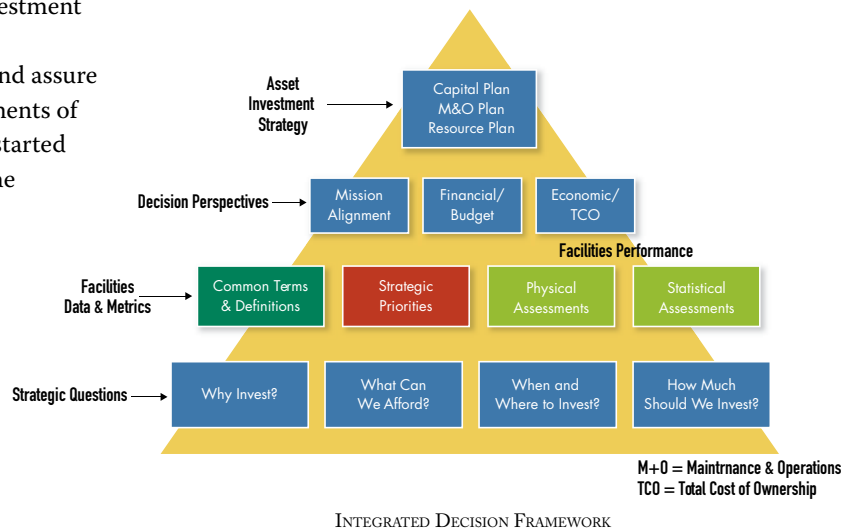
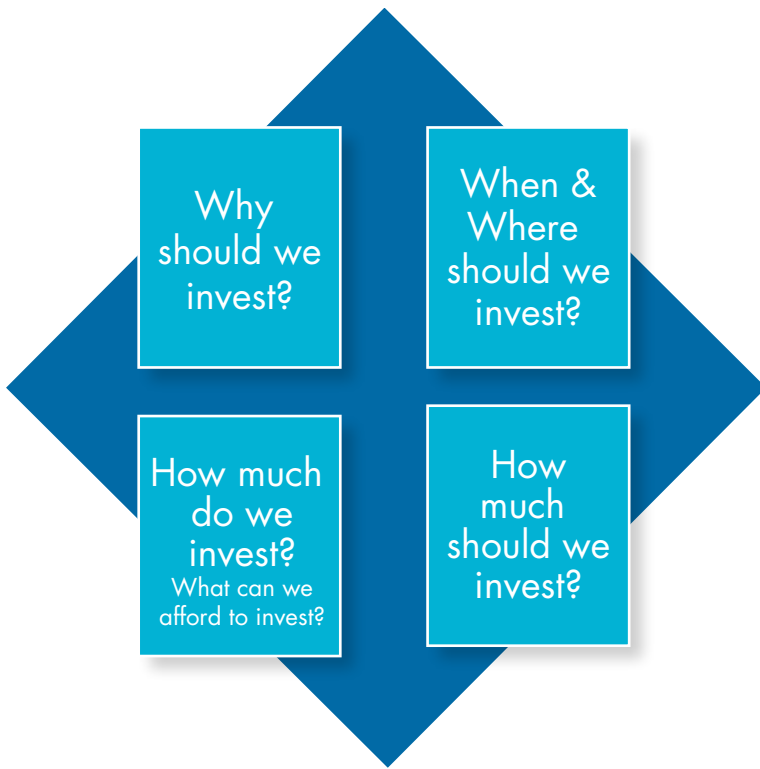


Figure 2: Strategic Questions



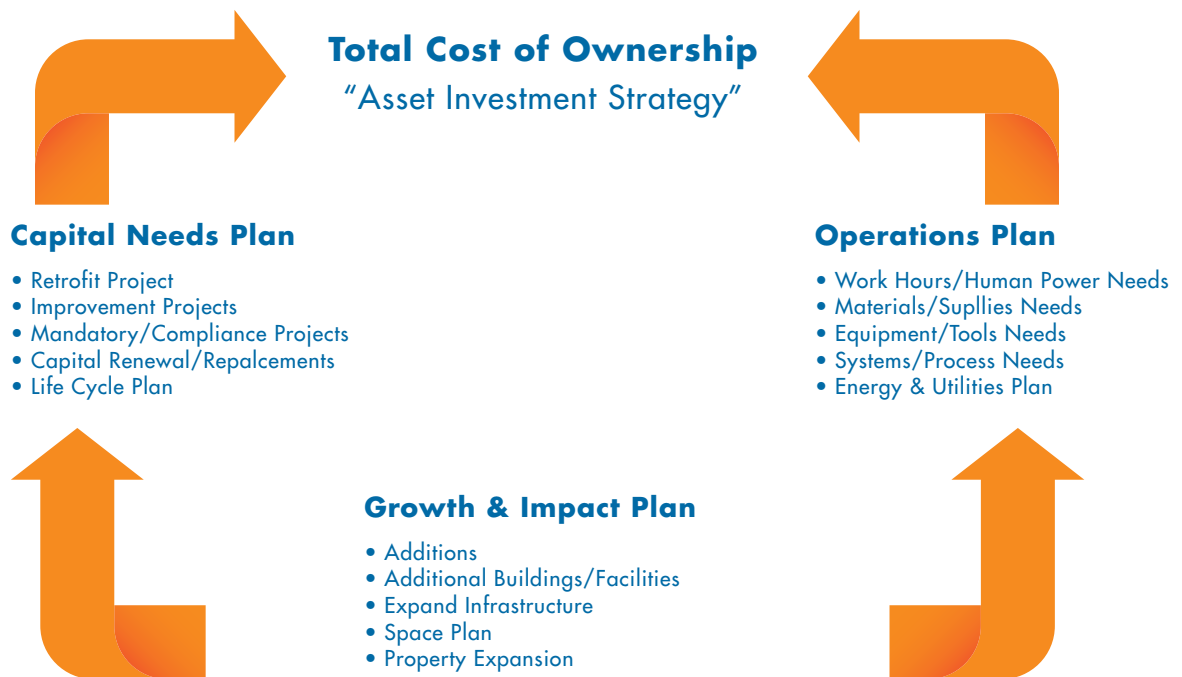
These are the questions asked by trustees and donors to secure capital funding and are the required language when managing assets over time. These owner/investment-driven questions support the total cost of ownership rationale.

Good decision makers require consistent accurate data over time. Measuring and metering performance is a critical part of the pyramid. A solid knowledge of collecting, measuring, and ensuring accurate data is required to achieve the desired results. Decision perspectives clarify where limited capital resources should be invested. Once you have the right decision perspectives you can build long-range, viable, and flexible capital plans that are easily integrated.

The planning for capital funding includes existing assets, retrofits, impacts, future growth, and market. These plans may change at any time, but firmly represent the values moving forward. Each comprehensive plan supports a funding source and the research is summarized in the following three funding sources:

- **Growth & Impact Plan = BIRTH & BURIAL/ PROJECT DELIVERY Funds**
Nonrecurring Funding—One-Time Projects
- **Operations Standard Plan = MAINTENANCE & OPERATIONS Funds**
Recurring Funding—Annual Budgets
- **Capital Needs Plan = RECAPITALIZATION Funds**
Periodic Recurring Funds—Existing Assets

Figure 3: Comprehensive Plans Include



The Strategic Investment Pyramid, if followed, teaches good process, viability, confidence, and the possibility of sustainable practice and resources.

Armed with the APPA TCO model and the Strategic Investment Pyramid, APPA's researchers developed criteria for a second TCO research project. This research, primarily funded by ASHRAE, was an effort to learn if these models would work in a nonprofit environment and would be sustainable. In addition, ASHRAE was interested in the data collected on HVAC systems and how they would impact their Service Life/Operations cost database. The research is completed, and the final report is being peer reviewed by ASHRAE technical committees. We will share results from the APPA/ASHRAE research effort in the future.

APPA is undertaking an exciting new standards development project under the auspices of its role as an American National Standards Institute (ANSI) accredited standards developer. Read further for more information about the future of total cost of ownership for educational facilities.

Doug Christensen is president of Christensen Facilities Group, LLC, Orem, UT, and a longtime proponent of the concept and value of total cost of ownership; he co-chairs the APPA Total Cost of Ownership Work Group. Christensen is a past APPA President and served nearly 39 years in facilities and asset management at Brigham Young University. He can be reached at doug.christensen@comcast.net.

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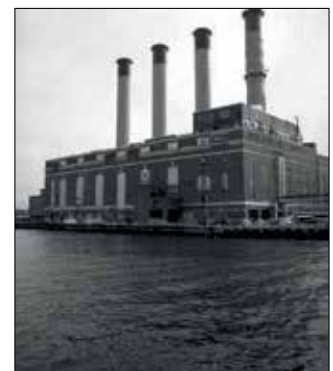
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Defining TCO—A Leadership Tool

By Ana Thiemer

Total cost of ownership (TCO) addresses the very issues at the heart of any asset management program—how to effectively manage assets while getting the most bang for your buck. Applying TCO to our day-to-day operations is more feasible than one might think. TCO embraces technology, data, and, most importantly, leadership skills.

TCO principles have been acknowledged throughout history, encompassing many industries and businesses, thus highlighting that this good advice has typically been around much longer than we realize. For example, the definition of TCO as “total cost of *occupancy*” stresses that the same principles translate to the leased and owned market.

BREAK DOWN THE SILOS

TCO begins with leadership, sharp leadership that focuses on adapting to new directions, aligning constituencies, and inspiring the team. These leaders also focus on the effectiveness of the results. The TCO approach, utilizing leadership skills, removes the walls of a silo that obstruct communication and data flow between entities such as project management and facilities management or operations. Note some of the main silos in Exhibit A. These silos represent many of the organizational structures present in many asset management organizations today. In many

cases, the bigger the organization, the stronger the silos.

Effective TCO implementation actually retains organizational structures or silos. However, the change occurs in the interaction and communication between these organizational structures. Sharing of information increases, and the knowledge gap between the organizational structures decreases. This arrangement generates multiple positive implications not only for the organization, but for the campus customer as well.

Currently, assets are managed independently within organizations with little transparency between the different entities. For example, the operations and maintenance unit transfers little data and information on the dollar amount of work incurred on an asset to the capital unit of the organization. These units, working independently of each other, possess and retain critical information. This information, if distributed to others in the organization, would allow for better asset management.

WHY HAVE SILOS?

Although typical management silos encourage little to no transfer of data and knowledge about an asset, management silos offer expertise on specific tasks and scopes within the various stages of an asset. Without management silos, confusion and chaos may drive the organization into further mismanagement.

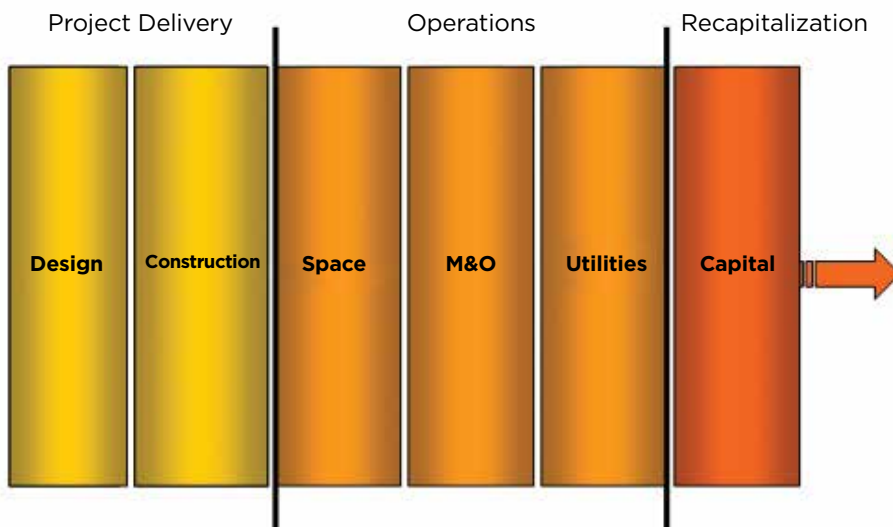
To manage assets effectively, management silos need to communicate and transfer accurate data to other units.

As a check and balance, accountability and approval processes mitigate the loss or miscommunication of data. Some management teams enlist in the support of a professional to transfer data through all levels of the asset’s life. Implementing TCO to create invisible silos creates a leadership opportunity.

VISION

Through TCO, leaders make the right decision by managing the total cost of owning any asset. TCO centers on all asset investments (i.e., first costs, ongoing maintenance costs, renewal or replacement costs, demolition costs, etc.) with all decisions emerging from

Figure 1: Management Silos



an accountability to the bottom line. Owners, asset managers and the financial administrators gain confidence in decision making by utilizing TCO. Financial administrators have full transparency of the investment: how the investment is operating, how the investment is performing, how much additional investment may be needed throughout the life cycle, and when to best reinvest in the asset.

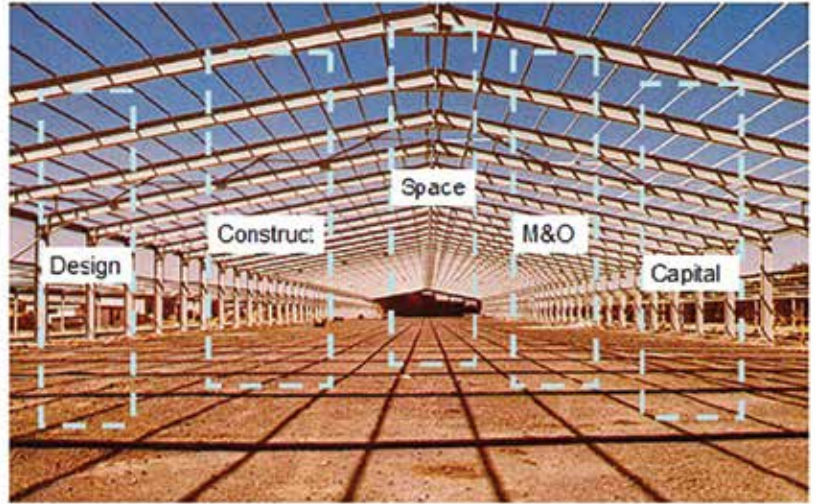
Employing TCO creates complete transparency and supports the owner. Trust is gained by allocating the appropriate resources to the investment and by managing the asset economically. However, a shift in the “business as usual” approach is required.

When the paradigm shifts, everything goes back to zero.

FRAMEWORK

Total cost of ownership is a leadership tool designed to manage all assets effectively. So, how does it work? TCO, a principle-based framework, identifies three costs needed to manage the life of an asset. Each can broadly be viewed as comprising one-third of the total cost of ownership of a facility.

Figure 2: TCO = Invisible Silos



An important part of TCO involves skilled leadership to promote the sharing of data and knowledge. Certainty of making the right decision engages knowledge from clearly delineated

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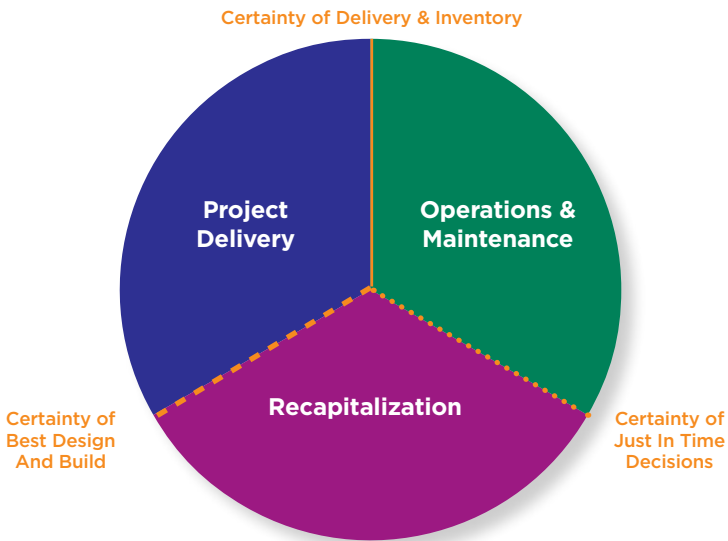
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Figure 3: Principle Based Framework

FRAMEWORK	Birth & Burial (non-recurring)	
	cost A	Concept to Bid
	cost B	Financing
	cost C	Construction/Install
	cost K	Decommission/Demolition/Disposal
	Maintenance & Operations (annual recurring)	
	cost D	Operations
	cost E	Planned Maintenance/Routine
	cost F	Repairs/Breakdowns
	cost G	Utilities
	Recapitalization (periodic recurring)	
	cost H	Retrofits/Improvements
	cost I	Programmatic Upgrade
cost J	Replacement/Renewal	

Figure 4: TCO Total Cost of Ownership



areas or silos, a principal component of total cost of ownership. Once achieved, knowledge about the asset is accessible to management, maintenance, decision makers, and investors. This information includes, but is not limited to, maintenance manuals for equipment, links to websites, building automated system readings, meter readings, work orders and history, service requests, preventive maintenance, replacement cost, and cash flow. Allowing data to be transparent across all organizational areas (or silos), produces the best decision and generates the highest return on investment.

TCO OUTCOMES

Currently, asset managers strive to ensure that the asset reaches the end of its useful life, pouring in thousands or possibly millions of wasted dollars to achieve this goal. What if the asset manager strove instead to provide the best decision based on data and knowledge about the asset? Implementing total cost of ownership allows for a total awareness of the investment of the asset. This includes:

- Recognition of when to mitigate future excessive costs based on current maintenance and repair costs,
- Knowledge on how to lengthen the life of the investment,
- Wisdom to determine which assets are most economical in their business environment;
- Intelligence on future cash flow projection over any length of time;
- Knowledge to create a virtual annual plan for new and existing investments; and
- Insight on both unnecessary expenditures and resourceful expenditures

At any point in time, asset managers demonstrate the successful execution of investment goals for an asset. Supervisors over the different areas (or silos) gain knowledge and wisdom about the total asset, transforming the facility manager to an *asset* manager. Asset management brings a total awareness of an asset, and in turn, allows organizations to see the best return on investment. Most importantly, the asset manager improves the relationship with the owner or investor.

Total cost of ownership is not a new concept, yet organizations are slow to implement. TCO requires skilled leadership to communicate information about an asset, and to make this information transparent to everyone in the organization. Integrating your organization with TCO can prove to be challenging; silos and “business as usual” methodologies are not easily transformed.

Ana Thiemer is assistant director, planning, at the University of Texas Austin. She is the CAPP rep to APPA’s Information and Research Committee, and she serves as co-chair of the APPA Total Cost of Ownership Work Group. She can be reached at ana.thiemer@austin.utexas.edu. This is her first article for *Facilities Manager*.

Establishing an ANSI/APPA TCO 1000 Standard

By Dana K. Smith, FAIA

The headlines out of Flint, Michigan and many other cities with failing infrastructure are politically charged and there is much finger pointing as to who is responsible.

The story in Flint Michigan has not yet fully played out, but the prospects are not looking good at this point. How long will it be before people become fiscally responsible for all of the new work put in place and put aside some of the tax revenue for future maintenance? It seems when politicians and leaders put money aside it gets tapped for other pet projects. Overtime, as the mandatory repairs come along, and the funds are no longer there. This is simply fiscally irresponsible.

Colleges and universities often fall into this situation too. They conceive the building of a new facility and may receive alumni donations for only the construction of a new facility. The facility is then built, and the institution is then challenged with sustaining it for the next 100-plus years.

It is interesting that in the United States we more often than not are of the view that a 100-year old building is “old.” I remember eating at an establishment in Paris that had served as a restaurant since the 15th century. It was a pleasant experience as well as a transformational one for me as I came to recognize

that there really should be no end date for any facility. It just may require some major renovation, which could even involve the structure. Everything has a life cycle and needs to be sustained, at least until its useful life has truly expired.

For an example of failed understanding of true “total cost,” one can turn to the real estate market during the last decade. Previously, mortgage companies used a model that indicated how much one could afford for a new mortgage, and the formula included enough additional income to cover the cost of operating and maintaining the home over at least the life of the mortgage. Over time those formulas have changed so more people could “afford” to buy houses. Problem was that the houses did not come with money trees to cover the costs, and many of the lending institutions ended up foreclosing and the taxpayers ended up bailing out the fiscally irresponsible lenders.

WHAT'S INCLUDED IN THE TOTAL COST OF OWNERSHIP?

While TCO is often called life-cycle cost, it is actually much more as we attempt to understand *all* the associated costs of a facility. While it certainly includes all first costs such as plan-

Figure 1: What Goes into Total Cost of Ownership



ning, design, and construction, TCO also includes the cost of accurate handover of data to the owner, including commissioning, which validates that this was the facility purchased and that it is performing as contracted. The owner needs to be able to accept and use the information for the life of the facility. It also includes the cost of operating and maintaining the facility, which is typically accounted for, over time, if not initially.

At the end of a facility's planned life, TCO includes the cost of disposal and any reclamation. Including this in the upfront

assessment will help minimize the use of environmentally unfriendly products.

Finally, the implementation of TCO includes business processes to capture life-cycle knowledge to be applied on future projects to refine the model, another completely overlooked facet.

THE 13 PRINCIPLES OF A TCO STANDARD

A standard is being developed through APPA as an ANSI approved standard entitled **APPA 1000**. It will be based on 13

principles that need to be brought to consensus so TCO strategies will be similar and can ultimately be compared. The 13 principles as presently drafted are listed later in John Bernhards' article and will be articulated in the standard. We look for your participation in the public review as we develop the standard over the next several months.

We have certainly had enough experience to be able to accurately predict when a product will fail at this point. After all, planned and engineered obsolescence is an art form in manufactured products and can be adjusted as needed to support customer acceptance.

You don't have to go any further than the auto industry for that example. At one point, U.S. cars were falling apart after a very few years, then the Japanese came along and built cars that lasted far longer—and people bought them. That ultimately turned around the U.S. auto industry and it is now far more competitive in quality and reputation for longevity.

That industry discovered that people will pay more to have a product they do not have to worry about if it will get them where they need to go. Yet in the facility industry we seem to be hard pressed to learn from experience. We collect very little life-cycle information, and we still rarely build reserve studies for our facilities. Typically, our maintenance budgets are fashioned around just how much we can scrape together so they do not fail catastrophically, which is not a fiscally responsible approach.

Yet only a few universities have adopted a total cost of ownership



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Figure 2: War Memorial Gym at Virginia Tech.

strategy not only for new facilities, but for all of their existing facilities as well. This results in quality facilities that will ultimately increase pride and attract more students. In addition, it can result in increased donations and grants to the university to keep it that way, therefore making TCO a truly sustainable and practical philosophy for the built environment. The alternative is painful to watch as a facility deteriorates in front of one's eyes.

CONCLUSION

While still a student, I was fortunate to be the assistant field engineer on a several million-dollar athletic facility being constructed at the university I attended. It was a wonderful facility, and I was proud to have worked on it. I finished school just before it opened.

Many years later I was on campus and walked through the once-beautiful facility, and I was amazed to see how run down it was. The happy ending is that I walked through again recently and it had been refurbished and again looked new. Hence, it appears the university does have a program to sustain their facilities, it is

just that their schedule may need to be slightly adjusted so that routine maintenance on the facility is done so it does not deteriorate too much before renovation. Clearly, it is not just first cost and renovation, but also maintenance and technology improvements that go into the total cost of ownership.

Total cost of ownership applies to every level, and it is at the heart of being fiscally responsible. Take the steps today to obtain a reserve study for all of your facilities and move toward adopting a total cost of ownership strategy for your college, university, or any facility with which you are associated. We look forward to your support of the *APPA 1000* TCO standard now under development, which will provide a common strategy and allow implementation of a meaningful facilities policy at all higher education institutions.

Deke Smith has construction, value engineering, life-cycle costing, and building information modeling experience and is an advocate for ensuring a sustainable future for the facilities and infrastructure industries. He is president of DKS Information Consulting, LLC, Herndon, VA, and serves as a co-chair of the APPA Total Cost of Ownership Work Group. He can be reached at deke@dksic.net.

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The APPA Total Cost of Ownership Standard—The Path Forward

By John Bernhards

An ongoing challenge facing educational facilities—and the facilities industry in general—is the ability to define, quantify, and consistently manage a building or facility by following the principles of total cost of ownership through all stages of a building’s life: project delivery (design and construction phase); maintenance and operations; and recapitalization. Maximizing the efficiency and use of the built environment requires a holistic approach, looking closely at each of these three phases and accurately projecting costs over a building’s full life.

In November 2015, through actions undertaken by the APPA Standards and Codes Council (ASCC), APPA announced its intention to develop an ANSI standard that supports the application of total cost of ownership principles and practices within the facilities sector. The TCO standard will be entitled *APPA 1000, Total Cost of Ownership for Facilities Asset Management*. As an ANSI Accredited Standards Developer (ASD), APPA will develop *APPA 1000* using standards development procedures crafted by the ASCC, and approved for use by ANSI.

The APPA TCO Work Group formally launched in March 2016, and comprises 26 stakeholders and leading TCO subject matter experts, including facility owners and managers in education as well as other sectors. Also among those serving on the TCO Work Group are knowledgeable facilities, design, engineering, operations experts from architectural firms, and equipment and software manufacturers. Additionally there are volunteer

leaders from other industry facilities organizations, the International Standardization Organization (ISO), and ANSI standards development organizations.

The *APPA 1000* standard will enable owners of facilities assets in education and other sectors to implement standardized TCO principles and practices within their building and infrastructure portfolio from “cradle to grave.” It will serve as a much needed blueprint for facilities owners to more effectively execute strategic cost planning and decision making at every stage of any given building and throughout the building’s life.

While total cost of ownership has long been a vision for facilities professionals, few have successfully implemented the concept. One of the reasons this transformation has not taken place is due to a lack of recognized and adopted standards. With a TCO standard, the owner and stewards of facilities assets can establish necessary policies that support a holistic approach to facilities cost management.

Within the sector of educational facilities, where institutions design, finance, build, operate, maintain, and ultimately dispose of their properties, a TCO approach provides a step for sound fiscal management. Significant savings can be realized when buildings, facilities, general site, and infrastructure decisions are made by expanding beyond the “first cost” mentality and looking at the total cost of ownership and ROI of those investments in facilities and supporting infrastructure.

The *APPA TCO 1000* standard will be developed in three phases. This first phase will identify and standardize the “key principles” of TCO, which are the essential requirements for implementing TCO for facilities and the built environment. This first phase will likely be completed by year-end 2016.

TCO PHASE TWO

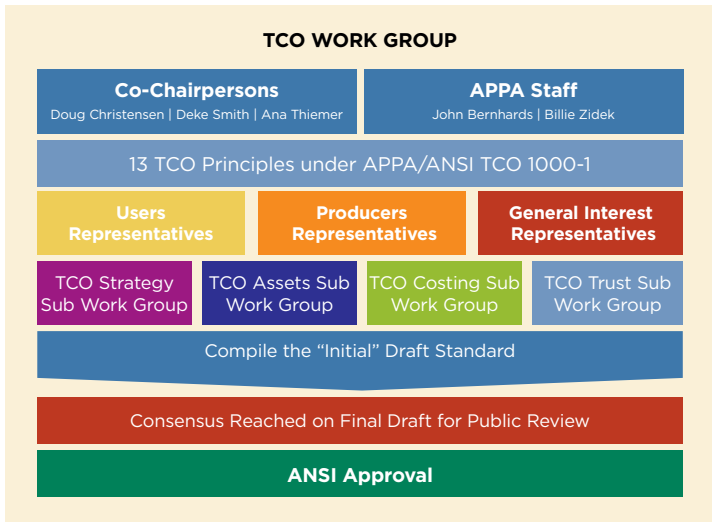
The second development phase of *APPA 1000* will be a concentration on the following necessary “certainties” when implementing total cost of ownership.

Certainty of Delivery and Inventory—In order for a facilities organization to perform most effectively, and to maximize the intended life and use of a building, it is imperative that there is an accurate listing and database of all building assets.

TCO’s Key Principles

(As Presently Identified by the TCO Work Group)

1. Location Hierarchy
2. Asset Classification
3. Managed Assets
4. Asset Costing
5. Asset Inventory
6. Asset Inspection
7. Asset Comprehensive Plan
8. Asset Decisions
9. Asset Annual Funding
10. Asset Reporting
11. Asset Sharing Data
12. Data Verification
13. Asset Performance



This enables the organization to successfully anticipate optimal maintenance and eventual replacement requirements of building systems, equipment, and material over time.

Certainty of Just-in-Time Decisions—With a full accounting of a building’s assets, it is then possible to track and monitor performance throughout the building’s life, and to contrast its performance to other buildings. If certain assets—whether they be equipment, assets, or building materials—perform for a shorter or longer period than anticipated, the availability of such collected information can be used to make more intelligent purchasing decisions, and improved repair and replacement decisions.

Certainty of Best Design and Build—Finally, with data collected from existing facilities, it is possible for owners, designers, and planners to make informed and cost-efficient decisions with regard to future refurbishing or new building design and construction projects. The application of TCO means that performance data of existing facilities provides a blueprint for best in class design for the purpose in which the building or facility is intended.

CONCLUSION

It is not the intent of the TCO Work Group to design APPA 1000 as a prescriptive standard. Rather, the intent is to leave room for adopters of an ANSI approved standard to develop the tools necessary to embrace use of the standard in their own organizational culture and information systems.

The TCO Work Group co-chairs—Doug Christensen, Dana “Deke” Smith, and Ana Thiemer—are to be commended for their immense efforts and for their attention to detail, as APPA successfully launches its TCO Work Group and program of work. In addition, the co-chairs have established Sub Work Groups (see diagram below) within the full TCO Work Group. The Sub Work

Groups are refining the focus on the work program and are developing draft language of APPA 1000 for consideration and approval among the full TCO Work Group membership.

This is an exciting endeavor and momentous time for the facilities sector, as APPA brings together the very best experts in facilities to define the path forward for the implementation and adoption of true total cost of ownership.

TCO WORK GROUP

Co-chair: Doug Christensen, APPA Fellow, APPA Past President, and Director of Facilities, *Brigham Young University (retired)*

Co-chair: Dana Smith, DKS Information Consulting, LLC

Co-chair: Ana Thiemer, *University of Texas Austin*

Bob Askerlund, *Salt Lake Community College*

Darryl Boyce, *Carleton University*

William Brodt, *National Aeronautics and Space Administration (NASA)*

Greg Ceton, *Construction Specifications Institute*

Cameron Christensen, *Brooklyn Academy of Music*

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Glenda Mayo, *University of North Carolina Charlotte*

Chuck Mies, *Autodesk*

Robert Quirk, *RJ Quirk, FMC*

Tom Smith, *University of Wisconsin*

Wayne Stoppelmoor, *Schneider Electric*

Jim Whittaker, *International Facility Management Association/ Facility Engineering Associates, P.C.* 

John Bernhards serves as the associate vice president of APPA, Alexandria, VA, and as the staff liaison and adviser to the APPA Standards and Codes Council. He can be reached at john@appa.org and at 703-542-3848.

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