

## **Emerging and Submerging Technologies - What Are They Worth?**

*Michael J. Diedrich, PE, ASA, CDP, Vice President  
AUS Consultants Valuation Services Group, Milwaukee, Wisconsin*

Several years ago, I bought a PC for my home. It had a 12 Mhz processor and cost around \$3,000. Four years ago, I bought a new PC for my home. It was a state-of-the-art 450 Mhz Pentium III processor with a 40 Megabyte hard-drive and it cost me about \$1,500. A year or two ago I could buy a 1.8 Ghz Pentium IV processor with a 40 Megabyte hard-drive for around \$900. Now it is a 2.2 Ghz machine for around \$500.

The primary impetus behind this trend is due to Moore's Law - the number of transistors per circuit will increase exponentially every two years. As the number of transistors per circuit doubles, but the cost of making a circuit stays about the same, we get increased computing power for less money.

Computers are an extreme example of how new technology creates functional obsolescence. The decreasing costs are a form of superadequacy - one can obtain the same item for less cost as one moves forward in time. The increasing clock speed of the processors could be considered equivalent to excess operating costs in that one will get more power at less cost with each generation.

However, technology can be other than electronic. Changes in construction techniques have affected the cost of building everything from cars to power plants. Functional obsolescence occurs when one can build something cheaper today compared to the past. Competitors with older plants have more costs to recover in their sales compared to competitors with newer plants.

The closer one is to computerization the more drastically one is affected by obsolescence. Technological change has created emerging and submerging technologies. Timing is the primary difference between whether one survives or drowns. An appraiser can measure functional obsolescence, as well as external obsolescence, by the use of a replacement model. But first some background development is needed.

### **Valuation Principles**

#### **Value Indicators**

Market Value is defined as the most probable price, as of a specified date, in cash, or in terms equivalent to cash, for which the **property** should sell after reasonable exposure in a competitive

market under all conditions requisite to a fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self-interest, and assuming that neither is under undue duress.

It is important at this point to distinguish what the **property** is. Depending on what the property is could determine which approach is most applicable. In most property tax cases, the property is usually the tangible real and personal property improvements and the underlying land.

Market value is usually determined by giving consideration to the three approaches to value: income, sales comparison, and cost. The appraiser investigates each method to determine its applicability to the property being appraised. Even if all approaches are used, the appraiser may give more weight to one method than another, if, in his or her judgment, one particular method is more applicable than the others.

The income approach measures market value as the present worth of the monetary benefits to be derived in the future by the ownership of the asset. The monetary benefits are measured by the income stream expected to be enjoyed by the owner of the asset. Buyers of special purpose industrial property have probably made their investment decisions giving significant consideration to this approach. Therefore, one might assume that an income indicator of value can be very important in an appraisal.

However, the buyers' income analysis arrives at the value of the assets added to the buyers' operations. This may not be the market value. It is akin to saying that a PC is worth more to a software development company than to Joe's Hardware because the software development company will derive more value from it.

It also must be pointed out that, unless carefully constructed, an income approach to value captures **all** of the assets used in a business – real property; personal property; intangible assets such as workforce and favorable contracts; and going concern.

In the sales comparison approach, the indication of market value is derived from an analysis of the prices of similar properties in an active open market.

A number of factors must be analyzed to determine whether the market price is indeed applicable to the subject property, or whether adjustments must be made to the market data. By its very definition, special purpose industrial property would suffer in the sales comparison approach due to a lack of comparable sales.

The cost approach seeks an indication of value based on the amount of money required to reproduce or to replace the production capacity of the property at the time of the appraisal. It is

based on the principle of substitution which says that one would not pay more for a property than the cost to construct improvements of equal desirability and utility without undue delay. It is assumed that the buyer is going to buy the subject property and will measure how much he or she will pay for the subject by considering his or her other alternatives. One alternative is to reproduce the exact same facility. Another alternative is to build and operate a different facility that produces the same output as the subject. This cost of building a substitute facility and the differential in operating costs between the substitute facility and the subject sets the upper limit for how much the buyer will pay for the subject.

The depreciation to be deducted from the cost new is described as follows:

*Depreciation in an improvement can result from three major causes operating individually or in combination. These causes are physical deterioration, functional obsolescence, and external obsolescence. The market recognizes the occurrence of depreciation; the appraiser merely interprets how the market perceives the effect of depreciation.”<sup>1</sup>*

Physical Deterioration is the loss in value caused by wear and tear in operation and exposure to the elements.

Functional Obsolescence is the loss in value within the property as a result of the development of improved technology. This includes such things as changes in design, materials, or process resulting in overcapacity, inadequacy, excess construction, lack of utility, or excess variable operating costs in the subject. Excess construction can exist because of the availability of similar facilities at lower capital costs. Excess operating costs can exist because newer facilities can operate at higher efficiencies than does the subject. If new equipment can run more efficiently than old, functional obsolescence can exist.

External Obsolescence is the loss in value resulting from influences external to the property itself such as the political climate; the economics of the industry in which the property is used and the extent to which it is usable in another industry; inferior quality of raw materials, labor, utilities, and transportation service; changes in the local economy; legal changes including legislation, ordinances, zoning, and administrative orders. Even new property can exhibit external obsolescence.

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<sup>1</sup> *The Appraisal of Real Estate, 11<sup>th</sup> Edition*; P 365.

The cost approach can be very relevant in appraisals for ad valorem purposes. The beauty of this method is that it can be used to appraise the tangible property separate from the intangible property or the business enterprise. The difficulty in this method is to pick the right replacement model when calculating the replacement cost and the proper measurement of depreciation.

By placing oneself in the shoes of a potential buyer, one can develop the cost approach. The principle of substitution is tantamount in this approach. What would it cost you to create an alternative to the subject?

The starting point is the replacement model. If the subject is new or there has been no technological change, the replacement model would be something identical to the subject. If the subject is not relatively new, the model can be developed by looking to the trade press and discussions with people familiar with the industry. The objective of this investigation is to find out what knowledgeable buyers would use instead of the subject. A properly constructed replacement model will help to identify functional and external obsolescence.

Once the model is priced out, that new price must be adjusted for differences in age, operating costs and economic conditions to make it equivalent to the subject. View the cost approach as a balance; on one side is the subject, on the other the model. How can you make the two balance out so that they are equivalent?

The differences in age can be accounted for with the physical deterioration calculation. This is usually some sort of age-to-life relationship. Operating cost differentials are discounted to present value over the remaining life of the subject. In addition, the economics of the industry and the subject must be examined to determine if external obsolescence exists.

### **Emerging and Submerging Technologies**

Two industries come to mind that have been affected by changes in technology. Each has been affected differently. The telecommunications industry has been affected negatively on their bottom line, while the power industry has not.

#### **Telecommunications**

The telecommunications industry has been drastically affected by changes in technology. By forecasting an ever growing need for bandwidth many companies placed an ever growing amount of fiber optic cable. They were eventually blind-sided by the collapse in the "dot.com" business and the increasing capacity of the electronics used on the fiber optic cable.

Technology has increased the capacity of optical networks in terms of transmission speeds. Fiber optic speeds have increased from 100 Mbps in the mid 1980's to over 10 Gbps today. This

increase in speed is dramatic when one considers the level or declining electronic equipment prices.

In what has become a commodity business, the increase in the supply of circuits, via increases in the capacity of electronics and increases in the number of fibers coupled with the drop in demand has drastically dropped the price of circuits. As the speed of the electronics double every two years, it will be some time before demand catches up to the supply of circuits.

With this environment, it is unlikely that much of the now dark fiber will ever be lit. Also, the embedded, slower electronics has taken a drastic hit when they can be replaced at faster speeds for lower unit costs.

What this means from a property tax valuation perspective is that there has been a drastic drop in the telecommunications industry. Technological improvements means that the current plant's capacity can be replaced with fewer fibers and faster electronics. From a cost perspective, the older plant has excess capacity and can be replaced at a lower cost than the embedded cost. The market recognizes this fact by the drastic plunge in telecommunications stocks recently. From an income perspective, when the prices for which circuits are sold have dropped by almost 90%, it gets a little hard to make money.

## **Power**

Technology, in both the equipment and the way things are built, has affected the power industry as well. The current state-of-the-art power plants are Combined Cycle Gas Turbine (CCGT). A natural gas fired gas turbine is coupled to a generator. The hot exhaust is sent through a Heat Recovery Steam Generator (HRSG) to turn water into steam, which drives a steam turbine coupled to a generator.

Competition between gas turbine manufacturers has driven prices down and efficiencies up. From the early to late 1990's prices dropped up to 50% for gas turbines. Efficiencies went up during this time period due to the increased competition. Up to 70% of a plant's life-cycle cost is due to fuel, therefore purchasers will pay a premium for the most efficient model.

The way CCGT's are built, relative to older plants, has changed as well. Instead of a custom designed plant, CCGT's are built by combining essentially "off-the-shelf" components, which greatly reduces the construction schedule.

From a cost perspective, depending on the type of plant, a new plant can replace the output of an older plant at less than half of the embedded cost. Obviously, adjustments must be made for the type of fuel - again, fuel costs account for a large percentage of the life-cycle costs.

## **Comparison and Conclusion**

Here we have two industries that have been drastically affected by technology and have seen their stock prices plummet, but for different reasons. The telecommunications industry is due primarily to ignorance of Moore's Law, and therefore due to their assets, but the power industry is due to shady business practices that have nothing to do with their assets.

What are the differences between the assets that cause this? First and foremost is technology and proximity to Moore's Law. The telecommunications industry's equipment is driven by transistors and abide by the doubling of transistors every two years. Power plants have limits on their efficiency gains due to thermodynamics. Any gains in efficiency are incremental and are starting to come at great costs. Newer, state-of-the-art plants are much more sensitive and tricky to run than the older models.

Another reason for the differences is due to the markets in which each industry operates. There appears to be an ever increasing need for electric power. We all have more electronic gadgets in our homes and offices which consume more power. The telecommunications industry bet on the growth of the dot.com industry to consume bandwidth. That bet lost in the short run.

Costs are another reason for the differences. It is an easier decision to switch out electronics on an optical network for several hundred dollars a unit than to build a new power plant for millions of dollars. Coupled with this are the external factors that make it easier to change out the electronics than to build a power plant. There are no public protests when a telecommunications company increases the speed of their optical network. Announce the plans for a power plant and the NIMBYs (Not In My Back Yard) and BANANAs (Build Absolutely Nothing Anywhere Near Anyone) start protesting.

These difference explain the differences in values of the assets of these two industries - both affected by technological change.

