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# The life-cycle audit: A way to understand and communicate the need for facility reinvestment

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is the President of Diversified Intelligence, a life-cycle audit software and services company which he founded in 1994. Under his leadership, Diversified Intelligence has issued successively more powerful versions of Facility AuditMate, a life-cycle audit programme widely adopted by institutions in the US and Canada. Diversified Intelligence has also conducted facilities audits for a variety of public and private organisations, including Entergy Services, the US Navy, the Massachusetts Department of Housing, the South Dakota Department of Transportation, Charleston Parks and Recreation, and Bowling Green State University. Jay frequently speaks on life-cycle audits and in recent years has been invited to make presentations at conferences organised by TFM, the National Association of Physical Plant Administrators, the Building Owners and Managers Association, and the International Facilities Managers Association. Before starting Diversified Intelligence, Jay was a building inspector and project manager for the University of Virginia, where he was responsible for inspection database design, programming, and facilities inspection.

## Abstract

A life-cycle audit is a multifaceted tool which helps facilities managers achieve a variety of goals. A life-cycle audit produces a comprehensive, detailed summary of immediate facilities needs. It also helps facilities managers forecast their needs 20 years into the future, and it helps them make a much more persuasive case for facilities reinvestment. As such, it is a compelling, cost-effective alternative to traditional facilities inspections.

## Keywords:

life-cycle audit, facilities reinvestment, facilities inspections, condition assessment, deferred maintenance, facility condition index

## TRADITIONAL FACILITIES INSPECTION

What is the matter with a traditional facilities inspection? Nothing at all — if its limitations are clearly understood. Conducted by an experienced team of architects and engineers, a facilities inspection provides a detailed snapshot of a given facility at a specific moment in time. It is an invaluable aid in helping facilities managers identify deferred maintenance and establish specific project needs for their facilities portfolio.

It is true, however, that reports from even the most experienced inspectors are, to some extent, subjective. For instance, depending on experience and temperament, one team of inspectors might

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## Facilities inspections vs Life-cycle audits

recommend that a roof system be replaced, while another might decide that replacement could safely be deferred for a few years. As long as managers and engineers agree on a set of basic premises, they can create a report that is consistent, if not completely objective.

It is when they are used as a predictive device that facilities inspection reports display serious shortcomings. Facilities inspections are essentially historical in nature. Their value is highest the moment they are concluded, but fade rapidly over time. A facilities inspection report evaluates the condition of a component at a specific moment; it cannot predict whether the component will be performing adequately five years into the future. The only way to find out is to schedule another facilities inspection five years hence, a costly proposition.

## THE LIFE-CYCLE AUDIT

Unlike a traditional facilities inspection, a life-cycle audit is designed explicitly to help facilities managers and financial officers plan for facilities reinvestment. It can reveal the condition of facilities today, but more importantly, it can project their condition 5, 10 or even 20 years into the future. It gives facilities managers the ability not merely to respond to changing building conditions, but also to plan for them.

## Computer-based model

Like the facilities inspection, the life-cycle audit begins with a survey of building components and subsystems, but here the two approaches diverge. Life-cycle audits rely on computer-based, statistical methods whose forward-looking equations incorporate such factors as component unit costs and component life cycles. With this information in hand, it predicts when individual building components and subsystems will reach the end of their useful lives and determines how much funding should be set aside to replace these components. Life-cycle audits create a dynamic model of a building's condition, rather than a static image.

In practice, a life-cycle audit is less assessment than enumeration. Buildings are viewed as assemblages of components, with a lifespan and a cost based on nationally recognised life cycle and component cost data. As shown in Figure 1, the auditor need only identify the component (its lifespan and unit costs are predetermined), measure its size, and indicate the year of installation to complete data entry for a single component. The life-cycle audit programme will automatically generate the year of replacement and the replacement cost.

## Customisable

One of the strengths of the life-cycle audit is that it can be readily customised. Although based on industry standard replacement costs and component life cycles, life-cycle audit software can be tailored to the condition of an individual component. If a component seems to be wearing out prematurely, its lifespan can be reduced. Replacement cost information can also be adjusted to reflect regional differences in the cost of materials. Even the annual rate of

**Facility AuditMate Pro - [ENTER FIELD DATA]**

File Edit View Help

Components Enter Data Reports Utilities Facilities Projects

Number Facility Name  
Russell East

Quantity: 13320 S.F. @ \$6.95 Lifespan: 20

Year Installed: 1989 Years Offset: -6

Note: Hurricane Hugo roof - in poor condition

Class Description

Exterior Closure	Painting, Exterior on Masonry or Stucco, Elastomeric
Exterior Closure	Painting, Exterior on Wood, Primer and 2 Coats
Exterior Closure	Storefront Double Door, Metal and Glass
Exterior Closure	Storefront Single Door, Metal and Glass
Exterior Closure	Metal Double Hung Window, Single Paneled
Exterior Closure	Aluminum Frame and Glazing
Exterior Closure	Window Shutters, Vinyl-Coated Aluminum
Roofing and Drainage	Built Up Roof, Smooth Surfaced
Roofing and Drainage	Parapet Caps, Galvanized Metal
Roofing and Drainage	Downspouts, Galvanized Steel, Heavy Duty
Interior Construction	Toilet Partition, Plastic Laminate

Figure 1: Typical data entry information for a building component

Open assumptions

inflation, used for determining replacement costs, can be modified. With life-cycle audit software, facilities managers can create a predictive tool that most closely reflects local circumstances.

Essentially, a life-cycle audit, as opposed to a facilities inspection, is an open process. The facts used to evaluate a component — the year of installation and its size — can be readily determined, and the assumptions used in making predictions about lifespan and unit cost are transparent. In a traditional facilities inspection, these assumptions are often unstated and, consequently, unexamined. They may not be applied consistently during a specific inspection or, over a period of years, from one inspection to another.

Another significant difference between a life-cycle audit and a traditional facilities inspection is cost. Licensed engineers are not required to conduct an accurate, comprehensive life-cycle audit, so the cost of the audit itself is less than a comparable inspection. Furthermore, data collected during an initial life-cycle audit does not need to be updated. A life-cycle audit is a one-time affair, yet produces a dynamic data set that can easily and reliably be used to create 5-, 10- and 20-year plans. Even facilities inspections conducted at 5-year intervals — a costly exercise — cannot approximate the predictive value of a single life-cycle audit.

Lower cost

LIFE-CYCLE AUDIT: A PROVEN VERSATILE TOOL

Life-cycle audits have been applied to a variety of facilities with equal success. A life-cycle audit has been used successfully in fast-

## Case studies

growing Travis County, Texas, which surrounds the bustling state capital of Austin. County government officials were stymied in their effort to accommodate growth and build new facilities, because they had difficulty putting a firm figure on the cost of maintaining existing structures, which covered 1.1 million square feet. A life-cycle audit gave them the facts they needed to address deferred renewal needs while planning for growth.

Administrators at Washington and Lee University in Lexington, Virginia, faced a different problem. It was not simply the extent of their facilities — totalling 1.6 million square feet — that made them difficult to track. It was the range of construction methods and materials contained in their buildings. A full one-third of the structures at this historic, 250-year-old university are more than 75 years old, making developing a plan for facilities re-investment for such diverse holdings a challenge. Facilities managers at the university found that the lifespan and unit cost database underlying the life-cycle audit could easily be adapted to the requirements of historical renovation, enabling the school to develop a more rational planning process and to highlight areas that need attention.

The private sector has also adapted life-cycle audits. They are especially attractive as a cost-effective alternative to facilities inspections and are used by corporations with widely distributed facilities or by those that have just acquired facilities as a result of a merger.

### HELPING FACILITIES MANAGERS UNDERSTAND THEIR FACILITIES

Entergy Services is a case in point. Entergy Services is a Fortune 500 energy company engaged primarily in electric power production, retail distribution operations, energy marketing and trading and gas transportation. The challenge Entergy faced in managing its facilities was substantial. It was responsible for 201 buildings totalling 3.8 million square feet. They were located in four states and included everything from office towers and customer service centres to storerooms and line sheds. Even after it decided to focus initially on its most strategic holdings, the extent of structures requiring study and the diversity of these structures made launching a facilities inspection campaign undesirable. Entergy Services needed a consistent method with good predictive powers that could be scaled to its needs. It turned to a life-cycle audit.

Entergy looked at a variety of strategic components including roofs, doors and windows, HVAC, plumbing, electrical, fire protection, paint, carpet and other flooring, and parking lots and fences. In essence, the company's facilities managers were interested in every component with a lifespan of 50 years or less. Their target was to gather between 30 and 40 records per building, though facilities managers can adjust this number depending upon the age of a building, its condition and its specific function.

Once they have entered the life-cycle data in their system,

Persuasive reports

planners from Entergy and other organisations conducting life-cycle audits find that the possibilities for analysing the data are virtually inexhaustible. They can easily generate a number of persuasive reports and graphs that otherwise would take untold man-hours to complete. For instance, they can chart the deferred costs for a single class of components across their entire system (Figure 2).

They can also track these deferred costs by components over any interval they chose (Figure 3). Being able to predict when, for instance, their roofing costs would spike not only allows Entergy to budget appropriately, but gives them the information they need to bargain more effectively with vendors.

Entergy also used their life-cycle audit to track deferred renewal for each building in their system and note their facility condition index (FCI). The FCI is the ratio of deferred costs in a facility to renewal costs and can be used to spot locations in need of immediate attention and to guide decisions about these structures' future. An FCI index over 10 per cent is usually cause for concern (Figure 4).

Life-cycle audits can also readily produce another related graph, grouping facilities by age (Figure 5).

Facility condition index

Deferred Components for All Facilities (One Class)				14/12/2004
Class: Roofing and Drainage			Facilities, Your Institution	
Component	Facility	Deferred Cost	Years Deferred	Note
Built Up Roof, Tar and Gravel	WN	\$83,984	18	
Built Up Roof, Tar and Gravel	RW	\$94,120	18	
Built Up Roof, Tar and Gravel	LJPassage	\$4,634	18	
Gutters, Aluminum, Hung	Plant	\$606	8	
Gutters, Galvanized Steel, Hung	LJPassage	\$697	8	
Skylight	Strom Th	\$960	8	
Built Up Roof, Smooth Surfaced	RE	\$92,574	1	in poor condition
Total		\$277,575		

Figure 2: Deferred costs for a single class of components across the entire system

Reinvestment Projections for All Facilities (One Component)					14/12/2004
Component: Built Up Roof, Tar and Gravel			Inflation Rate: 2%		Facilities, Your Institution
Facility	Reinvestmen current year	Reinvestmen 2005-2009	Reinvestmen 2010-2014	Reinvestmen 2015-2019	Reinvestment since current year
Chapel	\$0	\$72,071	\$0	\$0	\$72,071
Reception Center	\$0	\$0	\$32,235	\$0	\$32,235
Library	\$0	\$0	\$172,006	\$0	\$172,006
Little John	\$4,634	\$0	\$0	\$0	\$0
Quad 1	\$0	\$51,974	\$0	\$0	\$51,974
Quad 2	\$0	\$54,505	\$0	\$0	\$54,505
Quad 3	\$0	\$49,112	\$0	\$0	\$49,112
Russell West	\$94,120	\$0	\$0	\$0	\$0
Strom Thurmond Center	\$0	\$0	\$0	\$1,648	\$1,648
Women's North	\$83,984	\$0	\$0	\$0	\$0
Totals	\$182,738	\$227,662	\$204,241	\$1,648	

Figure 3: Deferred costs for a single component over the next 20 years

## Summary Data for All Facilities (FCI Report)

14/12/2004

Facilities, Your Institution

Facility	Renewal Cost	Deferred Cost	DC/RC (FCI)
Ashby Jones	\$1,828,147	\$176,748	9.7%
Chapel	\$2,865,054	\$18,167	0.6%
Gym Field House	\$2,290,846	\$33,500	1.5%
Reception Center	\$300,699	\$0	0.0%
Learning Center	\$118,296	\$447	0.4%
Library	\$2,549,285	\$481,207	18.9%
Nursing	\$890,553	\$0	0.0%
Norris Wingo	\$1,247,415	\$123,013	9.9%
Totals	\$12,090,295	\$833,082	6.9%

An FCI greater than 10% indicates poor condition.

Figure 4: Summary FCI report provides strategic benchmarking at a glance

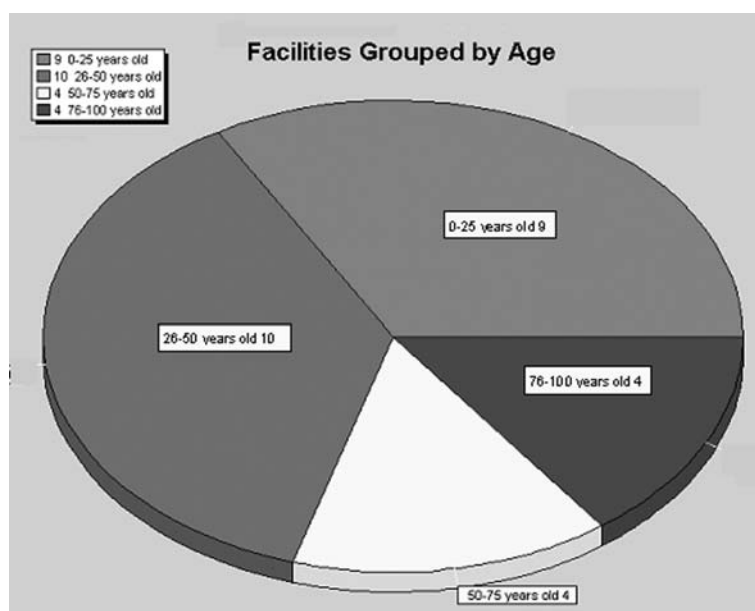


Figure 5: Graphic representation of the age of the plant

## Predictive modelling

Perhaps the most powerful tool for facilities managers is the 20-year funding blueprint (Figure 6). This chart contains a wealth of definitive information that is of the utmost importance in helping facility managers gain a comprehensive overview of their facility reinvestment needs.

The first bar represents current reinvestment needs, based on the total cost for components that have already reached the end of their useful lives. This chart can help managers note trends and identify years with unusually high reinvestment needs. And it can indicate an average annual funding level, while factoring in inflation to create an accurate long-term estimate. Equally important, this chart can be modified using a variety of hypothetical scenarios, for

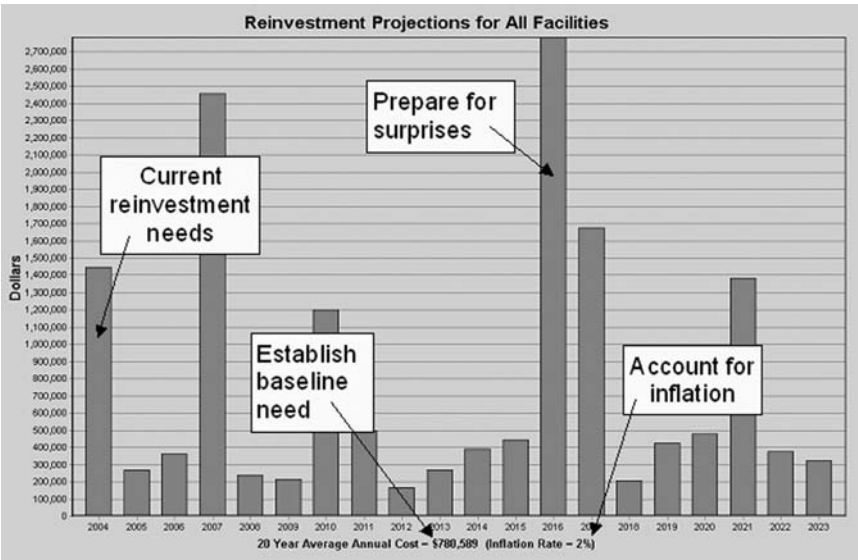


Figure 6: Twenty-year funding blueprint

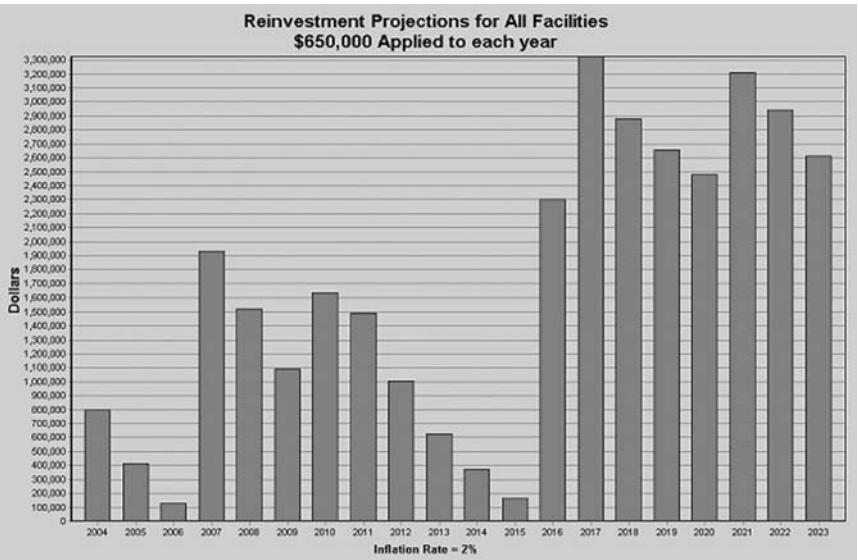


Figure 7: Calculate reinvestment projections based on hypothetical funding levels

instance, allowing managers to assess the effects of different funding levels (Figure 7).

**MAKING A CASE TO DECISION MAKERS AND FINANCIAL PLANNERS**

The life-cycle audit gives facilities managers an invaluable tool for understanding their facilities and estimating their reinvestment needs, now and at any time in the foreseeable future. But their usefulness to facilities managers extends far outside their own offices to the conference rooms where financial decisions are made.

Life-cycle audits — and the charts and reports that can be generated from them — are superb communications tools that can be easily understood by policy makers and financial planners. They give facility managers the means not only to project their annual facilities renewal needs, but also to build consensus to address them.

## Build consensus

There are several reasons for this. The first is that the assumptions that support the life-cycle audits — the lifespan and unit cost data — are open for all stakeholders to review and discuss. Once those assumptions are agreed upon, the reports and graphs that are based on those assumptions must receive support and consensus. By pointing to the codes and manuals that provide authority for these assumptions and by explaining the factors that may have led them to modify them, facilities managers shift the emphasis of the conversation from process to outcome. If they can instil confidence in the assumptions underlying the process, they stand a good chance of generating confidence in their conclusions.

Contrast this situation with the traditional facilities inspection report, whose process is almost entirely hidden. The subjective conclusions of even the most well-informed, experienced expert can always be subject to challenge and can lead to the seemingly endless wrangling with which facilities managers are all too familiar.

## Clearly communicate need

Another reason that life-cycle audit reports and charts are such effective communication tools is that they present information in a format familiar to financial decision makers. With life-cycle audits, financial decision makers do not become mired down in analyses of the physical condition of each component in their facilities; rather they are presented with the financial implications of this condition. The 20-year funding blueprint is a highly effective communication tool, as it conveys in concise graphic form the overall facilities re-investment needs of an entire organisation — and creates the foundation necessary to understand the consequences of any decision that they take.

In essence, life-cycle audit reports and charts provide common ground. The topic of the conversation shifts from technical issues, which are the purview of facilities managers, architects and engineers, to financial issues, where facilities managers and decision makers both have expertise. In the process, facilities managers can shift the emphasis from their own to-do list to the larger institutional priorities.

Equally importantly, through the use of life-cycle audit reports, facilities managers can present their recommendations for the institution in a forward-looking light. While a facilities inspection sheds light on deferred maintenance, a life-cycle audit focuses on facilities reinvestment. Money spent on deferred maintenance removes a deficit. Money spent on facilities reinvestment provides a return that can be measured in reduced operational expenditures, increased efficiency and new market opportunities.



## **A BETTER ALTERNATIVE**

In the last five years, life-cycle audits have become increasingly well accepted. Their advantages over traditional facilities inspections have become more widely appreciated and can be summarised as follows:

- They have predictive power. The traditional facilities inspection may be used, at best, to forecast facilities reinvestment needs two or three years into the future. A life-cycle audit creates a dynamic model that can be used to predict reinvestment needs 20 years ahead or more. Such reliable long-term forecasting has become increasingly essential as profit margins and budgets become increasingly tight.
- They are based on objective data. Life-cycle audits incorporate unit cost and lifespan information from industry authorities.
- They are based on consistent data. Life-cycle auditors simply identify components, measure them and establish their installation year. This means that consistent data are collected from one building to the next and from one audit to the next.
- They are lower cost. The cost for a single life-cycle audit is approximately half that of a comparable facilities inspection. The market rate for a standard facilities inspection is approximately 10 cents/square foot. A typical life-cycle inspection is 5–7 cents/square foot. A principal reason for this is that a life-cycle audit, as contrasted with a facilities inspection, does not require the services of a licensed architect or engineer. Individuals familiar with facilities management issues can easily be trained to conduct them.
- They need only be done once. A single life-cycle audit is all that is required to produce data that can be extrapolated into the future. This is a source of additional savings.
- They are easy to maintain. Once the life-cycle audit is completed, new components and structures can be added to it over time. When a component is replaced, all that needs to be done is to change the date. Most life-cycle audit programmes also give facilities managers the ability to append notes or even photographs and CAD drawings.
- They generate an abundance of clear, detailed reports and graphs. Facilities managers can, with equal ease, generate aggregate information as well as information on any single component, and they can do so for a single year or a series of years.

Ultimately, though, the bottom line for facilities managers is that a life-cycle audit can give them a more comprehensive, detailed sense of their facilities needs and help them make a much more persuasive case for facilities reinvestment. Not only can it help facilities managers understand their responsibilities better, it can help them secure the funds needed to carry them out.

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