Assessing Functional Obsolescence in a Rapidly Changing Marketplace

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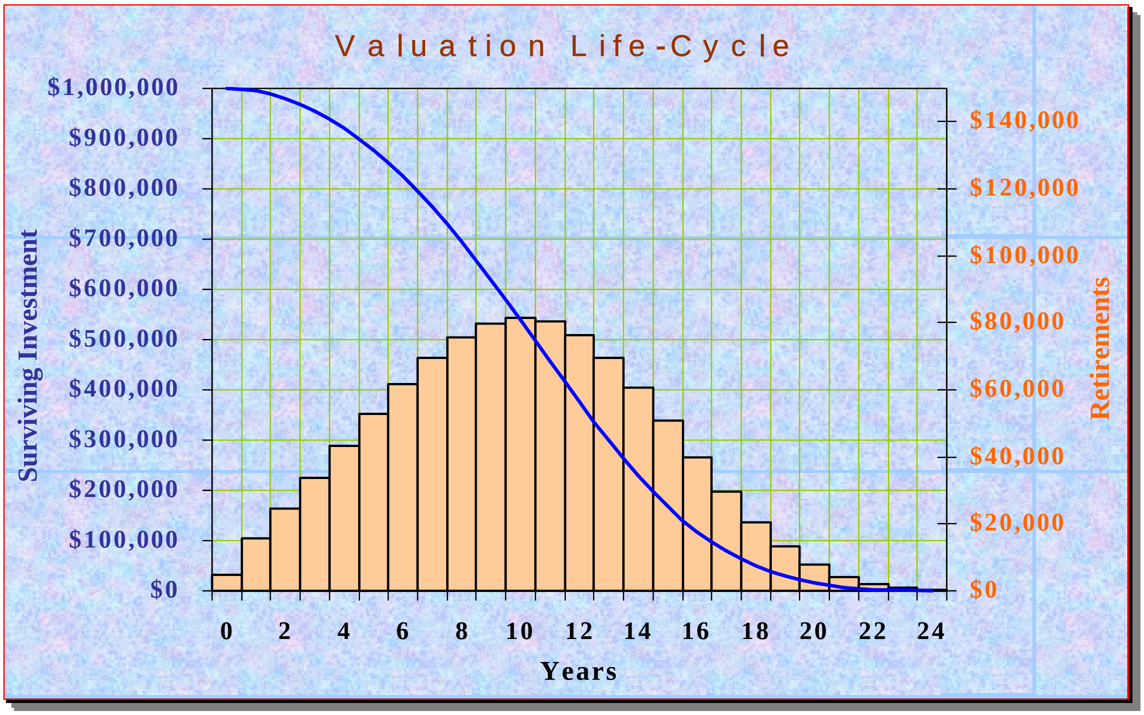

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Abstract

A fair appraisal of the value of tangible personal property must reflect the realities of the marketplace. Today, major technological, regulatory, and market changes are reshaping many industries. The reality of these changes is a profound impact on the economic lives and value of tangible personal property.

This paper presents a Cost-based approach to valuation, which objectively quantifies both Physical Depreciation and Functional Obsolescence, and provides a process to include any additional factors influencing the value of the property. The net impact of the various causes of Functional Obsolescence are separately determined and combined with that of Physical Depreciation and any other forms of economic loss. The resulting assessment of the economic lives and value reflects the realities of the marketplace and all of the factors influencing it. Additionally, the proposed model provides a methodology to statistically combine any number of separately quantified influences to value. The paper also summarizes the results of four case studies, which document the accuracy of this approach to value.

Background

> *Ten years ago a modern digital telephone switching system was expected to have a economic life very close to its physical life expectancy, 15 to 18-years. Today, a modern digital switch has an economic life expectancy of only about 6 to 7-years; far less than its physical life.*

Technological obsolescence, deregulation, increased competition, and increasing market demands for high-speed data communications, are but some of the causes reducing the functionally of digital switching equipment. Collectively, such influences to value are commonly called Functional Obsolescence, and they are having a profound impact on the economic life and value of the personal property of many companies. The challenge to the appraiser is how to effectively capture and quantify the full impact of all causes of Functional Obsolescence.

The traditional techniques employed by most appraisers, for various reasons, often prove ineffective in assessing Functional Obsolescence. As a result, many appraisals subjectively account for Functional Obsolescence. Often, a single factor, based on the judgment of the appraiser, is used to adjust the value to reflect Functional Obsolescence. History has shown that most subjective assessments of Function Obsolescence grossly understate the full extent of its influence. While subjective assessments are sometimes necessary, there is no replacement for an objective and quantifiable assessment of Functional Obsolescence.

To this end, some appraisers use a *comparable-market* approach to assess Functional Obsolescence. The logic supporting this choice is that the net impact of Functional Obsolescence is reflected in the replacement cost. While this approach has some merit, it does not account for the impact that <u>future</u> changes in the marketplace have on <u>today's</u> economic life and value. Using a market-based approach to value inherently and incorrectly assumes that the Functional Obsolescence realized to date, will either not exist in the future or remain constant in the future. The fact of the matter is that the influences of Functional Obsolescence increase with the passage of time. Thus reducing the future functionality of the asset, which directly reduces the economic life, today. Using a market-based approach to assess Functional

Obsolescence will therefore tend to overstate the economic life and resulting value of personal property.

Another impediment to using a market-based approach is that often, especially for utilities, a truly comparable market does not exist. To the extent that the market is not completely comparable, the appraiser must make adjustments to the market data to account for the incomparability. More often than not, the needed adjustments are extensive and subjectively determined. This greatly reduces the reliability of the assessment.

The Income approach to value also has critical limitations when Functional Obsolescence is present. The present worth of future net income streams must reflect the economic lives of the embedded property, and only capture the income contribution from the embedded property. These two criteria, alone, make an Income approach very difficult if not impractical to achieve when Functional Obsolescence is present.

When Functional Obsolescence is present, a cost-based approach to value will produce the more reliable and accurate assessment of value. It will allow the appraiser to separately quantify the impacts resulting from Physical Depreciation, Functional Obsolescence, and any other economic influences. The valuation process outlined in this paper is objective, supportable and yields accurate results when correctly applied.

Overview of the Cost-based Valuation Process

The fundamental process involves assessing the individual impacts of all relevant influences to value; then combining them to yield the net accumulated depreciation and the resulting remaining value. There are three general classes of influences: Physical Depreciation, Functional Obsolescence, and other economic influences.[1]

Because of the differences in the nature of the classes of depreciation, each must be modeled using techniques appropriate for the class. Physical depreciation is best modeled using traditional mortality (actuarial) techniques. Functional obsolescence

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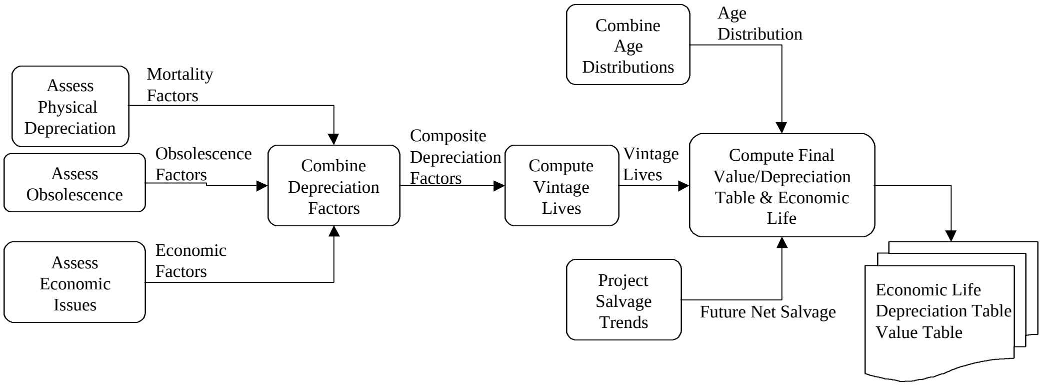
[1] In this paper the influences of depreciation are grouped into three homogeneous classifications: Physical Depreciation, Functional Obsolescence, and Other Economic Influences. These groupings were selected to classify the various causes of depreciation by the methodology that is most applicable to their assessment, and to promote the understanding of the nature of depreciation. Other classifications are certainly acceptable.

is modeled using an extension of technology substitution analysis. Other economic influences, although rare, can occur in a variety of forms; therefore the approach taken is case specific. Ultimately, the impact of depreciation for each class is formatted in terms of the forward-looking probabilities of lost value (herein called depreciation probabilities). In this form, the influences from any number of causes of depreciation are readily combined and the net depreciation determined.

The basic approach is modeled in Figure 1. Each major class of depreciation is separately assessed. The various probabilities from the three causes of depreciation are then combined into net probabilities of depreciation for each vintage (labeled as Composite Depreciation Factors in the diagram). At this point the full depreciation table and economic lives can be computed.

Figure 1

Depreciation Process Diagram



The following sections describe objective techniques for addressing the three classes of depreciation: Physical Depreciation, Functional Obsolescence and other Economic Losses.

Physical Depreciation

Physical depreciation is the loss in value of an asset due to exposure to the elements. The causes of Physical Depreciation include wear and tear with usage, deterioration with age, and accidental or chance loss or destruction.

Physical depreciation is best modeled using traditional physical mortality techniques. These techniques are rooted in actuarial theory as applied to human beings; and were established by Messrs. Gompertz and Makeham in the 19th century. The application of physical mortality techniques to tangible property began in the 1920s as a result of massive studies conducted by the Bell System and by the staff at Iowa State University. These studies proved conclusively that actuarial theory accurately models the effects of physical mortality on personal property.[2]

The physical mortality process uses observed mortality history to establish a mortality survivor curve that reflects past and anticipated mortality patterns. The survivor curve can be expressed using the fundamental form of the Gompertz-Makeham actuarial model, or the survivor curve may be selected from a number of *standard* survivor curve families. The two most popular families of survivor curves are Iowa Curves and Bell Curves.[3]

The shape of survivor curves are independent of the life in that a given survivor curve can be scaled to any physical life expectancy and still maintain its inherent mortality pattern. Survivor curve are selected based on how well the curves mortality pattern fits the historical or expected mortality pattern of the subject property. Figure 2 illustrates a typical survivor curve. Once the mortality survivor curve is determined, the appraiser has everything needed to compute the probabilities of loss due to Physical Depreciation.

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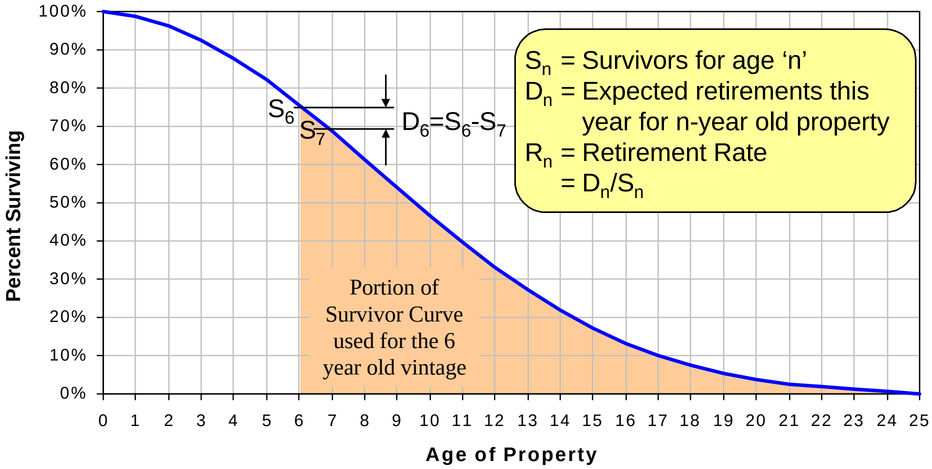
[2] *Public Utility Depreciation Practices*, August 1996, National Association of Regulatory Utility Commissioners.

[3] Each type of survivor curve (e.g., Compertz-Makham, Iowa, or Bell) can approximate that of the others, therefore, the choice of which type of survivor curve to use is one of preference only.

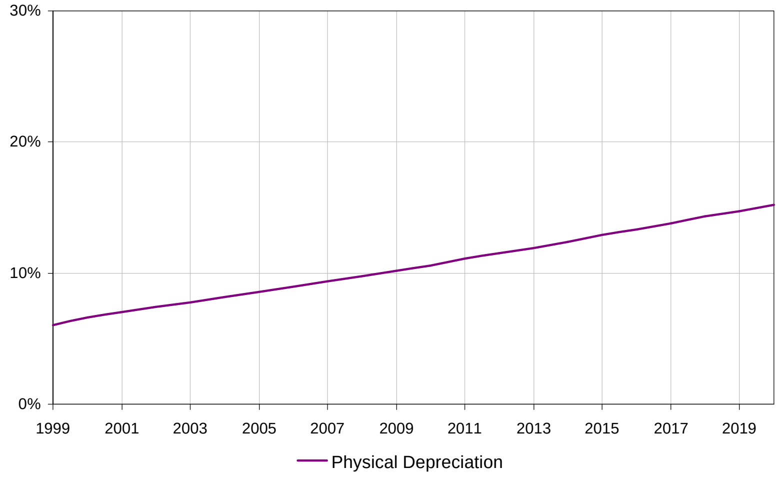
Figure 2 – Typical Mortality Survivor Curve



Consider a six-year old vintage that has traditional mortality characteristics consistent with the survivor curve of Figure 2. The expected depreciation for the current year equals the survivors for age 6 (the property's age at the start of the year) less the survivors for age 7 (the property's age at the end of the year). The probability of Physical Depreciation for the current year is denoted as R_6 in the figure, and equals the depreciation for the current year divided by the beginning of year percent surviving, or $(S_6\text{-}S_7)/S_6$. Repeating this calculation for subsequent years yields the future annual probabilities of Physical Depreciation for the subject vintage of property. Further repeating this calculation for all vintages of property completely defines the expected physical depreciation of the property.

Figure 3 illustrates the future annual probabilities of depreciation derived in this fashion for a given vintage. In this form the physical probabilities of depreciation can be readily combined with the other causes of depreciation. It is important to recognize that at this point, these probabilities reflect only the Physical Depreciation of the property.

Figure 3 – Annual Probabilities of Physical Depreciation



Functional Obsolescence

Functional obsolescence is the loss in value (i.e., depreciation) resulting from a *relative* deficiency of the asset to function for its *intended* purpose. The functional requirements of equipment are subject to change over time. Changing consumer expectations, for example, may promote new functionality that older equipment cannot accommodate; or enhancements to new generations of equipment may increase efficiency. In both of these situations, the functionality of the older equipment relative to its intended purpose is reduced. Both examples are a form of Functional Obsolescence. The relative loss in functionality reduces the value of the older equipment to the property owner.

There can be many forms or causes of Functional Obsolescence; making it difficult to separately quantify the loss in value of each cause. Some of the more common causes of Functional Obsolescence are listed below.

- Regulatory changes
- Increased competition
- Changes in market demands and expectations
- Improved efficiency of new equipment
- Lower prices for new equipment
- Increased functionality of new equipment
- Greater capacity of new equipment
- Other Technical changes

Each of these items contributes to the level and rate of Functional Obsolescence and will ultimately either directly or indirectly lower the utilization of the subject property. While it is impossible to separately quantify the impact of each cause of Functional Obsolescence, the combined impact is reflected in the collective reduction in the relative utilization of the subject property. When Functional Obsolescence is occurring, regardless of the cause, the usage of the subject property relative to that of the newer and more functional property declines.

New combined turbine generation plants, for example, are increasingly generating more electric power relative to total power production. Fiber optic communication cables are also increasingly carrying more of the world's communication traffic. In each of these cases, there are many factors that are causing the Functional Obsolescence; however the net impact is manifested in the overall decline in relative utilization of the older equipment.

Consider the case of fiber optic communication cables substituting for older technology copper cables. Some of the drivers of the function obsolescence of copper cables include: the deregulation of long-distance and the local telephone industries, increasing competition, lower cost, changing consumer expectations, increased demand for high-speed access to the internet, and the increased technical superiority of fiber optic communication systems; just to name a few. Each of these drivers is independently contributing to the Functional Obsolescence of copper cable. The total Functional Obsolescence resulting from all drivers is reflected in the decline in relative usage of copper cable. See Figure 4. The shift in market usage from one technology to another is called *Technology Substitution*.

Technology Substitution analysis measures and projects the market takeover (substitution) of a new technology for an older technology. When the relative market penetration of the newer technology is plotted over time, the result is an S-shaped curve. This pattern of technology substitution has been known for some time, however, not until 1971, did two General Electric researchers defined a model for the S-shaped curve[4]. Their model is commonly called the Fisher-Pry model. The Fisher-

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[4] J. C. Fisher and R. H. Pry, "*A Simple Substitution Model of Technological Change, Technological Forecasting and Social Change*", 1971.

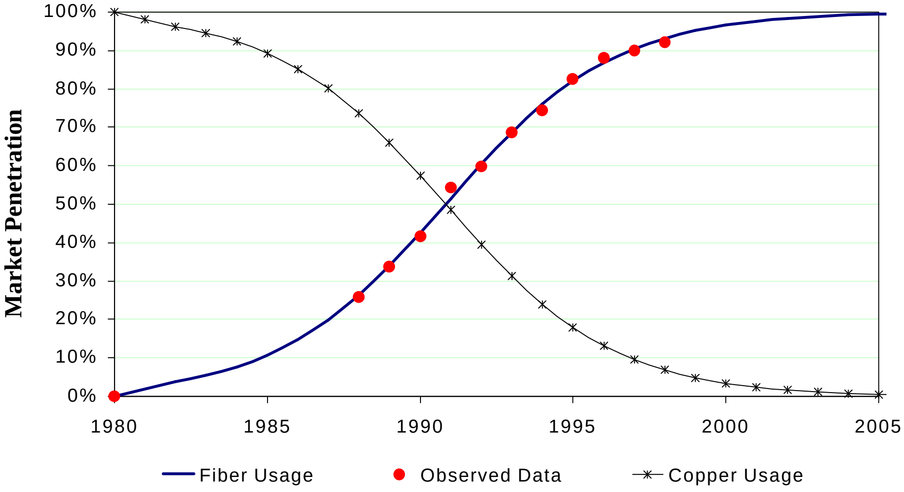
Pry model has proven to be very accurate in predicting the pace of technology substitution and the resulting obsolescence.[5]

When the technology substitution pattern is documented in terms of the relative usage of the old equipment versus that of the newer equipment, it provides an indicator of the Functional Obsolescence of the older technology. This indication may then be used to directly determine the accumulated depreciation resulting from Functional Obsolescence.

The actual fiber substitution for copper cables in the telecommunications Interoffice network is plotted in Figure 4. In the figure we observe that fiber optic penetration is following the classic S-shaped substitution curve. The corresponding decline in the relative utilization of copper cable is also depicted. This decline in utilization gives an indication of the Functional Obsolescence of copper cables.

Figure 4 - Fiber Substitution

(Telco Interoffice Network)



Once the technology substitution patterns are established, the appraiser can then relate the rate of substitution to the rate of Functional Obsolescence. Consider the fiber substitution illustrated in Figure 4. From the observed substitution pattern, we know that the substitution of copper cables does not begin until after 1980. Prior to

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[5] Over 200 technology substitutions, in industries ranging from chemical to aviation, have been identified to fit the Fisher-Pry model. R. C. Lenz and L. K. Vanston, *"Comparisons of Technology Substitutions in Telecommunications and Other Industries"*, Technology Futures, Inc., 1986.

1980, the Functional Obsolescence of copper cables due to fiber cable was negligible, if any. From the figure we can also concluded that by the year 2005, virtually all Interoffice communication will be carried over fiber cables. Any copper Interoffice cables still remaining will be totally obsolete and their value reduce to the residual value. Thus, from simple observation of the substitution of fiber for copper cables, we can objectively conclude that the obsolescence of copper will begin after 1980 and complete around the year 2005.

Functional obsolescence is a gradual process. Like the substitution, it also begins very slowly and gradually accelerates until the market is saturated and the obsolescence is nearly complete. History has shown that the obsolescence is often negligible in the initial stages of the substitution. It generally becomes measurable when the replacement technology begins to penetrate the mass market or about 10% of the total market. In the fiber example, the obsolescence of the copper would be expected to become noticeable around 1985 or about 5 years after fiber deployment began. As the substitution progresses, the initial lag-interval diminishes. By the end of the substitution, the new technology has captured virtually all of the market from the old technology. Obsolescence is assumed complete, with any remaining equipment assigned a residual value.

Figure 5
Technological Obsolescence

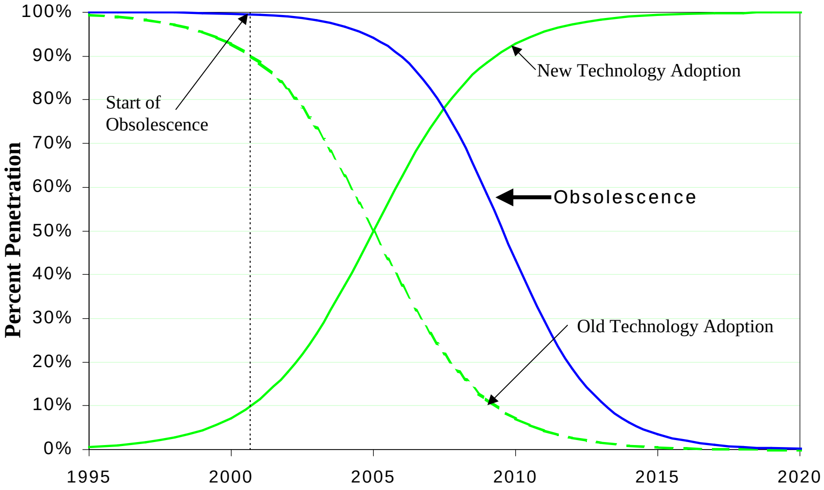


Figure 5 depicts a typical substitution of a new technology for an old technology, along with the projected obsolescence of the old technology. The curve labeled ‘Obsolescence’ reflects the percentage of the current value remaining, as a direct result of Functional Obsolescence. This curve is commonly called the percent surviving.

Once the Functional Obsolescence pattern is established the annual impacts of obsolescence may be calculated in terms of the annual rates of obsolescence. These rates reflect the probabilities of depreciation (or displaced value) resulting from Functional Obsolescence. This is accomplished using the obsolescence curve of Figure 5. For any given year, the net annual probability of depreciation, *p(t)*, is equal to the remaining value, *Ob(t)*, at beginning of year less the end of year value, divided by the beginning of year value. The formula is provided mathematically below.

$$r(t) = \frac{Ob(t) - Ob(t+1)}{Ob(t)}$$

This approach of assessing the value impact of Functional Obsolescence allows the appraiser to accurately determine the net impact of Functional Obsolescence, without having to specifically quantify the impact from each cause. The resulting impact to value is readily documented in terms of the annual probability of depreciation (see above equation), which is easily combined with the impacts from Physical Depreciation and other economic losses. Additionally, actual case studies have demonstrated the accuracy of using this approach to assess Functional Obsolescence. The results of four case studies are provided later in this paper.

Other Economic Influences

All forms of depreciation are Economic Depreciation. In the context of this depreciation process, Physical Depreciation and Functional Obsolescence are separately quantified. Thus, by definition, Economic Depreciation relates to any other depreciation influences not reflected in the assessments of Physical Depreciation and Functional Obsolescence.

Economic Depreciation may take a variety of forms. The challenge to the appraiser is to document the depreciation impact in terms that are readily combined with the other causes of depreciation. Regardless of the reported form of Economic Depreciation, the appraiser must equate the loss in terms of annual probabilities of deprecation by vintage. Like obsolescence, most types of Economic Depreciation are equally applicable to all vintages.

> *Consider the case where a telephone company is expected to loose 35% of their access lines to competition over the next 5 years. The economic loss is not necessarily 35%.*
>
> *Suppose, starting in the year 2001, the company expects to loose 5% of their base the first year, 15% the next two years, and 5% the forth year. After that, the company expects to have effectively dealt with competition and expects that lines gained from competition will offset lines lost to competition. With this additional information, the problem is solved. The projected percent loss in access lines represents annual probabilities of Economic Depreciation. In this form they can be readily combined with other causes of depreciation. In this case, the losses are applicable to all vintages equally.*

Total Accumulated Depreciation

Up until this point, the causes of depreciation have been documented in terms of future annual probabilities of depreciation. The next step in the process is to determine the accumulated depreciation as of a particular date, usually the beginning of the year. The first step in determining the accumulated depreciation is to combine the impacts from the various causes of depreciation. This is commonly done at the vintage level to facilitate valuation by age of plant.

All cause of depreciation are impacting the subject property simultaneously. For example, a given section of copper cable is exposed to both Physical Depreciation and Functional Obsolescence. To determine the total probability of depreciation, the appraiser must statistically combine the individual probabilities.

While both Physical Depreciation and obsolescence are present, only one can cause the displacement of a given item of plant. That is, the probabilities are mutually exclusive. For example, if copper cable has a 10% likelihood of being displaced due to physical reasons and a 15% likelihood of being technologically displaced; the net probability of being displaced is 23.5% (not 25%).

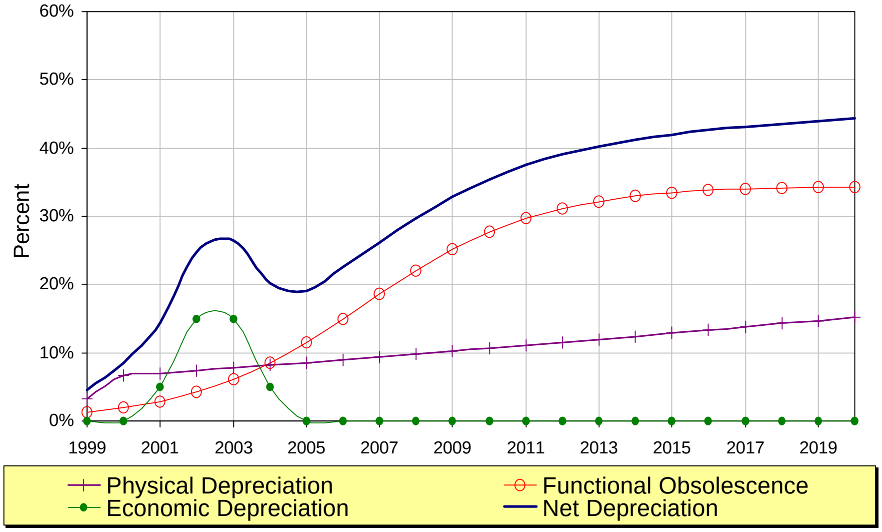
> *Consider: of the 100% of the cables subject to retirement due to Physical Depreciation, 10% will be retired leaving 90% of the original cables. Of these, 15% are subject to retirement from obsolescence; thus, 76.5% (90 – (90*15%)) are likely to still be in service at the end of the year. Thus, the net probability of depreciation is 23.5% or (100 – 76.5). The formula for combining mutually exclusive probabilities is given as:*

$$r_T = r_1 + (1 - r_1) \cdot r_2$$

$$\begin{aligned} &= 0.15 + (1 - 0.15) \cdot 0.10 \\ &= 0.15 + (0.85) \cdot 0.10 \\ &= 0.15 + 0.085 \\ &= 0.235 \text{ } or \text{ } 23.5\% \end{aligned}$$

Figure 6 illustrates the effect of combining different probabilities of depreciation for a single vintage. In this illustration, the individual probabilities of depreciation from the three classes of depreciation, Physical, Functional and Economic, are plotted separately along with the combined probability of depreciation resulting from all three. The Economic Depreciation plotted in the figure reflects the probabilities from the competitive loss example given above. While this illustration includes only one cause of Economic Depreciation, if additional causes are present, they can be independently assessed and combined using this methodology.

Figure 6
Annual Probabilities of Depreciation for the Three Classes of Depreciation



The table of values corresponding to the probabilities plotted in Figure 6 is provided in Table 1. The total probability of depreciation resulting from the three causes of depreciation is given in Column D. Once this is determined, the vintage-level depreciation factors and economic lives can be determined. This is a multi-step process.

First, the appraiser must compute the percentage of the property that has not been depreciated. This can be thought of as the percentage of the current value remaining projected forward in time; and is labeled *Surviving Value* on Table 1. The percent surviving at the end of the year is the percent surviving at the beginning of the year less the depreciation for that year; and equals the beginning of year percent surviving times one minus the probability of depreciation (1–Column D) for that year. The results are given in Column E.

Table 1
Annual Probabilities of Depreciation for a Single Vintage

BOY	Annual Probabilities of Depreciation				Surviving Value E
	Physical Depreciation A	Technological Obsolescence B	Economic Deprecation C	Net Depreciation D	
1999	3.2%	1.3%	0%	4.5%	100.0%
2000	6.7%	2.0%	0%	8.5%	95.5%
2001	7.0%	2.9%	5.00%	14.3%	87.3%
2002	7.4%	4.3%	15.00%	24.7%	74.9%
2003	7.8%	6.1%	15.00%	26.4%	56.4%
2004	8.2%	8.6%	5.00%	20.2%	41.5%
2005	8.6%	11.5%	0%	19.1%	33.1%
2006	9.0%	15.0%	0%	22.6%	26.8%
2007	9.4%	18.6%	0%	26.2%	20.7%
2008	9.8%	22.1%	0%	29.7%	15.3%
2009	10.2%	25.2%	0%	32.8%	10.7%
2010	10.6%	27.7%	0%	35.4%	7.2%
2011	11.1%	29.7%	0%	37.5%	4.7%
2012	11.5%	31.2%	0%	39.1%	2.9%
2013	11.9%	32.2%	0%	40.3%	1.8%
2014	12.4%	33.0%	0%	41.3%	1.1%
2015	12.9%	33.4%	0%	42.0%	0.6%
2016	13.3%	33.8%	0%	42.6%	0.4%
2017	13.8%	34.0%	0%	43.1%	0.2%
2018	14.3%	34.1%	0%	43.5%	0.1%
2019	14.7%	34.2%	0%	43.9%	0.1%
2020	15.2%	34.3%	0%	44.3%	0.0%

The plot of percent surviving is commonly called the life-cycle plot and is depicted in Figure 7. The life-cycle plot gives a visual representation of the combined impact of depreciation on the value of the assets. It can be shown that the area under the percent surviving curve, divided by the starting value is the Remaining Economic Life for the vintage.[6] Numerically, the remaining life approximately equals the summation of the percent surviving (column E), divided by the starting value (100% in this case), less one-half year. For the values provided in this example, the expected remaining economic life for this vintage is approximately 5.3 years.

Once the appraiser has calculated the remaining economic life for each vintage, they can readily compute the accumulated depreciation using the classic age-life ratio (age divided by life). The ‘life’ referred to in the age-life ratio is the vintage average service life; which, for property tax purposes, equals the age plus the vintage

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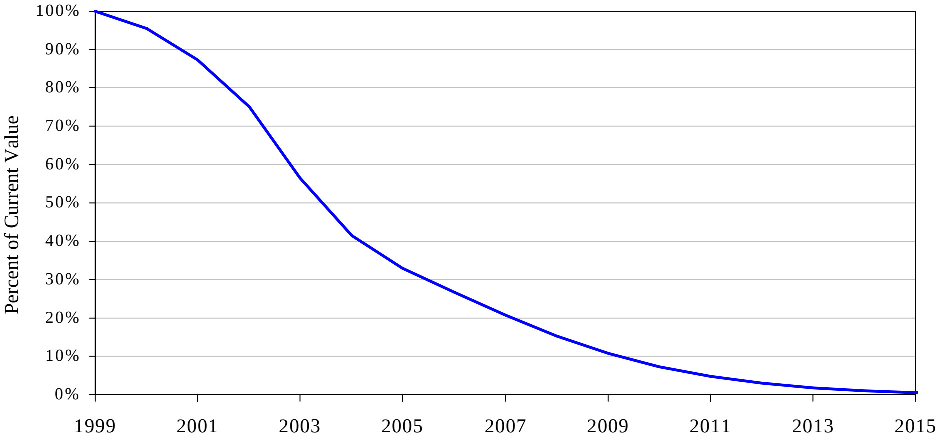
[6] The Life-cycle plot depicted in Figure 7 is for a single vintage, however, often the Life-cycle plot is developed for all vintages combined. In this form, Life-cycle plot gives a visual representation of the total impact of all causes of depreciation on the entire category of plant. Thus, the area under the curve yields the category-level Economic Life.

remaining life.[7] The vintage age-life ratio gives the net accumulated depreciation resulting from all causes of depreciation considered by the appraiser.

Figure 7

Forecasted Surviving Value
(for a single vintage)



Economic Lives

Generally, it is desirable, but not necessary, to identify the corresponding economic lives. The appraiser should be aware that the term *Economic Life* is used (misused) to denote different types of lives in different disciplines, and especially aware that each discipline is adamant that their use of the term is the correct one. Some of the more typical life parameters are described below.

Vintage Average Service Life (VASL) – represents the average economic life of each vintage. Due primarily to obsolescence, the VASLs are different for each vintage. The VASL equals the *realized life* plus the remaining life. In depreciation circles, the realized life is the average life realized by all equipment placed in the vintage; including equipment that has been taken out of service and disposed of. For appraisal purposes, only surviving equipment is considered, so the realized life is equal to the age of the vintage.

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[7] Note: in depreciation circles, often the vintage average life is taken to mean the average life of all equipment placed in that vintage – including equipment that has already been taken out of service and disposed of. For property tax purposes, the appraiser is only interested in assessing the value of those assets existing as of the assessment date.

Economic Life (most typical context) – More often than not, the term economic life is the expected life expectancy of newly placed equipment. It is equal to the VASL of the newest vintage.

Projection Life – By definition, the projection life is the same as the economic life, but in practice the term Projection Life is often more closely related to the investment-weighted average of the VASLs.

Average Remaining Life (ARL) or **Remaining Economic Life (REL)** – Generally these terms refer to the average remaining life for the entire class of property (i.e., all vintages). The term ARL is common in depreciation circles and the term REL is common in property tax circles. Both represent different names for the same life.

The easiest way to determine the ARL is to compute the investment weighted average of the individual vintage remaining economic lives. Alternately, a composite life-cycle plot may be produced and the ARL determined from the plot in the same manor used for each vintage. This is the most common and preferred approach. It not only provides the appraiser with a visual representation of the ongoing decline in value of the entire class of equipment; but also provides a means to easily compute the composite remaining life for subsequent years. The investment weighted annual probabilities of depreciation are used to produce the composite life-cycle plot.

Final Depreciation Table

For property tax purposes, accumulated depreciation is typically reflected in a Percent Good Table (sometimes called the Depreciation Table). The Percent Good table is a table of vintage factors that when multiplied by the original cost (or replacement cost) for each vintage yields the remaining value. The Percent Good factor equals one less the accumulated depreciation factor (i.e., the age-life ratio). Alternately, the remaining value factor is computed directly from the age and life using the following formula:

$$Remaining\_Value = \frac{Remaining\_Life}{Age + Remaining\_Life}$$

Most equipment has a residual value – that is, regardless of the condition of the equipment, it has some value to the owner, if only for its junk metal content. The Percent Good factors should not be allowed to fall below this residual value.

Residual Value

Generally, all equipment has some salvage value. Discarded and defective copper cable has some value to a copper junk dealer, for example. Likewise, discarded circuit packs may be refurbished and resold, and when they cannot be resold, they contain precious metals such as gold and silver that has value to the owner.

The minimum value of equipment is its Net Salvage (NS) value. NS is defined as the Gross Salvage (GS) less the Cost of Removal. GS is the amount received from the sale of discarded equipment; and the COR is the summation of all cost to the owner of disposing of the equipment. The salvage factors are typically depicted as a percentage of the original cost.

Because salvage is realized at the end of the Physical Life of the equipment, that is when the equipment is taken out of service and discarded, the appraiser needs to estimate the Future Net Salvage (FNS). If the remaining life is well into the future, the FNS may be significantly different from past and current salvage values. Generally, however, salvage trends are simple trends and do not present a problem to the appraiser.

Once the FNS is established, the accumulated depreciation factors should not be allowed to exceed 100 percent less the FNS percent. In terms of the Percent Good table, the remaining value of the equipment should not be allowed to fall below the FNS percentage. Thus, the FNS is the appraiser’s assessment of the residual value of the equipment.

How Accurate is This Approach To Value

The author has successfully used the approach presented in this paper extensively over the last nine years in various business applications. Some of the applications included, property valuations (including an assessment of the entire Public

Telecommunication Network in the U.S.)[8], asset impairment assessments[9], depreciation assessments, economic life studies, asset management, network planning, and long-range strategic planning.

For property valuations, ideally, the accuracy of the assessment is how close the assessed value is to the actual value. Since there is no exact gauge for the actual value, a surrogate is needed. The remaining economic life provides a reasonable criterion one can use in lieu of the actual value.

The assessed value is a direct result of the projected remaining economic life. As noted above, the percent of value remaining (Percent Good) is computed using the age-life ratio; and equals the REL divided by the Age plus the REL. The only estimated value in this formula is the Remaining Economic Life. Generally, the valuation is conducted at the vintage level. The average or category-level Remaining Economic Life is simply the investment weighted average of the vintage lives. The category-level Economic Life provides a single measure against which one can evaluate the accuracy of this approach to value.

The author has documented and published four case studies that compare the estimated REL resulting from this approach to the REL actually realized. Three of the case studies used actual mortality experience from several companies spanning over 74 state jurisdictions and involving hundreds of thousands of units of property.[10] The fourth case study was specific to one company and one state jurisdiction.[11] The results of these case studies are summarized in Table 2.

Each case study used an effective date for the economic life near the start of measurable Functional Obsolescence. From this date forward, the observed Economic Life was determined from observed data collected from the FCC and from the participating companies. The estimated Economic Life was derived using observed data that predated the effective date of the life. In all cases, the estimated Economic Lives were within one half year of the subsequently realized Economic Lives.

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[8] S. L. Barreca, *Telecommunications Infrastructure Valuation Study*, 1998, Technology Futures, Inc.

[9] For example, BellSouth's multi-billion dollar asset write-down in the mid-1990s was based, in large part, on an asset impairment study using the methodologies presented in this paper.

[10] S. L. Barreca, *Comparison of Economic Life Techniques*, 1999, Technology Futures, Inc.

[11] S. L. Barreca, Technological Obsolescence – Assessing the Loss in Value on Utility Property, 1998, Journal of the Society of Depreciation Professionals.

In addition to these results, Table 2 also gives the estimated *Projection Life*. Here, the term Projection Life represents the Economic Life estimate using the prevailing life estimating techniques prescribed by the FCC and most state PSCs at that time. It is determined by taking a recent snapshot of observed mortality characteristics. Proponents of this approach argue that recent mortality history reflects all forms of depreciation, including Functional Obsolescence. These results are provided to point out the fact that while recent mortality history does, to some extent, reflect past influences of Functional Obsolescence, it does <u>not</u> provide indication of future Functional Obsolescence.

Table 2
A Case Study On The Accuracy of This Approach to Value

Case Study	Effective Date of Life	Observed Economic Life	Estimated Economic Life	Estimated *Projection Life*
Electromechanical Switching	1980	5.1	5.6	15.7
Interoffice Underground Metallic Cable	1987	4.2	4.2	23.6
Analog Switching	1990	4.4	3.9	10.1
LEC-A, Underground Metallic Cable	1986	6.5	6.8	NA

Conclusion

Functional Obsolescence is often the result of many factors, each of which contributes to the ongoing decline in value of personal property. The net impact of all causes of Functional Obsolescence is reflected in the reduction of the relative usage of the property. History has shown that reductions in relative usage follow predictable patterns; and as such, provide a means to collectively quantify the impact of all causes of Functional Obsolescence. This paper outlines an effective Cost-based approach to value that utilizes a combination of actuarial theory and proven technology substitution techniques to effectively measure the collective impact of Functional Obsolescence.

Additionally, the Cost-based approach to value presented in this paper provides a generic approach to valuation that facilitates separately quantifying any number of drivers of value and statistically combining them to yield the net remaining value.

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