MTS™ Journal

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The Journal of the International Machinery & Technical Specialties Committee of ASA

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The International Machinery & Technical Specialities Committee

As of July 1, 2023

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Vice Chair	Timothy Roy, ASA	Capitale Analytics	Indianapolis, IN
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Jo Crescent, ASA

MTS Journal Designer

Liz Krage

Recent MTS Advancements

Name	Designation	Specialty
Corey DeWitt	ASA	Aircraft
Yelnar Omarov	AM	Machinery & Equipment
Daniel Petticrew	AM	Machinery & Equipment
Yuzo Fujino	AM	Machinery & Equipment
David Waiyaki	AM	Machinery & Equipment
Dale Stahlecker	ASA	Machinery & Equipment
William Seijo	ASA	Machinery & Equipment
Michael Vetter	ASA	Machinery & Equipment
Sofia Lindberg	ASA	Machinery & Equipment
Gokul Kozhakkadan Puthiyaveettil	ASA	Machinery & Equipment

2023-2024 ASA Election Results

This is a partial list. Complete election results for all disciplines can be found at https://www.appraisers.org/asa-newsroom.

International President – Garrett Schwartz, ASA
International Vice President – G. Adrian Gonzalez, Jr., ASA
International Secretary/Treasurer – William Engel, ASA

MTS Chair – Jamie Allen, ASA
MTS Vice Chair – Timothy Roy, ASA
MTS Secretary/Treasurer – James Nutter, ASA

MTS Discipline Committee Member-at-Large

Richard Ellsworth, ASA, ARM, IA
Jeffrey L. Lank, ASA
Barbara Spoor, ASA, ARM

Editor's note:

Congratulations to Garrett Schwartz and William Engel for their achievements! They are continuing the strong tradition of MTS Discipline members holding ASA International officer positions.

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asainfo@appraiser.org

Johnnie White

ASA CEO Update
Why Join ASA?

YOU are a Critical Component in the Next Phase of The ASA Difference Campaign

Johnnie White, MBA, CAE, CMP, CEO/EVP

Remember the reasons why YOU joined ASA? Although every member's path to membership may be unique there are common reasons why, which primarily focus on *education, networking* and *resources*.

For many the first introduction to ASA came through a corporate leader encouraging the pursuit of *education* for job skills development or a requirement for promotions. For others it was a career change and the need/desire for the best education in the profession.

After pursuing the initial education and resulting accreditation and membership, the next primary focus was on the benefits of *networking* offered by the Society. Many have benefited from ASA's immediate and vetted network of multidiscipline professionals for technical advice, client referrals, or career opportunities.

As a member continued to grow and expand their career or practice, the need for related *resources* grew in importance with attention given to ASA's Benefit Partner Program, Career Center, Job Bank, Marketing Toolkit and much more.

Today, our Society is at a critical crossroad. New ASA champions are needed to mentor and introduce the next generation of valuers to ASA. We are diligently working to address this. Our next phase of *The ASA Difference* campaign will focus on recruitment and spotlight the benefits of joining ASA. An international effort will take place over the next coming months complete with targeted e-mails, social media posts, ads, earned media pitches, participation at key events and member testimonial videos—all spotlighting the benefits of joining ASA.

How can YOU help? Here are three easy ways:

(1) Share your ASA experience with new employees or contacts looking for job advancement or a new career;

(2) Recommend the Society's educational offerings and path to accreditation and membership; and

(3) Mentor their pursuit.

Together, we can further the growth of ASA and continue its legacy of being the most recognized and respected valuation professional organization around the world.

Looking forward to seeing you and your colleague or mentee October 1-3 in New Orleans for the 2023 ASA International Conference.

Johnnie White
Johnnie White, MBA, CAE, CMP, CEO/EVP

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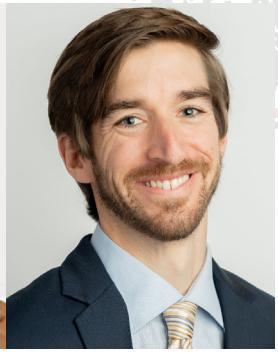
Letter from the Discipline Governors

Sam Shapiro, ASA, and Ryan Kinahan, ASA, MTS Governors

Sam Shapiro



Ryan Kinahan

We trust everyone is gearing up for a great second half of the year. Headquarters continues to work through exciting changes with the focus on driving membership value. Hopefully by now everyone is well versed with the new website and ASA difference marketing toolkit which offers very professional images and branding resources. With more marketing items in the pipeline, the focus remains on presenting polished items that convey the sense of professionalism and credibility that set apart the ASA designation. Even if you don't personally utilize these individually customized options, they serve to raise awareness of the ASA in the marketplace.

We appreciate all those who helped make the Equipment Valuation Conference a success as well as the myriad educational offerings available in person and remotely. The ASA continues to set itself apart not just in the initial educational coursework and experience requirements, but also the continuing education offerings to help keep us abreast of industry changes and best practices.

We look forward to welcoming in the newly elected committee members and ASA volunteers helping to keep the ASA in a state of continual improvement. If you have ideas, comments, or suggestions—reach out! Or, volunteer to contribute! We have been fortunate to have multiple truly deserving candidates in recent elections. This is a testament to our membership and is the only way we continue to grow and improve. Thank you for being a part of that and we hope to see you in New Orleans!

Sincerely,

Sam Shapiro, ASA
MTS Governor

Ryan Kinahan, ASA, CPA
MTS Governor

FAREWELL From Sam:

I would like to take a few moments of your time as this will be my last official letter as Governor, and I would like to reflect on the 31 years I have been a proud member of the ASA. Our goal has always been to better our society for the future and to keep the highest standards without compromise to our members.

Some feel the society owes them for the work they do. This is and always should be a non-profit organization—as such, it requires vital input from us as members to continue to improve. I was always a believer that the board of our society was too large and not balanced by designations. I saw the board reduced but still do not see it as equal to all nor a manageable size. We have a very capable CEO, and he should be applauded for the progress he has made for us all.

In moving forward, I hope that you as a society will be more deeply involved in the inner workings and help foster new members to continue to help our society thrive.

Thank you all for 31 wonderful years of allowing me to be a part of, and serve, the ASA.

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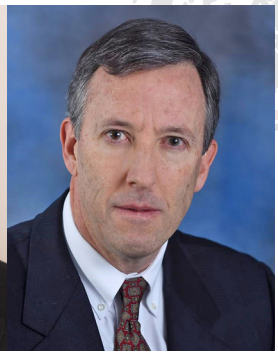
Letter from the MTSC Chair and MTS Education Update

Bill Engel, ASA
President, Strategic Asset Management
Chair, MTS Discipline Committee

Rick Ellsworth, ASA
Chair, MTSC Education Subcommittee


Bill Engel


Richard K. Ellsworth

MTSC Chair Letter

I am pleased to report that MTS keeps rolling along, making progress on many fronts.

Our virtual Equipment Valuation Conference held June 7, is "in the books" and I am pleased to say it was well attended, both domestically and internationally. Judging from the post-event survey comments, it was well received and attendees appear eager to see what next year holds.

The CEMP (Certified Equipment Management Professional) program is getting closer to fruition, and at this point we are further refining the content. This program is geared toward those people engaged in with equipment management responsibilities who work for banks, and equipment leasing and finance companies. It will provide an overview of how appraisals are developed along with giving attendees important points when reading appraisals. Additionally, webinars on residual setting and other topics of interest will be available. Stay tuned for more details.

The International Conference in New Orleans is quickly approaching (October 1 - 3). Besides sessions dealing with various equipment types (food processing, aviation ground support, and furnaces/ovens) other topics presented will include a closer look at indirect costs, buyer's premium, plastic recycling and trending. Additionally, we are having an onsite tour this year of a seafood production machinery facility. And that's not all! So if you have not yet made plans to join us, please consider it! (https://www.appraisers.org/asa-international-conference)

The MTS committee is developing a current Normal Useful Life study which we anticipate publishing by the fourth quarter of this year.

The MTS Journal has come a long way both in content and design. If you want to get noticed (and earn CE's as well), consider writing an article. Email Tim Roy for more details (tmroy@capitaleanalytics.com).

I would like to formally congratulate the new MTS Discipline Committee officers as they assume their new posts July 1:

Jamie Allen - Chair

Tim Roy - Vice Chair

Jim Nutter - Secretary / Treasurer

I feel confident that the MTS Discipline Committee is in great hands with this leadership team. I would also like to thank the entire committee and MTS membership for their support and putting up with my "dad" jokes the last two years. I wish you all the best and much success for many years to come.

Take care,

Bill

(continued on next page)

MTS Upcoming Education Q3 2023

MTS POV courses and education offerings scheduled for the 3rd quarter of 2023 include the following:

ME 203 POV Virtual	**Advanced Topics and Case Studies**	August 22-25, 2023
ME 218 Virtual	**MTS International Valuation Course**	August 29-30, 2023
ME 204 POV Virtual	**Advanced Topics and Report Writing**	September 12-15, 2023
ME 208 Marine Survey Hybrid	**Marine Survey**	September 28-29, 2023

The MTS Education Subcommittee is looking for presenters of webinar topics considered to be of interest to appraisers. Anyone with ideas or topics can contact Jeff Lank at Jeffrey.lank@kroll.com or Rick Ellsworth at rickkellsworth@gmail.com.

Rick Ellsworth, ASA, IA, ARM-BV, ARM-MTS
MTS Education Subcommittee Chair

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IN MEMORY OF JEREMY COX, ASA

Jeremy Cox was a dear friend, a great appraiser and fellow ASA instructor.

Outside of business, Jeremy was a loving husband to his wife Kim. He was a helpful person to anyone who asked for anything.

In his career, Jeremy brought a unique set of skills to our profession. He was a pilot, an A&P mechanic, and an aircraft broker. Late in his life he found his true calling—a love of performing aircraft appraisals. He was involved in teaching our appraisal classes as well as many other ASA Aircraft webinars and presentations.

The 10 items listed below came from Paula Williams of ABCI, who was a good friend of Jeremy Cox. This list hits the mark.

Safe travels, Jeremy.

Rick Berkemeier, ASA

Ten Things We Learned from JetValues Jeremy

As excerpted from aviationbusinessconsultants.com.

Here are ten—just a few of the many, many, many things he taught us:

1. Use your damn phone. As a phone.
2. Take the time to connect with people.
3. Know at least one great restaurant in every city you do business in.
4. Speak on podcasts, keynotes, events, teaching opportunities.
5. Everybody is important, even if you don't know them yet.
6. Put yourself in the other person's shoes and find a way to help them.
7. Connect your people to each other.
8. Speak your mind fearlessly.
9. You CAN succeed without social media, and it's not for everybody.
10. Love people.

Link to Jeremy Cox obituary

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ASAConnect

Connect with Fellow MTS Members!

Put one of ASA's most valuable benefits to work for you. The ASAConnect Machinery & Technical Specialties Members Group is the perfect place to post technical questions, solicit professional guidance, network, engage fellow experts by swapping experiences and more. Simply opt in, compose and send your message to the group. Receive and comment on messages as desired. Being connected is the perfect way to grow your practice or career.

Opt in to ASAConnect MTS Members Group today!
For more information visit https://connect.appraisers.org,
or contact asainfo@appraisers.org or (800) 272-8258.

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Estimated Normal Useful Life Study: A Refreshed Format and a Sample of Data Specific to Printing and Publication Equipment

Achin Chugh, ASA
PMG Valuation
MTS Committee Member


Achin Chugh

Abstract: *As discussed in previous issues, an update of the Estimated Normal Useful Life Study prepared by the Machinery & Technical Specialties (MTS) Committee is currently in process. For new readers, this article again provides the history of the study and guiding principles of the update process; other readers may want to skip straight to the sample compilation of data specific to the printing and publication industries.*

History of the NUL Study

Over the years, many machinery and equipment appraisers have referred to the Estimated Normal Useful Life Study prepared by the Machinery and Technical Specialties (MTS) Committee. The study has served as a resource to provide general guidance to appraisers regarding expected lifecycles of assets across a wide array of industries.

The study has been periodically reviewed to account for factors that can impact the expected economic useful life of assets such as technological changes, regulatory matters and the emergence of new industries and certain asset types becoming obsolete. As the last review took place in 2010, the MTS Committee has taken on the task of more formally updating this resource.

The data compiled for the original study was based on information gathered from a variety of sources that are commonly used in the appraisal profession as well as feedback from industry experts, dealers, and appraisers. In updating the study once again, members of the MTS Committee have relied upon the original study as a base starting point given the level of detail contained within it. The purpose of the current update is to enhance and modernize the document based on changes that have taken place over the last decade.

Additional guiding principles that the members of the MTS Committee working on this initiative wanted to abide by as best as possible included the following:

- Where possible, removing references to obsolete asset types that are not in operation due to changes in technology or use of modern materials. Along with this, there is also an effort being made to include new industries that have emerged that are key contributors to global economies and were not captured as part of the original study (such as renewable energy or data centers).
- The format of the study is also being refreshed as part of the current update, with a focus on presenting guidance specific to ranges of economic useful life in a format that is concise and easy to navigate. Similar assets that would fall within the same category or typically be classified in a similar manner as part of a particular process may be grouped together to make the data within the study easier to update going forward.
- Along with suggested ranges for expected normal useful lives, adding key considerations by industry that an appraiser may want to consider in estimating normal useful lives and an appropriate level of physical depreciation as part of their analysis. The purpose of this is to highlight to the appraiser certain factors (outside of just physical deterioration and expected economic useful life in years) that could impact the expected life of the assets, such as regulatory changes to phase out older technologies, impact of significant re-builds, and so on.

In terms of process, as noted above, the previous study is being used as the starting point and significant attention is being paid to ensure that the wealth of relevant data that is included within the original study is incorporated into the updated study. On an industry-by-industry basis, members of the MTS Committee assisting with the initiative are updating the content per the refreshed format by placing reliance on the previous study. After this initial step, the content is subject to a two-step review process where it is reviewed first by another member of the group assisting with the project and then by an industry expert who has significant experience valuing machinery- and equipment-related assets within that sector. Any feedback from the reviewers is incorporated prior to the content being finalized.

This article provides an excerpt of the information compiled for assets associated with Printing & Publishing Equipment. We welcome any feedback you may have as it relates to this initiative.

(continued on next page)

Sample Update: Printing and Publishing Equipment

DISCLAIMER: We are seeking to provide guidance on a reasonable range for Normal Useful Lives. In practice, this will vary based on a variety of circumstances, including but not limited to: sub-category/niche, application, work environment, geography, maintenance, macroeconomics, and owner circumstances. This is not a one-size-fits-all manual with an absolute range. It is a normal range estimate for appraisers to consider in addition to sound appraisal judgement with consideration for subject property nuances. Further, the appraiser should consider any available secondary market data to ensure that any values estimated utilizing the cost approach are appropriate and in alignment with market benchmarks. Shifting industry/market dynamics can have a material impact on values. The appraiser should also consider any additional obsolescence (such as functional or economic) and related factors. The normal useful life data presented is intended to be used as a reference or starting point and additional adjustments may be required to establish value.

Normal useful life (NUL) is separate from economic and accounting life. It is defined as follows for the purpose of this document:

> *The physical life, usually estimated in terms of years, that a new property will actually be used before it is retired from service. A Property's normal useful life relates to how long similar properties actually tend to be used, as opposed to the more theoretical economic life calculation of how long a property can profitably be used. (American Society of Appraisers, Valuing Machinery and Equipment. Washington, D.C.: American Society of Appraisers. 2020)*

NUL is to be a consideration of the life period at which point an asset would be retired or at which point significant investment (rebuilds or replacing major components beyond normal maintenance) would be required to add life back to the asset; or at which point technological improvements are likely to make the asset functionally obsolete. It should consider average use for an industry, which will vary. Once capital expenditures / improvements are made to an asset, the NUL is being extended and not representative of the original asset (it does not have an infinite initial NUL). On the other extreme, this does NOT consider negligence where no regular maintenance is performed.

The conclusions reached by the Committee's study are the result of qualitative research and consultation with industry experts. The reader is advised that no individual quantitative research, such as lifing studies or statistical analyses, has been performed. The opinions of NULs presented below are not intended to be precise. The MTS Committee assumes no responsibility for errors, omissions, or differences of opinion.

Table 1
Printing and Publication Equipment

Asset Classification	Assets Captured in Asset Category	NUL Low	NUL High
Primary Process Equipment	Plate Making Equipment, Developing Equipment	10	15
	Addressing & Mailing Machines, Binder Machines, Finishing Cylinders, Flexographic, Rotary Folders, Saddle Stitchers	15	25
	Presses (Printing, Flexograph, Gravure, Offset, Screen Printing, Publishing), Envelope Machinery, Rolling Machines	20	30
	Commercial 3D Printing*	3	7
Process Support Equipment	Aluminum Zinc Plates (Mostly Single Use Only)	1	2
	Casting Boxes, Belt Conveyors, Casting Molds, Platform Scales, Stacking Machines	5	10
	Paper Balers, Hydraulic Elevators	15	20
	Corrugators, Paper Cutters	20	25

(continued on next page)

Key Considerations

- For newer-technology printing and publishing equipment, consideration should be given to changes in technology due to software upgrades and so on that may result in expected estimates of economic useful lives lower than the ranges suggested above. This is especially true when considering digital equipment, which will have a much lower useful life.
- While appraisers must always be aware of the possibility of economic obsolescence, this can be especially true in the printing industry, where traditionally long-lived assets exist in a business sector that has ceded significant market share and revenues to digital media.
- 3D printing has its own considerations:
  - It is a rapidly evolving industry subject to continual change.
  - Review the nuances between various technologies: Fused Deposition Modeling (FDM), Stereolithography (SLA), Selective Laser Sintering (SLS), Metal FDM, Selective Laser Melting (SLM) And Direct Metal Laser Sintering (DMLS).
  - There is variability depending on manufacturer/vendor, parts availability, and vendor resale policy.
  - If the user is looking to sell on the secondary market and there is no pre-existing, signed subsequent user agreement in place from the vendor, a resale can be impossible (for example, Commercial HP 3D printers almost never change hands).
  - If not manufactured by a reputable company with parts on hand, newer machines can be rendered useless from small part failures. Conversely, some 20-year-old SLA equipment could still be in use, but value would be mostly tied to the first owner with minimal value to a third party.
  - 3D lasers are one of the largest maintenance wear items. Hours may serve as a gauge for expected life. Useful life will ultimately depend on how efficiently and precisely the laser continues to operate.
  - Older stereolithography lasers can be self-serviced or replaced, but many newer-generation machines require OEM servicing.

About the Author

Achin Chugh, ASA, is a partner in KPMG's Valuations practice and leads the Tangible Assets Valuation practice for KPMG in Canada. Achin has significant experience providing tangible assets valuation services in Canada and the US for a variety of applications, including financial reporting, tax planning, impairment, insurance, liquidation, and other financial compliance and regulatory purposes. Achin is a member of the MTS Committee, and a member of the Useful Life Study Subcommittee.
Email achinchugh@kpmg.ca.

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Valuation Techniques for Maritime Shipping Containers: Thinking Outside the Box

Nollaig Daly, AM
Director, Structured Asset Finance & Leasing, National Australia Bank

Nollaig Daly

Abstract: *This article explores the tools, including the latest technology, an MTS appraiser can use to develop appraisals of maritime shipping containers for financial institutions.*

Most appraisers are familiar with a handful of container types and sizes. However, there are dozens of configurations. Given the vastness of the subject, this article focuses only on the standard dry freight 20-ft. unit, but the same approach can be applied to other sizes and specifications.

A Quick Overview of Shipping Containers

Malcom McLean was an American businessman and transport entrepreneur. In 1956 he developed the first shipping container to replace the break-bulk style of handling freight. It was just eight feet tall and eight feet wide.

At that time, most cargoes were hand-loaded by longshore workers at a cost of $5.86 a ton. Using containers, it cost only 16 cents a ton, a 36-fold savings.

Since McLean's time, containerization has revolutionized global trade and led to major reductions in freight transit time, labor costs, decreased port congestion, and reduced losses from damage and theft.

Figure 1. *Malcolm McLean at Port Newark, 1957*
Source: *The American Business History Center, Business History, Malcolm McLean: Unsung Innovator Who Changed the World*

The Organization for Economic Cooperation and Development (OECD) estimates 90% of the world's goods are carried by sea, through 939 container ports. This rapid success was achieved through standardization—all being of standard size, material, and design allows containers to move seamlessly between sea, rail, and road.

On average 2.6m TEU[1] of new capacity is delivered annually, requiring significant capital investment. Banks often provide funding and will seek a valuation for financing purposes.

Manufacture and Regulation

When appraising a fleet of container boxes, there are many complexities to be considered, such as location, global trade imbalances, steel price variability, and so on. However, the appraiser's task is made a little easier by their standard design and regulation. A standard 20-ft. ISO container anywhere in the world is built to the exact same specification.

Regulation and ISO Standards

International Organization for Standardization (ISO) 6346 is responsible for all aspects of the design and testing of shipping containers, which must withstand the toughest conditions at sea and port.

Most are manufactured from maritime-grade corten steel, which is actually designed to rust, creating a thin layer of oxidization on the outer surface which acts as an additional layer of protection, preventing the metal from corroding further. Some surface rust is therefore permitted and does not prevent the equipment from being certified cargo worthy (CW).

(continued on next page)

CSC Plate

As required by the International Maritime Organization (IMO) to ensure a safe operating environment for logistics service providers, all new containers have a safety approval plate (CSC plate). The CSC includes details such as max gross weight, date of manufacture, CSC certification, and other useful information.

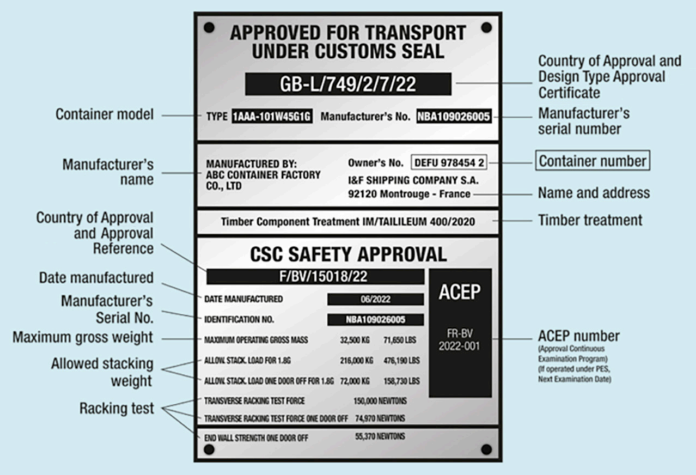

Figure 2. *Container CSC combined data plate explained | BIC*
Source: *Bureau International des Containers et du Transport Intermodal, https://www.bic-code.org/csc-combined-data-plate/*

Survey Documents

Accredited surveyors from classification societies, such as Bureau Veritas, DNV, or ABS, inspect each unit to verify CW status. Inspection is a requirement of the Institute of International Container Lessors, which also requires enrollment in an Approval Continuous Examination Program (ACEP) with physical inspections completed at the following intervals:

- 0 years (new),
- 5 years,
- 10 years,
- 12.5 years, and
- 15 years.

These survey documents are helpful to the appraiser in assessing condition. A CW unit generally is in good condition.

In spite of strict regulation and loading procedures, some cargo is lost each year at sea. However, it is relatively immaterial in quantity compared with global shipping volumes.

Cargo Worthy Life

Due to the ACEP and survey requirements, container boxes are usually retired from sea freight between the 10- and 15-year inspections, as the cost to bring to CW standard becomes prohibitive. The ongoing retirement of CW units requires new containers to be delivered each year as replacement stock.

The average age of sea freight retirement is around 12.5 years. Units are then sold into the secondary market for other applications such as storage or cargotecture,[2] which includes offices, retail spaces and housing of many varieties.

Following CW retirement, a container can easily surpass another 10+ years of use, but this timeframe can vary depending on application.

Manufacturer and Costs

More than 97% of shipping containers are manufactured in China, from 3 factories. China's access to cheaper labor and ongoing productivity improvements has helped to keep the cost down and prices have not kept pace with inflation. In 1979, a new 20-ft. unit was $2,100. In 2022 the price averaged about $2,650 but dropped as low as $1,488 in 2016.

Figure 3. *APL England cargo ship lost 40 containers in rough seas off the NSW coast.*
Source: *Australian Maritime Safety Authority*

(continued on next page)

Table 1
Container Descriptions

Condition	Description
Cargo Worthy	Cargo worthiness can be certified by a third-party surveyor pursuant to a physical inspection of the shipping container. The CW standard implies that the container has a valid CSC Plate.
New or One Trip	A one-trip container is basically new and CW. It has been shipped from the Chinese factory internationally and is typically loaded with cargo. It's only loaded one time and only makes one trip. It does not go into shipping service. Once it arrives at the destination it is sold in the aftermarket for storage or other applications. These containers are usually in Very Good condition.
Wind & Watertight WWT	Commonly used criteria that makes no reference to the quality of under-structure and should therefore not be considered as safe for the transport of cargo unless it was explicitly confirmed that containers meet CW by a surveyor.
As Is	'As is' condition may have damage from the shipping process, structural problems, or significant rust. These containers can no longer be considered "WWT."

Common Descriptions

Beyond cargo worthy status, some other commonly applied terms and their meanings are listed below. Only the CW units are permitted for maritime transport.

Given the uniform design requirements, the appraiser does not usually need to adjust based for brand, design features, construction material, etc.

Fleet Ownership

Banks usually provide funding to large corporations involved in the sector. Standard dry bulk maritime containers account for 86% of the global equipment pool, with owners based in Europe (27.4%), the Americas (37%) and northeast Asia (31.3%).

Shipping companies own approximately 50% of units, with the balance owned by leasing companies such as Triton and Textainer.

A container can spend more than 50% of its lifespan either idle or being repositioned while empty.

This represents a non-revenue generating period involving additional costs (such as storage and repositioning) that are assumed either by the shipping or the leasing company.

These inherent complexities make it a challenging asset class. Owners need to be capable and have access to the latest technology to operate a fleet efficiently and generate a profit.

Asset Identification

All CW Container Boxes are fitted with a unique code from the Bureau of International Containers (BIC code)[3] that can be used by the appraiser to appropriately identify the asset.

BIC codes form an essential part of the ISO 6346 standard, an international standard which describes the identification of a shipping container. The standard is maintained by the BIC and covers the serial number, owner, country code, and size of any given shipping container.

Physical Inspection and Location

Shipping containers operating in a global supply chain can rarely be individually inspected. Many will be on the high seas or at a distant port—so most appraisals will be desktop.

Most liner companies have an internal container tracking system that interfaces seamlessly with other industry participants using application programming interfaces (API) that enable separate software components to communicate with each other using a set of definitions and protocols. Nearly every app on a cell phone uses some variety of API. Containers are generally tracked using a BIC API.

Each unit's real time location can be tracked using free online platforms such as SEARATES and Track and Trace. Moves are read and transmitted electronically by terminal or depot cameras using optical character recognition (OCR). Appraisers can use these platforms to accurately establish the equipment's location.

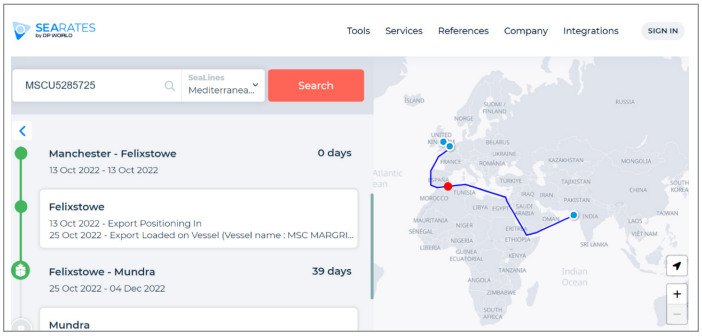

Figure 4. *Reference tracking a MSC container via Online Container & Freight Tracking System – Searates.com*

(continued on next page)

Market Dynamics

The container box market is volatile, regularly driven higher and lower by difficult-to-predict factors such as trade wars, recessions, raw material costs, pandemics, and geopolitical conflicts. Prices can swing widely over a short time, as evidenced in the Harrisons data for 20-ft. containers in Figure 5.

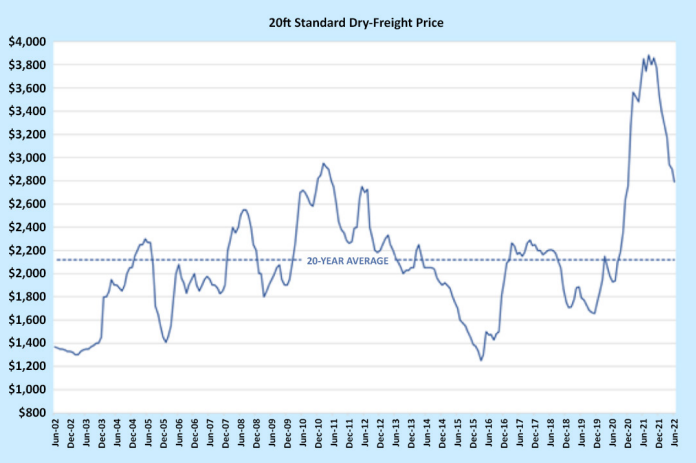

Figure 5. *Reference Harrisons 20ft unit secondary market average price*
Source: *Courtesy of Harrison Consulting, http://harrison-consulting.org/*

Price changes can occur very quickly, so it is important to base values on the most recent available data.

The importance of the effective date in the valuation report cannot be overstated.

Demand for container shipping is linked to world trade, and global recessions can have a significant impact on demand and prices.

As of 2022, the busiest world trade routes for container ships[4] were these:

- East Asia to North America route, with 31.2M TEU annually
- North Europe and Mediterranean Region to East Asia route, with 26.3M TEU annually
- North America to North Europe and Mediterranean Region route, with 8.0M TEU annually

Repositioning Costs

Trade imbalance has been an inescapable part of the container shipping industry since its origin. Repositioning of empty containers represents about 5% to 8% of a shipping line's operating costs. About 20% of all the containers carried by maritime transportation are empties and not earning income. This also accounts for price differences between ports with a surplus versus ports with demand. Therefore a unit's geographical location is key in assessing value.

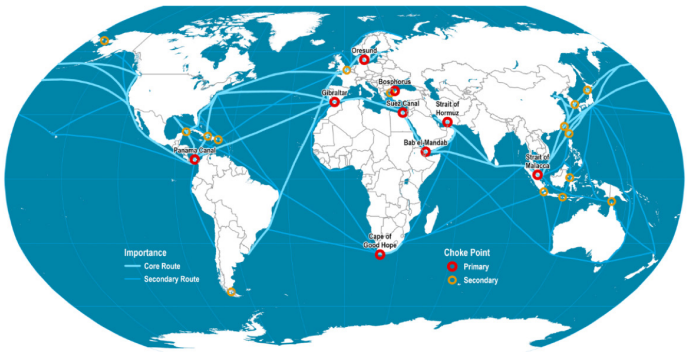

Figure 6. *Major global trade routes*
Source: *Main Maritime Shipping Routes | Port Economics, Management and Policy (porteconomicsmanagement.org)*

Short Term Outlook

The global stock of shipping containers increased by 13% to almost 50 million TEU in 2021. That was three times the previous growth trend, according to maritime research consultancy Drewry. Global sentiment is currently weaker, arising from reduced customer spending, inflationary pressures, higher interest rates, and the ongoing Russia-Ukraine war—all are likely to supress container shipping demand.

These factors combined mean that there is excess fleet capacity of 6m TEU, which is impacting secondary market prices and lease rates.

Unsurprisingly, container equipment manufacturing has also dropped, with Drewry stating this year could be "one of the worst on record," estimating that fewer than 700,000 TEU will be produced. This compares with 3.77M TEU manufactured last year, which itself was a huge 47% reduction from 2021's record output.[5]

These factors are partially offset by significant new vessel deliveries in 2023 and 2024, which may absorb some of the excess. The delivery schedule of new ships is very strong with slot capacity expected to increase by 3.6m TEU in 2023 and by over 3.9M TEU in 2024—these vessels will need CW containers.

Figure 7. *Shanghai port on Jan. 8, 2023. An estimated 6 million containers are idle globally*
Source: *Caixin Global, caixinglobal.com*

(continued on next page)

Drewry also projects a trend of carriers operating larger equipment pools in the future given the logistics problems and container availability issues faced during COVID. Liner companies have posted record profits over the past two years and are investing in new containers at a faster pace than lessors.

Eventually any excess capacity will be absorbed as replenishment stock as aged containers reach the end of their CW life. However, there can be extended periods of excess capacity, which materially impact lease rates and secondary values.

In conclusion, forecasting the future of container shipping is almost an impossible task for any appraiser—history has shown that it tends to operate in a boom-and-bust fashion.

Buying and Selling

The container rarely stays with its first buyer for its entire life. Resale often takes place multiple times.

Technology has enabled buyers and sellers of shipping containers to connect and transact at low cost.

Platforms such as BOXXPORT and Container xChange facilitate the purchase and selling of large quantities of shipping containers all over the world.

Container xChange reports that it has more than 1,500 users ranging from lessors and shipping liners to container traders and other buyers. Sales and purchases are conducted at much lower costs than the traditional remarketing channels.

Importantly, the system links buyers and sellers with assets in the same location, thus also reducing repositioning costs. When assets must be relocated to a more favorable port, it allows for reduced repositioning costs by linking owners with "single journey" requirements and liner companies with spare capacity.

An extract from the platform is shown below in Figure 8.

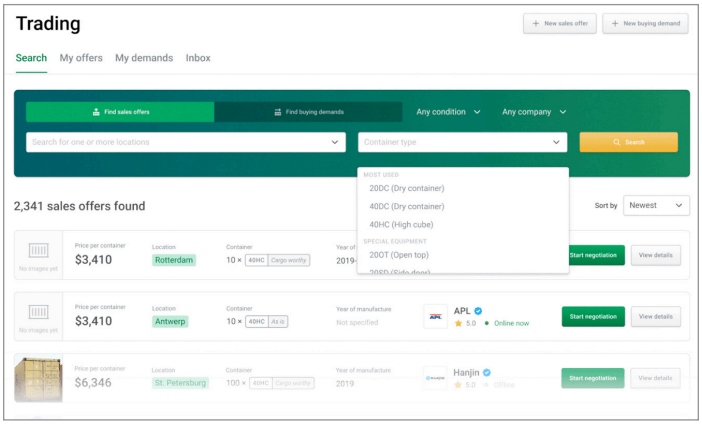

Figure 8. *Container-xChange Platform unit for sale*
Source: https://www.container-xchange.com/

For seaworthy containers, in the event of a change of ownership of one or more containers (but not of an entire fleet), the containers must be re-marked with the BIC code of the acquiring party. The buyer is responsible for marking them with a valid BIC code prior to departing the depot.

For units being sold for storage, office conversion, building, and the like, the purchaser does not need to apply for a BIC code.

Sales Comparison Approach

For banks, the preferred valuation methodology is generally the sales comparison approach, because it reflects what the market will actually bear for a particular asset.

Financial regulators all over the world now require banks to demonstrate the value of security, and market sales data is most compelling in that regard.

Annual reports from leasing companies, such as Triton and Textainer, often have useful information on the price at which significant quantities (tranches) of units were traded or average lease rates. However, this is usually historical data, and the appraiser may need to perform adjustments to make it reflective of the latest market conditions.

Sales data is also available from multiple reputable sources, including Drewry[6] and Harrison Consulting,[7] whose databases go back multiple decades. Both periodically publish new and used prices.

Thanks to digitization and online trading platforms, secondary market pricing is now more transparent and available in real time.

For example, Container-xChange publicizes aggregated used prices regularly. The containers are of various ages and conditions, such as "Brand New," "As Is," "Cargo Worthy," and "Scrap." An extract from late 2022 is shown in Figure 9 and demonstrates the price differential based on location.

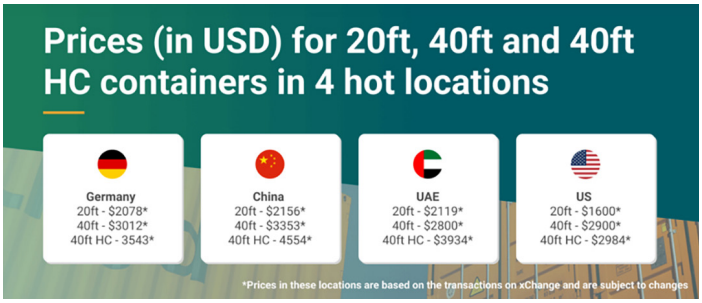

Figure 9. *Aggregated unit prices*
Source: https://www.container-xchange.com, *November 2022*

(continued on next page)

The market value of a 20-ft. unit was $1,600 in the US versus $2,156 in China. These differences arise from trade imbalances between net importers and net exporters.

Container age does influence price, but often the price is set based on availability at a location and a buyer's immediate need.

Multiple shipping containers will often be sold as a tranche without significant price adjustment for the individual age profile. The most important criteria are cargo worthy status and location.

CW generally means "Good" condition but newer units less than 3 years old are often in "Very Good" condition.

In conclusion, prices may vary significantly depending on age, condition, CW status, and location. Sales data is a key input to the valuation process but needs to be considered along with the outcomes of the income and cost approaches.

Long-Term Sales Data

Banks usually seek a valuation at a point in time (often when the shipping containers are brand new), but due to extreme volatility it does not really help in assessing transaction risk over the life of the loan.

By providing long-term prices over cargo worthy life (for simplicity assumed to be 0–12.5 years), you will assist your client in understanding asset value variability.

Banks have particular interest in historical low prices observed in economic downturns and are generally delighted when this information is provided.

In this sector, a recent low was observed in 2016 and 2017, evident in the historical sales prices.

Over a 15-year period leading up to 2022, the average ex-factory price was about $2,650, which provides a useful data point to financiers of new units and can be compared to the low of $1,488 in 2017 and a high of $3,690 in 2021.

Similarly, the global average historical resale price of a 12.5-year-old unit was around $1,200 but did see lows of around $700 in 2017. This variability is graphically indicated in Figure 10.

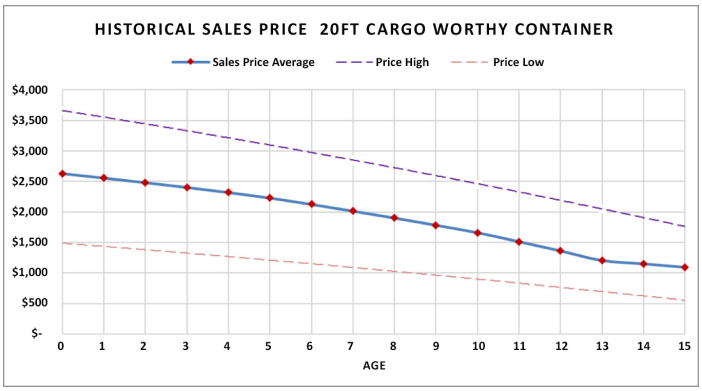

Figure 10. *Sales price average, price low (2016 & 2017), price high 2021*

(Note: as with all statistics, averages will vary with assumptions including the size of the data set and unit location. It is intended as a guide only.)

This data is particularly useful to banks considering refinance risk at the end of a term loan. Where the unamortized amount exceeds the projected future value, the loan will no longer be fully secured and will be deemed a riskier investment.

Although historical lows are useful data points, there is no guarantee that future values won't drop even lower.

Nevertheless, banks really appreciate this information, as it helps them make more informed decisions.

Cost Approach

Put simply, the cost approach subtracts all forms of depreciation—physical depreciation (PD), functional obsolescence (FO) and economic obsolescence (EO)—from the replacement cost new (RCN) to arrive at an opinion of fair market value (FMV).

There are several limitations of this method as applied to shipping containers, most notably establishing an appropriate RCN and quantifying economic obsolescence.

Replacement Cost New

Establishing the replacement cost new is problematic. We have already discussed the high degree of variability for ex-factory pricing.

The price of a new container has risen and fallen over the last 4 decades, but not predictably with any published index, although the price is closely related to the input cost of hot rolled steel as indicated in Harrisons' published data in Figure 11.

Steel prices tend to be highest during economic expansionary periods, which is also when global freight levels are highest, so there is a natural correlation between the two.

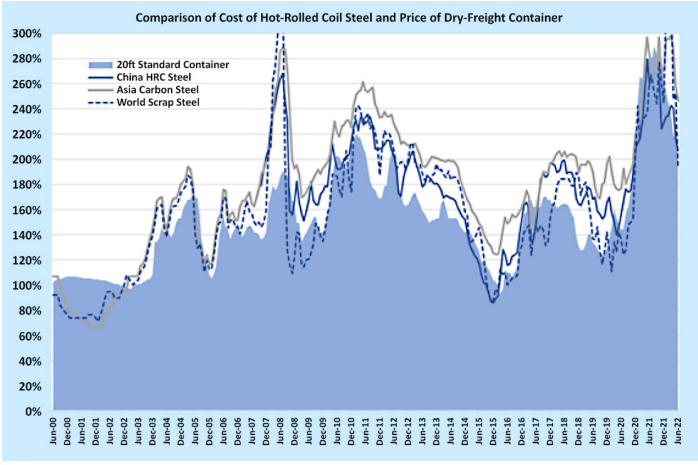

Figure 11. *Historical prices of new containers and steel*
Source: *Courtesy of Harrison Consulting, http://harrison-consulting.org/*

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Depreciation and Obsolescence

Whilst PD and FO are most straightforward, it is often difficult to establish if EO is even present—and then how to quantify it.

PD can be assessed quite easily by knowing the age of the unit and assuming an average CW life of 12.5 years.

There are low levels of FO for standard container boxes, with the basic design unchanged for decades. Strict regulation governing the sector ensures all CW units are built to the same standard size, design, and construction materials. Buyers do not typically differentiate between the Chinese manufacturers.

A unit's physical location does directly influence price, but this will vary through the loan term as the units enter a global supply chain.

Given the significant macro factors that influence the sector, predicting EO over the life of the asset is not possible.

EO at a point in time can sometimes be derived by comparing the output of the cost approach with that of both the sales comparison and income approach. Differences between estimates of FMV can sometimes be attributed to EO.

In summary, the cost approach is useful in that it highlights the degree of input variability for the asset class. However, it is unlikely to provide a credible opinion of value on its own.

Income Approach

The income approach is essential to the valuation as the bank seeks to confirm the asset's earnings potential justifies the initial capital investment. If not, then the ability to recover a lending exposure may be impaired.

New units funded at peak levels in 2021 ($3,690) require a significantly higher income stream to justify the investment compared to those funded in 2022 at $2,650.

Whilst the theory behind the income approach is sound, it is sometimes difficult to implement. An appraiser who forecasts future lease rates with any certainty probably does not understand the shipping sector!

> Those who have knowledge, don't predict.
> Those who predict, don't have knowledge.
>
> — *Lao Tzu, 6th Century BC Chinese Poet*

The income approach is widely applied (and debated) in valuation circles. Its main limitation is that estimates of FMV are highly sensitive to assumptions of future earnings, inflation, interest rates, and so on—all of which are difficult to predict over the life of the asset.

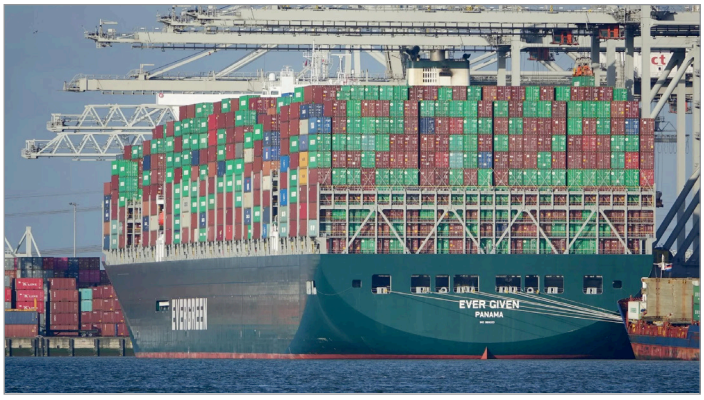

Figure 12. *Ever Given in March 2020 at the ECT Delta terminal in the Port of Rotterdam*
Source: *Suez Canal Authority planning to expand southern section of waterway (ship-technology.com)*

Income approach calculated using net earnings over the remaining CW life of the container boxes (lease revenues minus costs) plus terminal value are estimated, which are discounted back using an unlevered discount factor.

Lease Rates

For simplicity, appraisers often rely on average historical rates to predict future earnings. This can provide useful insight into sector trends and emerging risks. Still, the appraiser must be forward-looking in estimating earnings and not overly reliant on the past.

Where assets are on a long-term lease (LTL) to an investment-grade counterparty, then future cash flows can be predicted with some degree of certainty and an appropriate discount rate is applied to lease payments for the rest of this committed term. Such certainty is rarely the case. Typical lease durations can be as long as 10 years and as short as 6 months.

At expiry, the appraiser will need to estimate idle time and re-lease rates, future maintenance costs, and so on for the balance of the unit's CW life—no easy task!

Cash flows that are further into the future are usually discounted at higher levels as they are more uncertain.

According to Drewry, new 20-ft. containers achieved LTL rates of $0.46 in 2019 compared with $1.04 in 2021—an increase of 124%, demonstrating the difficulty in predicting future cash flows accurately.

Both Textainer and Triton are now reporting a significant easing of the market with many containers being returned "off-lease" early—even where early termination penalties apply.

Some appraisers will present a range of FMV with the lower point reflective of weaker long term lease rates.

(continued on next page)

One option is to prepare a sensitivity analysis for your client where assumptions around future lease rates and utilization are explored, developing a very useful tool for assessing transaction risk.

The income approach provides a good-sense check and is usually triangulated against data from the sales comparison and cost approaches to arrive at an opinion of value.

Conclusion

Shipping containers are long-life assets whose fair market value is highly correlated with macro-economic factors. Cargo worthy status and location are also key drivers of value.

Preparing a valuation for financing purposes requires significant care. A bank that lent money in 2021 when containers were at peak prices may see their position significantly underwater now, given a material drop in the market.

Finally, banks prefer valuations where supporting information and research is included.

Providing historical economic downturn data can help the bank make informed decisions and structure loans to mitigate some market risk and is a great way to build long and trusted client relationships.

About the Author

Nollaig Daly, AM, is Director of Structured Asset Finance and Leasing with the National Australian Bank, where she works globally with corporate and government clients. Nollaig was elected to the American Society of Appraisers MTS Discipline Committee in 2021 as part of the global technical advisory team. Her expertise includes the industries of shipping, aviation, mining, rail, industrials, construction, and infrastructure.
Email: nollaig.daly@nab.com.au.

[1] A TEU or Twenty-foot Equivalent Unit is an exact unit of measurement used to determine cargo capacity for container ships and terminals.

[2] Parikh, Jhanavi, "Cargotecture: The Architecture of Shipping Containers," Rethinking the Future, Materials & Construction, November 5, 2020, https://www.re-thinkingthefuture.com/2020/11/05/a1990-cargotecture-the-architecture-of-shipping-containers/

[3] Bureau International des Containers was founded in 1933 as a neutral, non-profit, international organization whose mission is to promote the safe, secure, and sustainable expansion of containerization and intermodal transportation.

[4] United Nations Conference on Trade and Development (UNCTAD), "Trade and Development Report 2022," October 3, 2022, https://unctad.org/publication/trade-and-development-report-2022

[5] https://www.maritimegateway.com/carriers-piled-up-with-massive-container-surplus/

[6] https://www.drewry.co.uk

[7] harrison-consulting.org

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Application of BLS Trends in the Cost Approach

Fernando Sosa, ASA
Director, Machinery & Equipment Valuation Practice, Cushman & Wakefield

Fernando Sosa

Abstract: *The purpose of this article is not to discuss the cost approach, the indirect method, or the many indices available to utilize in the indirect method. Instead, it discusses the two different producer price indices (PPI) that the Bureau of Labor Statistics (BLS) provides, identifies the differences between them, provides a comparison with a sample analysis, and determines if there is a material difference between the two indices and if one should be used over the other.*

Trending with Indexes

Trending is a method of estimating a property's reproduction cost new in which an index or trend factor is applied to the property's historical cost to convert the known cost into an indication of current cost. An index measures the change in prices over a period of time. For appraisers, there are many different sources at our disposal, such as these:

- Bureau of Labor Statistics (BLS)
- Marshall Valuation Service (MVS)
- Handy Whitman
- Self-developed

BLS measures labor market activity, working conditions, price changes, and productivity in the US economy to support public and private decision making. BLS is an agency of the US Department of Labor and provides statistical guidance to the department and its agencies and works in partnership with those agencies to support their data needs.

As MTS appraisers we utilize BLS to track inflation rates, which are used to calculate our trend factor, which is then applied to the historic costs of the assets in our application of the indirect method of the cost approach.

Producer price indices (PPIs) are a family of indices that measure the average change over time in the selling prices received by domestic producers of goods and services. PPIs measure price change from the perspective of the seller. This contrasts with other measures, such as the Consumer Price Index (CPI), that measure price change from the purchaser's perspective. Seller's and purchaser's prices may differ due to government subsidies, sales and excise taxes, and distribution costs.

There are two main PPI classification structures, which draw from the same pool of price information provided to the BLS by cooperating company reporters:

1. Industry Classification (PCU output)
2. Commodity-Based Final Demand-Intermediate (FD-ID) System (WPU output)

These two PPI classifications are discussed below. Note that because BLS data is constantly changing, accessible citations are not provided for individual images illustrating the industry data from the BLS website.

(continued on next page)

Industry Classification (PCU)

- A Producer Price Index for an industry is a measure of changes in prices received for the industry's output sold outside the industry (that is, its net output). The BLS PPI publishes approximately 500 industry price indices in combination with over 3,700 specific product line and product category sub-indices, as well as roughly 500 indices for groupings of industries. North American Industry Classification System (NAICS) index codes provide comparability with a wide assortment of industry-based data for other economic programs, including productivity, production, employment, wages, and earnings.
- PCU is the prefix for series identifiers for current price indices grouped by industry according to NAICS.

Image 1
Industry Data

Inflation & Prices

Database Name	Special Notice	Top Picks	Data Finder	One Screen	Multi-Screen	Tables	Text Files
Prices - Consumer							
All Urban Consumers (Current Series) (Consumer Price Index - CPI)		TOP PICKS		ONE SCREEN	MULTI SCREEN	TABLES	TEXT FILES
Urban Wage Earners and Clerical Workers (Current Series) (Consumer Price Index - CPI)		TOP PICKS		ONE SCREEN	MULTI SCREEN	TABLES	TEXT FILES
All Urban Consumers (Chained CPI) (Consumer Price Index - CPI)		TOP PICKS	DATA FINDER	ONE SCREEN	MULTI SCREEN	TABLES	TEXT FILES
Average Price Data (Consumer Price Index - CPI)		TOP PICKS		ONE SCREEN	MULTI SCREEN	TABLES	TEXT FILES
Prices - Producer							
Industry Data (Producer Price Index - PPI)		TOP PICKS	DATA FINDER	ONE SCREEN	MULTI SCREEN	TABLES	TEXT FILES
Commodity Data including "headline" FD-ID indexes (Producer Price Index - PPI)		TOP PICKS	DATA FINDER	ONE SCREEN	MULTI SCREEN	TABLES	TEXT FILES
Prices - International							
Import/Export Price Indexes (International Price Program - IPP)		TOP PICKS	DATA FINDER	ONE SCREEN	MULTI SCREEN	TABLES	TEXT FILES

Source: https://www.bls.gov/data/home.htm

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Commodity-Based Final Demand-Intermediate Demand (FD-ID) System (WPU)

- **Commodity-Based FD-ID** price indices regroup commodity indices for goods, services, and construction at the subproduct class (six-digit) level, according to the type of buyer and the amount of physical processing or assembling the products have undergone. The PPI publishes over 600 FD-ID indices (seasonally adjusted and not seasonally adjusted) measuring price change for goods, services, and construction sold to final demand and to intermediate demand. The FD-ID system replaced the PPI stage-of-processing (SOP) system as PPI's primary aggregation model with the release of data for January 2014. The FD-ID system expands coverage in its aggregate measures beyond that of the SOP system by incorporating indices for services, construction, exports, and government purchases.
- **WPU/WPS** are the prefixes for series identifiers for Commodity and FD-ID indices. The identifiers combine a WPU (not seasonally adjusted) or a WPS prefix (seasonally adjusted) with a commodity code.
- This data set became effective with the January 2014 PPI data release in February 2014. According to BLS this shift results in significant changes to the PPI news release, as well as other documents available from PPI. The transition to the FD-ID system is the culmination of a long-standing PPI objective to improve the SOP aggregation system by incorporating PPIs for services, construction, government purchases, and exports.

Image 2
Commodity Data

Inflation & Prices

Database Name	Special Notice	Top Picks	Data Finder	One Screen	Multi-Screen	Tables	Text Files
Prices - Consumer							
All Urban Consumers (Current Series) (Consumer Price Index - CPI)		TOP PICKS		ONE SCREEN	MULTI SCREEN	TABLES	TEXT FILES
Urban Wage Earners and Clerical Workers (Current Series) (Consumer Price Index - CPI)		TOP PICKS		ONE SCREEN	MULTI SCREEN	TABLES	TEXT FILES
All Urban Consumers (Chained CPI) (Consumer Price Index - CPI)		TOP PICKS	DATA FINDER	ONE SCREEN	MULTI SCREEN	TABLES	TEXT FILES
Average Price Data (Consumer Price Index - CPI)		TOP PICKS		ONE SCREEN	MULTI SCREEN	TABLES	TEXT FILES
Prices - Producer							
Industry Data (Producer Price Index - PPI)		TOP PICKS	DATA FINDER	ONE SCREEN	MULTI SCREEN	TABLES	TEXT FILES
Commodity Data including "headline" FD-ID indexes (Producer Price Index - PPI)		TOP PICKS	DATA FINDER	ONE SCREEN	MULTI SCREEN	TABLES	TEXT FILES
Prices - International							
Import/Export Price Indexes (International Price Program - IPP)		TOP PICKS	DATA FINDER	ONE SCREEN	MULTI SCREEN	TABLES	TEXT FILES

Source: https://www.bls.gov/data/home.htm

(continued on next page)

Searching for PPI Data Using Industry Classification

To search for PPI data using the Industry Classification, use the search bar to do the following:

1. **Select an industry.**
2. **Select one or more products.**

Source: https://data.bls.gov/PDQWeb/pc

Image 3
Industry search: Select an Industry

Image 4
Industry search: Select products

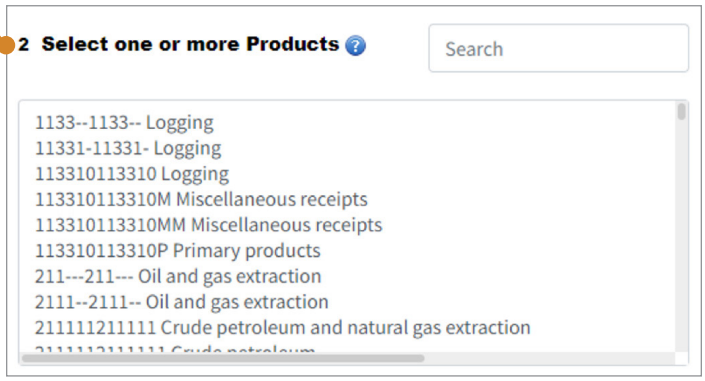
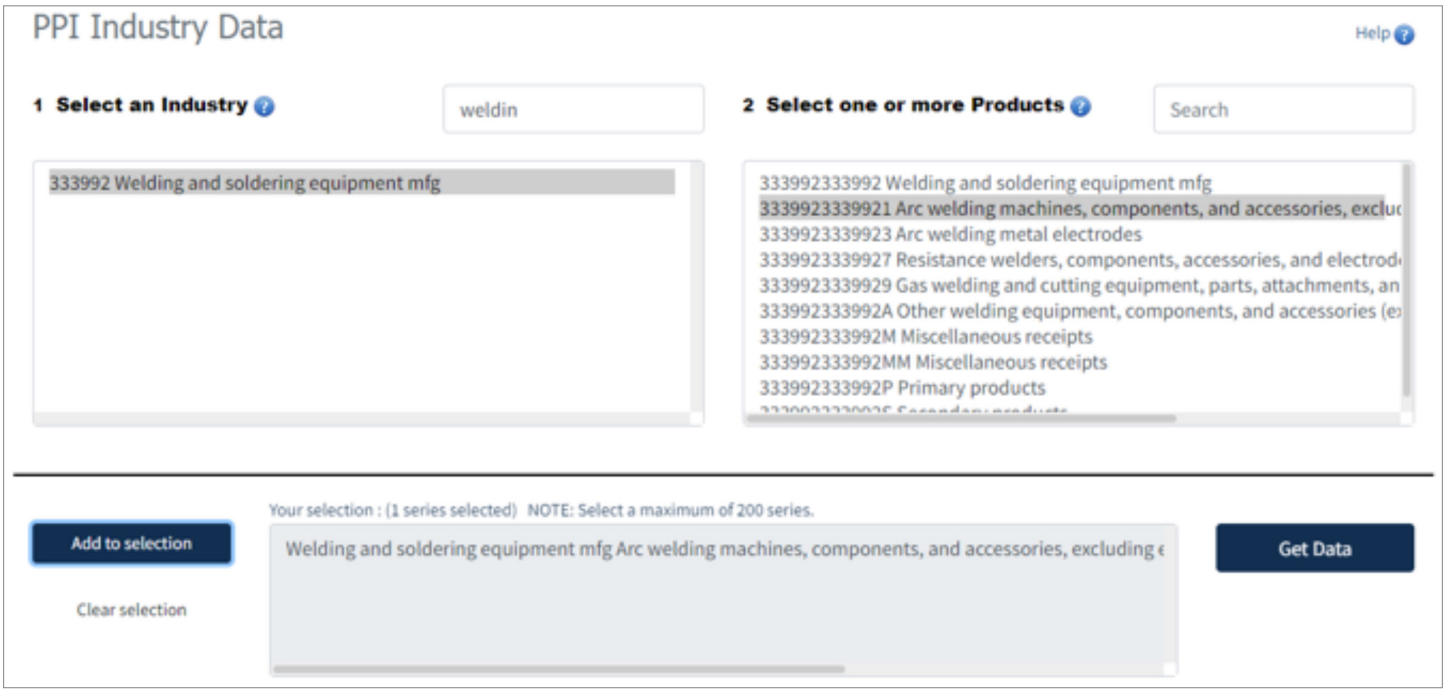


Image 5
Industry search: Select industry and products



This search yields the PCU data shown in Image 6.

(continued on next page)

Image 6
Industry search "PCU" data

PPI Industry Data

Series Id: PCU3339923339921
Series Title: PPI industry data for Welding and soldering equipment mfg-Arc welding machines, components, and accessories, excluding electrodes and stud welding equip., not seasonally adjusted
Industry: Welding and soldering equipment mfg
Product: Arc welding machines, components, and accessories, excluding electrodes and stud welding equip.
Base Date: 198412

Download: xlsx

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	220.5	221.6	221.7	224.0	227.2	227.1	227.1	227.1	227.1	227.1	227.1	227.1
2014	227.1	227.1	227.1	234.9	234.9	234.9	234.9	234.9	234.9	234.9	234.9	234.9
2015	234.9	234.9	234.9	241.8	241.8	241.8	241.8	241.9	241.9	241.9	241.9	241.9
2016	241.9	241.9	241.9	244.9	244.9	244.4	244.5	244.9	244.6	244.8	245.2	245.9
2017	245.7	246.1	249.3	251.4	251.5	251.4	251.7	252.3	252.6	252.4	255.4	255.3
2018	261.0	264.2	263.4	263.4	269.0	269.0	275.6	275.6	275.7	275.7	275.7	275.7
2019	281.0	281.0	281.0	281.1	282.2	282.2	284.1	284.1	284.1	284.1	284.0	284.0
2020	284.2	284.2	284.2	288.4	288.5	288.5	291.0	291.3	291.3	291.3	291.3	291.3
2021	291.3	296.1	296.1	299.2	318.0	318.7	329.999	329.999	343.141	343.141	343.141	361.234
2022	361.636	361.636	369.403	379.578	380.696	392.310	392.310	398.701	398.701	398.701	398.701	398.701(P)
2023	398.848(P)	398.848(P)	398.848(P)									

P : Preliminary. All indexes are subject to monthly revisions up to four months after original publication.

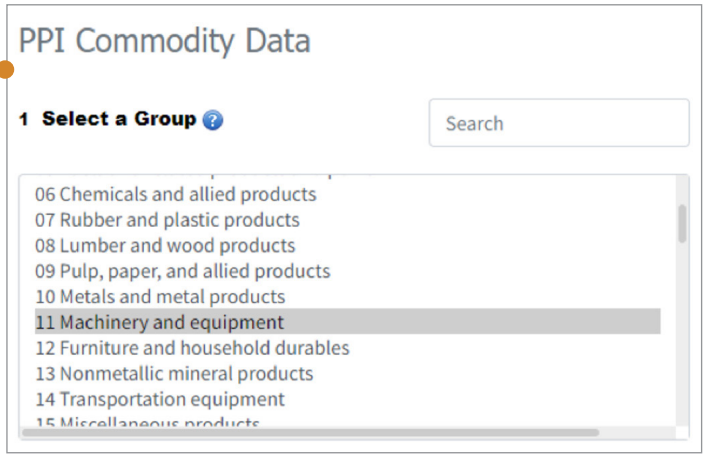
Searching for Commodity-Based PPI Data

To search for commodity-based PPI data, use the search bar to do the following:

1. **Select a group.**

   This is different from the search for an industry. The commodities are included in different baskets of groups that can be selected. Therefore, the appraiser must be careful when selecting the appropriate group to begin their search. In this example we will select *11 Machinery and Equipment.*

Image 7
Commodity search: Select a group



(continued on next page)

2. **Select one or more items.**

   Once the group has been selected, the appraiser can select one or more items just as with the PPI Industry data information.

3. **Select seasonal adjustment if desired.**

   Since this PPI measures commodities in addition to machinery and equipment, a seasonal adjustment factor can be selected to adjust the index based on seasonal effects within a particular industry.

Image 8
Commodity search: select items

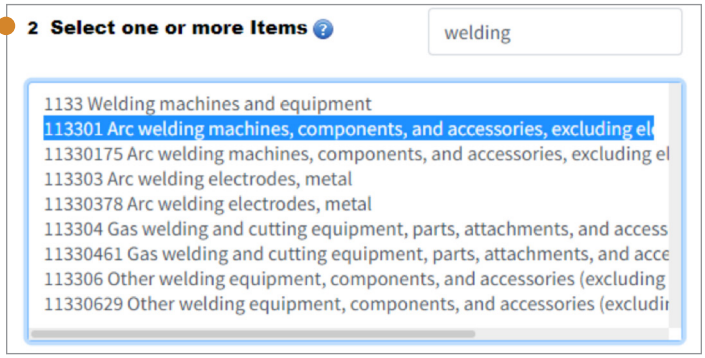


Image 9
Commodity search: select seasonal adjustment

Image 10
Commodity search: group, items, seasonal

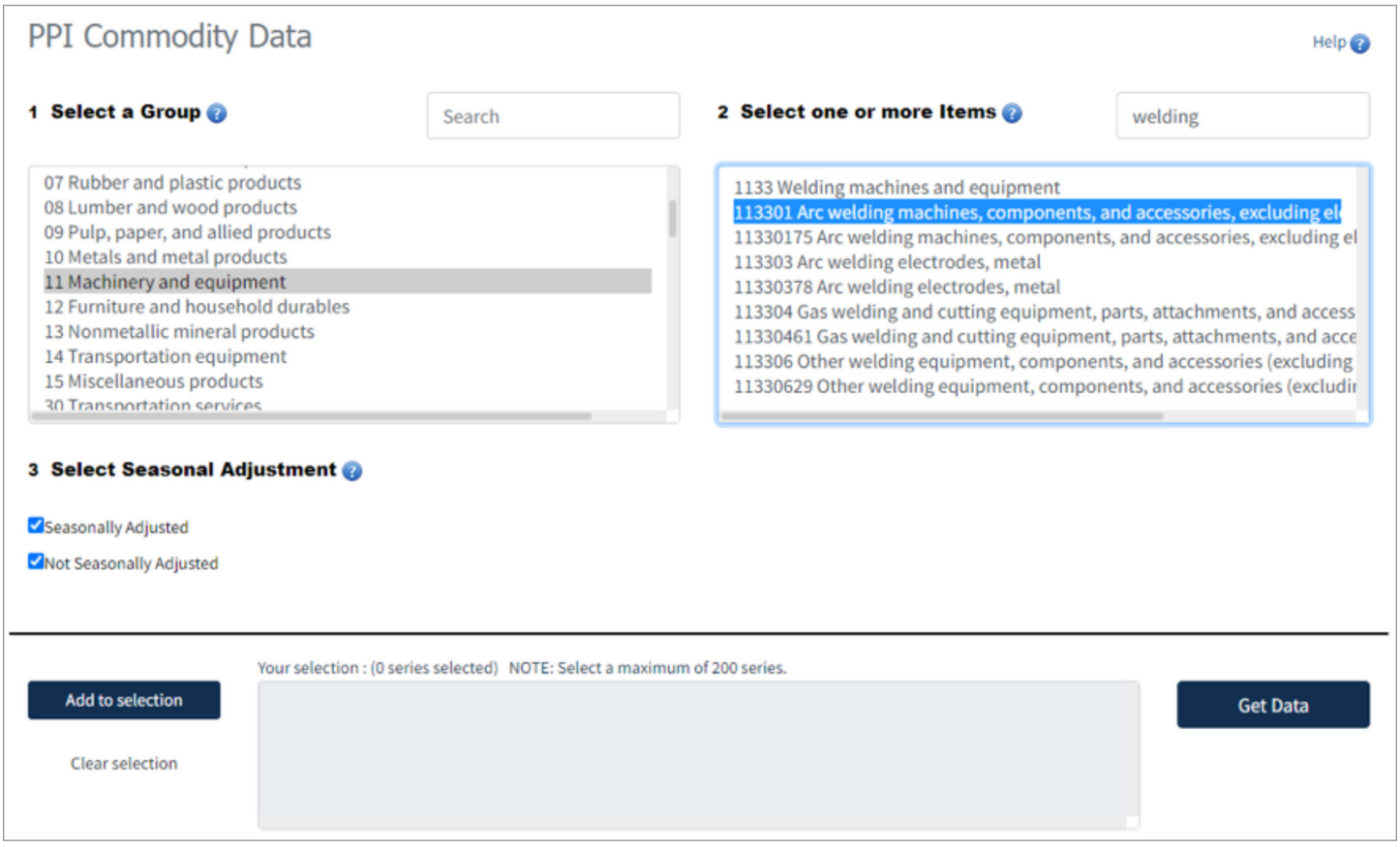


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Image 11
Commodity search: WPU data

Series Id: WPU113301
Not Seasonally Adjusted
Series Title: PPI Commodity data for Machinery and equipment-Arc welding machines, components, and accessories, excluding electrodes and stud welding equip, not seasonally adjusted
Group: Machinery and equipment
Item: Arc welding machines, components, and accessories, excluding electrodes and stud welding equip
Base Date: 198200

Download: xlsx

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2004	172.3	172.8	175.3	175.4	175.5	176.4	176.6	176.6	176.6	178.3	179.1	179.1	176.2
2005	179.1	181.3	181.3	181.3	181.9	183.2	186.0	185.2	185.7	185.5	185.6	185.6	183.5
2006	185.6	188.0	188.1	188.3	189.3	189.4	191.8	195.6	196.8	196.5	196.5	196.5	191.9
2007	200.1	200.1	200.3	202.2	202.2	202.2	202.3	203.0	203.0	203.2	203.2	203.2	202.1
2008	204.1	204.1	204.4	206.8	206.8	205.4	212.5	212.5	212.5	212.5	212.5	212.2	208.8
2009	212.2	212.0	211.6	211.6	211.6	211.6	211.7	212.1	212.1	212.1	212.1	212.1	211.9
2010	212.1	212.1	212.1	212.1	213.4	216.7	216.8	216.8	216.8	216.8	216.8	216.8	215.0
2011	216.6	218.2	222.6	224.0	224.1	224.1	224.1	224.1	224.1	226.0	226.0	226.0	223.3
2012	226.3	229.1	229.1	231.3	231.6	231.6	231.6	231.3	231.3	231.5	231.5	231.5	230.6
2013	231.5	232.6	232.8	235.2	238.4	238.1	238.2	238.3	238.3	238.3	238.4	238.4	236.5
2014	238.4	238.4	238.4	246.6	246.6	246.6	246.6	246.6	246.6	246.6	246.6	246.6	244.5
2015	246.6	246.6	246.6	253.9	253.9	253.9	253.9	253.9	253.9	253.9	253.9	253.9	252.1
2016	253.9	253.9	253.9	257.0	257.0	256.6	256.7	257.0	256.7	257.0	257.4	258.1	256.3
2017	257.9	258.3	261.7	263.9	264.0	263.9	264.2	264.8	265.2	264.9	268.0	268.0	263.7
2018	273.8	277.2	276.3	276.3	282.2	282.2	289.0	289.1	289.1	289.1	289.1	289.1	283.5
2019	294.7	294.7	294.7	294.7	296.0	296.0	297.9	297.9	297.9	297.9	297.9	297.9	296.5
2020	298.0	298.0	298.0	302.4	302.5	302.5	305.2	305.4	305.4	305.4	305.4	305.4	302.8
2021	305.5	310.5	310.5	313.7	333.5	334.2	346.065	346.065	359.847	359.847	359.847	378.821	338.209
2022	379.242	379.242	387.387	398.058	399.231	411.410	411.410	418.112	418.112	418.112	418.112	418.112(P)	404.712(P)
2023	418.267(P)	418.267(P)	418.267(P)										

P : Preliminary. All indexes are subject to monthly revisions up to four months after original publication.

This search yields data very similar to the PPI Industry search. However, instead of PCU data, the search now provides a WPU data set.

(continued on next page)

Index Comparison

Now that we have discussed PCU versus WPU and how to search for this data, we will now compare that data between the two indices and see if there is truly a material difference between the two. In this case study I have selected three common asset classifications that can be found in many MTS appraisal engagements: welding equipment, computer equipment, and general machinery and equipment. The following pages provides a comparison between these three asset classes.

Graph 1 shows that the difference between PCU and WPU data is only five percent, which in my opinion would be immaterial, and that the indices tend to follow each other closely. In this example the application of both indices would provide a result with a minor difference in the reproduction cost new.

Graph 1
PCU vs WPU Welding Equipment

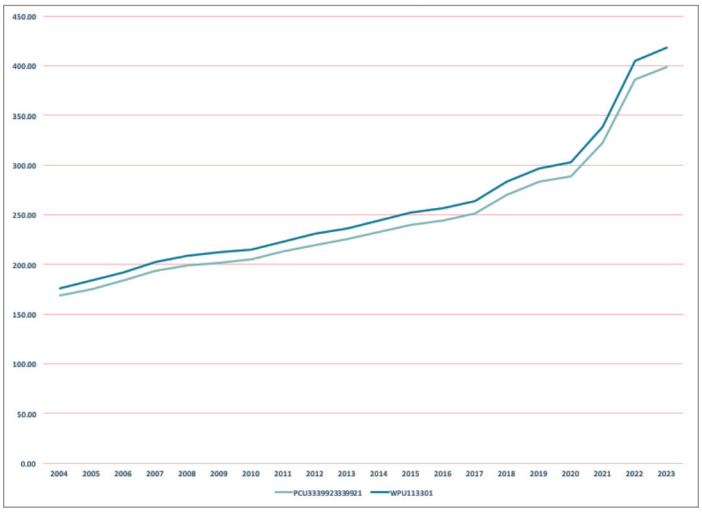

Table 1
PCU vs WPU Welding Equipment

Year	PCU3339923339921 PPI industry data for Welding and soldering equipment mfg-Arc welding machines, components, and accessories, excluding electrodes and stud welding equip., not seasonally adjusted Indices	WPU113301 Arc welding machines, components, and accessories, excluding electrodes and stud welding equip Indices	Delta
2004	168.40	176.20	4%
2005	175.30	183.50	4%
2006	183.40	191.90	4%
2007	193.20	202.10	4%
2008	198.90	208.80	5%
2009	201.80	211.90	5%
2010	204.70	215.00	5%
2011	212.70	223.30	5%
2012	219.70	230.60	5%
2013	225.40	236.50	5%
2014	233.00	244.50	5%
2015	240.10	252.10	5%
2016	244.10	256.30	5%
2017	251.30	263.70	5%
2018	270.30	283.50	5%
2019	282.80	296.50	5%
2020	288.80	302.80	5%
2021	322.51	338.21	5%
2022	385.92	404.71	5%
2023	398.85	418.27	5%

(continued on next page)

In this example, when comparing PCU vs. WPU data for computer equipment, there is a clear difference in the deflationary rates between the two PPI indices. While both indices show a deflationary rate that follows an apparently similar path, the WPU's deflationary index falls more sharply than the PCU index. Another interesting point is that the PCU and WPU indices are close to each other until the midpoint of 2005–2006. At that point there is a sharp widening between the indices. Information is not readily available from BLS regarding the basket of goods included in both indices, but the sudden sharp widening between the indices, while they still follow a similar path, leads me to believe that there was a change in the basket of goods being measured at that time.

Nonetheless, the indices appear to stabilize in 2010 and follow a similar path but with a wide gap between the two indices. The application of both indices would provide a similar rate of deflation but with a wide gap.

Graph 2
PCU vs WPU Computer Equipment

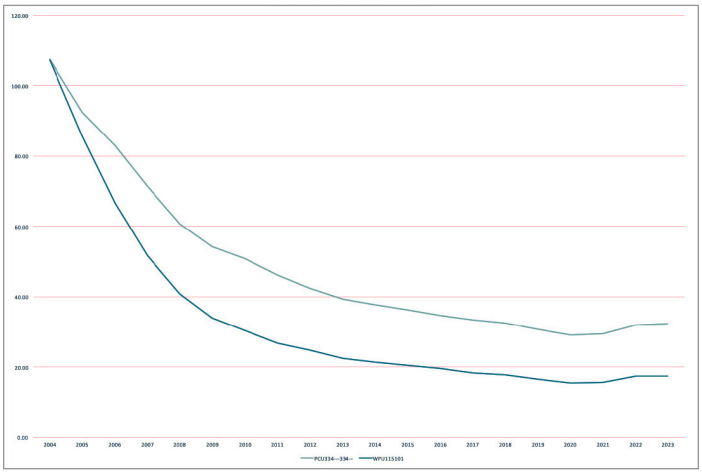

Table 2
PCU vs. WPU Computer equipment

Year	PCU334---334--- PPI industry sub-sector data for Computer & electronic product mfg, not seasonally adjusted Indices	WPU115101 PPI Commodity data for Machinery and equipment - Electronic computers, not seasonally adjusted Indices	Delta
2004	107.40	107.30	0%
2005	92.40	85.50	-8%
2006	82.80	66.50	-25%
2007	71.40	51.60	-38%
2008	60.60	40.80	-49%
2009	54.20	34.00	-59%
2010	50.70	30.30	-67%
2011	46.20	26.80	-72%
2012	42.30	24.80	-71%
2013	39.30	22.50	-75%
2014	37.60	21.30	-77%
2015	36.20	20.40	-77%
2016	34.70	19.50	-78%
2017	33.30	18.40	-81%
2018	32.50	17.80	-83%
2019	30.70	16.60	-85%
2020	29.10	15.40	-89%
2021	29.43	15.63	-88%
2022	31.95	17.34	-84%
2023	32.34	17.50	-85%

(continued on next page)

Graph 3 illustrates a widening gap starting in 2019, which could be due to the impacts of COVID and the current inflationary economic conditions in the US. However, something else has occurred. The PCU and WPU index crossed each other in 2012 and their respective indices have inverted. Without knowing the specific basket of goods that was utilized or how the indices were calculated we can only speculate as to why these two indices crossed and inverted. Another interesting point is the wide gap in 2004 which narrowed before the curves crossed and began to widen again.

Graph 3
PCU vs WPU general equipment

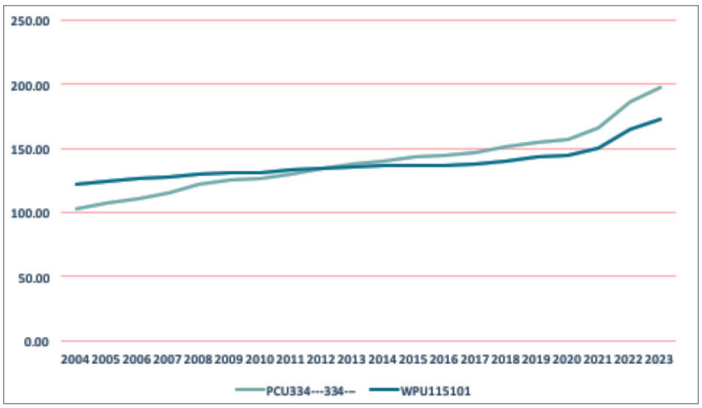

Table 3
PCU vs WPU general equipment

Year	PCU3339--3339-- PPI industry group data for Other general purpose machinery manufacturing, not seasonally adjusted	WPU11 PPI Commodity data for Machinery and equipment, not seasonally adjusted	Delta
	Indices	Indices	
2004	103.00	122.10	16%
2005	107.60	123.70	13%
2006	111.20	126.20	12%
2007	115.00	127.30	10%
2008	121.40	129.70	6%
2009	125.40	131.30	4%
2010	126.50	131.10	4%
2011	130.00	132.70	2%
2012	134.30	134.20	0%
2013	137.10	135.20	-1%
2014	140.30	136.20	-3%
2015	142.70	136.90	-4%
2016	144.40	136.90	-5%
2017	146.70	137.90	-6%
2018	151.00	140.30	-8%
2019	154.80	143.30	-8%
2020	157.00	144.90	-8%
2021	165.32	149.95	-10%
2022	186.43	164.96	-13%
2023	196.95	172.27	-14%

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Primary Differences Between PCU and WPU

1. PCU is not seasonally adjusted.
2. WPU automatically provides a seasonal adjustment for categories which require this adjustment.
3. PCU publishes approximately 500 industry prices indices in combination with over 3,700 specific products.
4. WPU publishes approximately 600 FD-ID indices which are seasonally and not seasonally adjusted.
5. The WPU became effective in January of 2014. So there may be many appraisers that are not aware that this is an additional option when applying the indirect method.

Conclusion

The purpose of this article is to present the two BLS indices available for use, explain how to search the indices, and to provide a comparison between the two indices. Whereas one appraiser may select the PCU Index and another may select the WPU Index, there is no wrong answer. The application of indices is subjective from appraiser to appraiser. In performing appraisals, the appraiser should, when possible, also apply the direct method and test that the applied trend provides a reasonable inflationary/deflationary to the assets. Even though the three provided examples show differences between them, the indices still follow a similar path.

While there are many sources available to appraisers in the application of the indirect method such MVS and BLS, which are two common sources for indices. Appraisers should be able to support why the selected indices was chosen to calculate the trends and be prepared to defend those selections during audit review, litigation support, or in general.

The case study illustrates a scenario where the indices show a wide gap, and in such situations the appraiser should consider any current external factors affecting those asset classes—such as inflation, supply chain issues, tariffs affecting the industry, and so on—to determine which of the two indices should be applied. More importantly, the appraiser should consider the results of the direct method (performed to the best of their ability) and review the relationship between the results provided by the direct and indirect methods; such a comparison could theoretically guide the appraiser to an appropriate selection of indices.

In closing, it is important to note that the many external factors—global economic conditions, supply chain issues, and tariffs—currently affecting appraisals do not affect all industries the same way. Some industries are experiencing inflationary curves while others are experiencing deflationary curves. Appraisers may see the impact of the current global economic situation even more clearly in the future as we trend assets acquired in the past couple of years. At any point in the appraisal timeline, it is important that the appraiser understand not just the assets they are appraising but the industry as well. This will help in selecting the most defendable inputs for their application of the cost approach.

About the Author

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Identification of Pleasure Boats

Stephen Knox, ASA
Knox Marine Consultants, Richmond, Virginia

Stephen Knox

Abstract: *Valuation of pleasure boats is a specialty within the MTS designation. This article presents an overview of pleasure boat marine vessels focusing on the different types of powerboats and sailboats. Much of this information, and all of the images reproduced in this article, are from the author's booklet, Boat Basics.*[1]

Pleasure Boat Overview

Almost all modern pleasure craft—whether powerboats or sailboats—are made of fiberglass. There are a few exceptions, most notably very large yachts (over about 70 feet), which are usually made of aluminum. Custom built smaller yachts may also be aluminum. Aluminum is light and strong and is well suited to one-off construction (that is, building just one boat at a time.) Both powerboats and sailboats can be made of aluminum.

Until about 1960 all yachts were wooden. Some of those oldies are still around, and of course some small builders are still building powerboats and sailboats in wood.

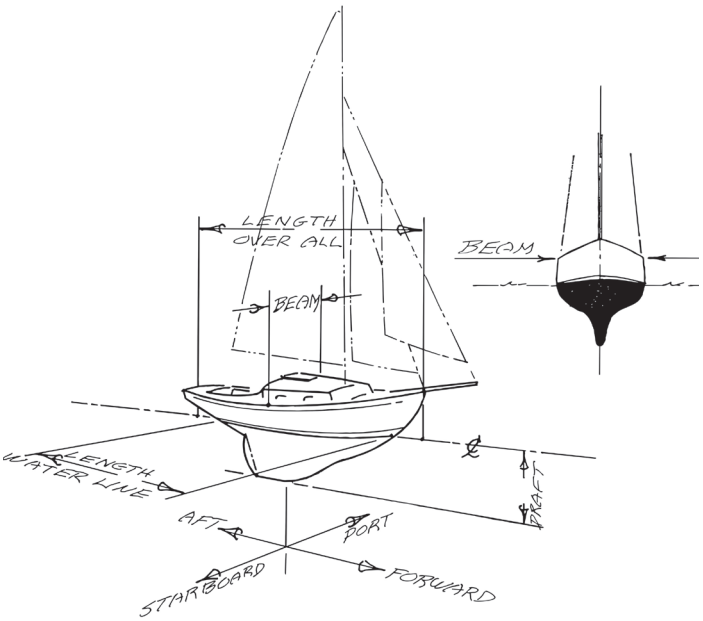

Figure 1: *Which way is which?*
Directional terms are the same for sailboats and powerboats.

Figure 2: *Sport fisherman with outriggers, no tower.*

Identifying Powerboats

Powerboats can be divided by the type or shape of the bottom, as well as the type of hull above the waterline. Most powerboats are built as monohulls—i.e., one hull, the shape most people think of when they think of powerboats. However, catamaran hulls (two hulls below the water) have increased in popularity over the last few years. Their builders claim better speed with less power, and a smoother ride in chop.

Powerboats are also categorized by what the designer has done above the waterline.

Sport Fishermen

A sport fisherman has an open cockpit where the passengers can handle fishing rods. They are usually designed and equipped with an eye to fishing only. The cockpit is relatively low to the water, even on larger boats, to facilitate landing large fish. Most sport fishermen have aluminum outriggers—long poles that can be dropped out sideways from the boat. They allow the fishing lines to be trolled further from the boat, so there is less chance of the lines tangling in a turn. Many have large fighting chairs in the center of the cockpit, where a fisher can sit and play a large gamefish.

All sport fishermen have flying bridges. Many also have tuna towers, a welded pipe structure that allows the captain a higher operating position, for spotting fish. Sport fishermen range in size from about 35 feet up. The smaller ones typically have twin gasoline engines. From about 40 feet up, most have diesel engines. All production sport fishermen have twin engines. Some by custom builders have a single engine.

The early sport fisherman was spartan. Builders coined the term convertible to designate a boat with a cruising interior as well as a sport fisherman deck layout. The terms have now become interchangeable, since all production sport fishermen are built with cruising interiors.

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Motor Yachts

Motor yachts are larger boats designed exclusively for cruising. Sizes range from about 40 feet up. Almost all are powered by diesel engines. Most have two operating stations: an enclosed pilothouse on the main deck level and a flying bridge. Engines are typically located midships. Larger motor yachts usually have a large enclosed lounging area at the after end of the main deck.

Motor yachts are usually semi-planing hulls. They don't truly plane but go faster than true displacement hulls. Speeds range up to about 20 knots.

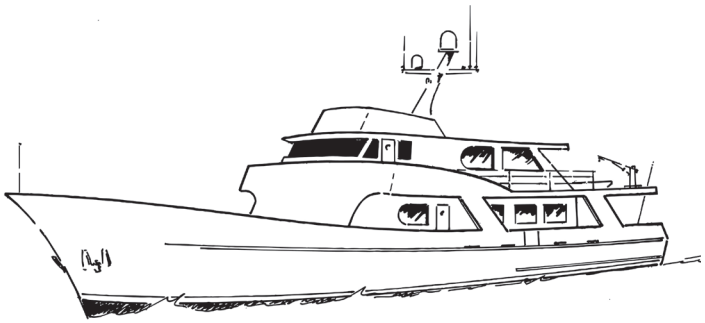

Figure 3: *Large motor yacht*

Figure 4: *Motor yacht on a lift*

Figure 5: *A typical express hull*

Express Cruisers

Express cruisers have a large open cockpit, usually at two levels. From the after part of the cockpit, there is usually a step up to the helm area. Express cruisers are built from about 30 feet up. Almost all have twin inboard engines, though some in the smaller size range may have inboard/outboard engines. Engines are usually located under the helm station for inboard engines, or under the aft cockpit for inboard/outboards.

Center Consoles

Center consoles are open fishing boats powered by outboard engines. The name comes from the operating console in the center of the cockpit. The remainder of the deck is open, allowing fishers to walk completely around the perimeter. Until about 10 years ago the largest center consoles were about 30 feet, powered by twin outboards. Now it seems that boat builders are vying to see who can build the largest center console and who can hang the most outboard engines on the back. The current leader is about 53 feet with four outboards rated at 600 HP each.

Trawlers

Trawlers are displacement hulls, that is, they do not plane. The maximum speed of a trawler is limited by the length. Speeds are typically about 10 knots. Almost all trawlers are powered by diesel inboard engines. Some have single engines, some have twin engines. Trawlers are made with a lower station as well as a flying bridge. Some have one or the other.

Trawlers are designed for long distance cruising. They are relatively slow as powerboats go, but very economical to operate. Many are fitted with generators and other cruising amenities.

Figure 6: *The author's 18 feet center console*

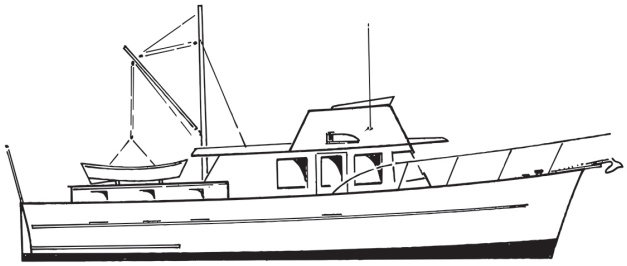

Figure 7: *Trawler*

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Pontoon Boats

Pontoon boats are very popular on inland waters. Sizes range from about 16 feet to about 30 feet. Typically, pontoon boats have a flat open deck, with bench-type seating. The larger models sometimes have small enclosed cabins aft. Almost all are powered by a single outboard engine. A few larger models are equipped with a single inboard/outboard engine.

Houseboats

Houseboats vary tremendously in size and complexity. The smaller houseboat hulls are usually made of fiberglass. Larger hulls are sometimes aluminum. Sizes range from 20 feet to over 60 feet. Houseboat bottoms are typically almost flat, with only a very shallow vee shape. Smaller houseboats are powered by one or two outboard engines. Larger ones have inboard/outboard power.

Powerboat Propulsion

Powerboats may also be categorized by the type of power: inboard, outboard, or inboard/outboard (sterndrive).

Outboard Engines

Smaller boats are usually powered by one or more outboard engines mounted on the transom. Outboard manufacturers are building larger and larger engines. Outboard are currently available over 600 HP. The larger engines drive boats up to about 50 feet. The boat is steered by turning the outboard engine(s).

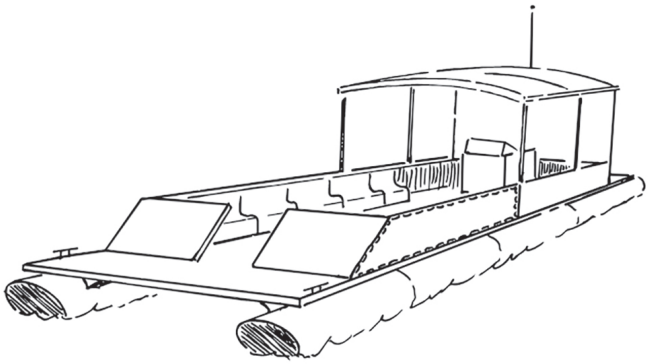

Figure 8: *Pontoon boat*

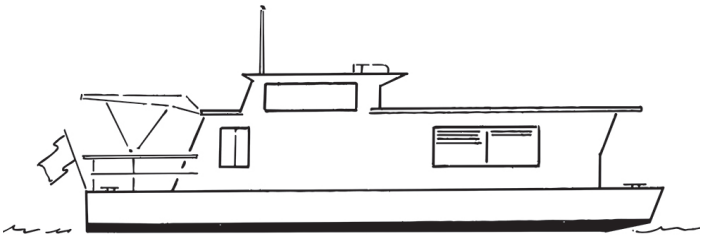

Figure 9: *Houseboat*

Inboard/Outboards (Sterndrive)

Powerboats from about 20 to 30 feet may be pushed by one or two inboard/outboard engines. A converted automotive engine (usually a V8) is mounted inside the boat. A sterndrive is mounted on the boat's transom. Small four-cylinder engines are rated for 140 HP. Large V8s may deliver as much as 360HP. The boat is steered by turning the sterndrive. As larger outboards have become available in the last decade the sterndrive has faded in popularity.

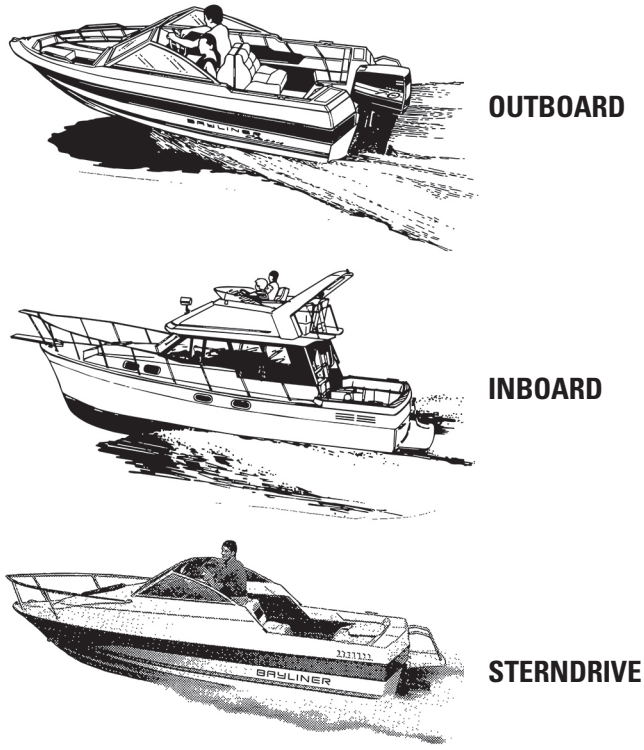

Figure 10: *Outboard, inboard, and sterndrive propulsion*

Figure 11: *Fishing boat with twin outboards*

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Inboards

On large powerboats, a gasoline or diesel engine (or two) is mounted inside the boat. A shaft runs out through the hull and drives a propeller. Gasoline engines are identical to those found on inboard/outboard boats. Gasoline is typical on boats up to about 35 feet. Diesels are predominant on larger boats. Large diesel engines develop thousands of horsepower. Steering is by a separate rudder.

The jet drive is a special type of the inboard. The engine turns a jet pump rather than a propeller. Jet drives are usually found on speed boats and ski boats.

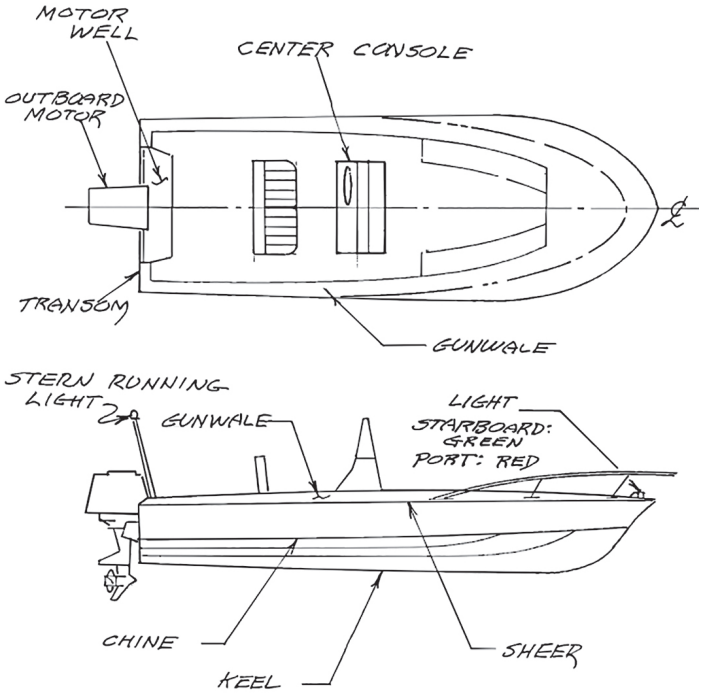

Figure 12: *Powerboat terminology: center console runabout*

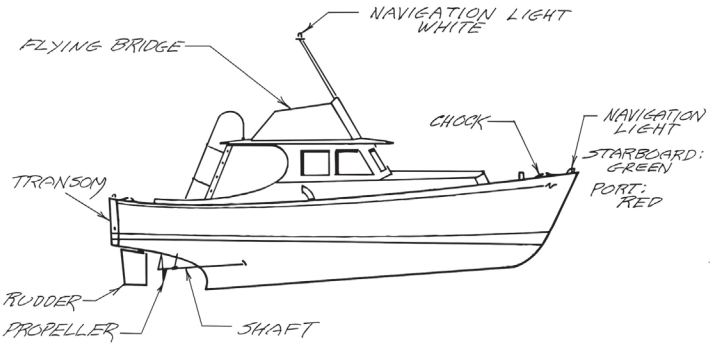

Figure 13: *Powerboat terminology: mid-size sportfisherman*

Categorizing Sailboats

Sailboats, powered primarily by wind, can be categorized by hulls or sail plans, also known as rigs.

Hull Types

Like powerboats, sailboats can be categorized as monohulls or multihulls. Monohulls are the conventional construction. They feature a ballasted keel. Both the weight of the ballast and the hydrodynamic forces on the keel act to keep the boat upright as wind acts on the sails.

Probably the best-known catamarans are the Hobie line of small sailboats. However, cruising catamarans have become more popular in the last decade or so. There are now several production builders producing cruising catamarans in the 30- to 40-foot range. Catamarans are unballasted and depend on their wide beam to provide stability. Some have a single outboard engine mounted between the two hulls. Some larger models have an inboard engine in each hull. Another variation is to have a single engine driving a large hydraulic pump. The pump supplies hydraulic power to hydraulic motors in each hull, which turn propeller shafts.

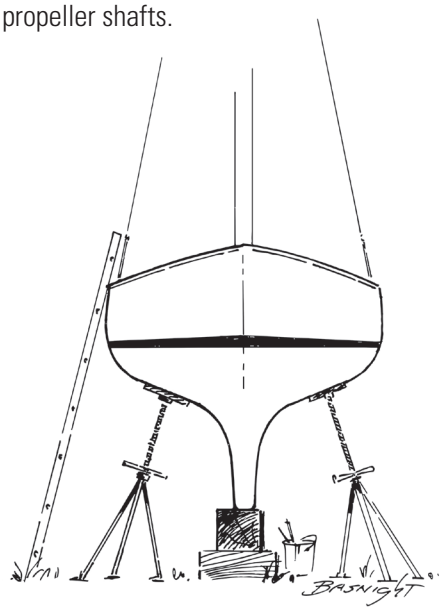

Figure 14: *Monohull sailboat*

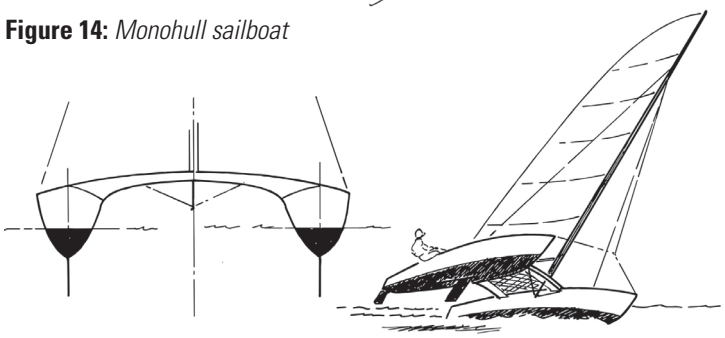

Figure 15: *Catamarans*

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Sail Plans

Sailboats are also categorized by their sail plans, or rigs.

Sloops

The sloop is the most common sail plan. The sloop has a single mast, with the mainsail aft of the mast and a jib or genoa carried forward.

Cutter

The cutter is a variation of the sloop. The cutter has two forestays, so that two sails can be carried forward. In a true cutter, the mast is further aft than on a sloop. The mainsail is, therefore, a little smaller.

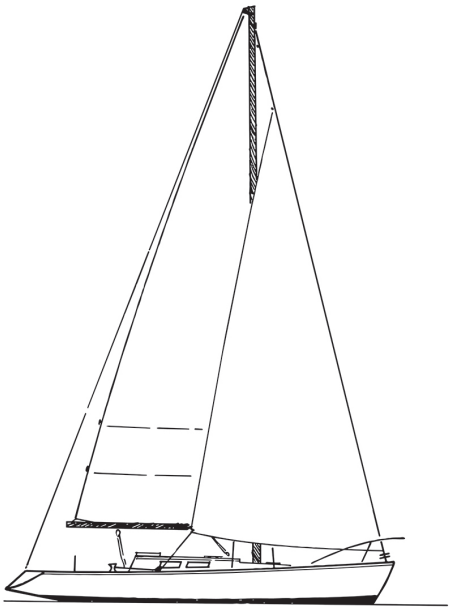

Figure 16: *Sloop with masthead rig*

Figure 17: *Cutter with fractional rig*

Ketch, Yawl, and Schooner

The ketch and yawl have a second smaller mast aft. The schooner has the main mast aft, with a smaller mast forward.

Motorsailers

Sailboats are also sometimes categorized as motorsailers. Motorsailers generally have smaller sail plans and larger engines than average. There is no hard and fast line here.

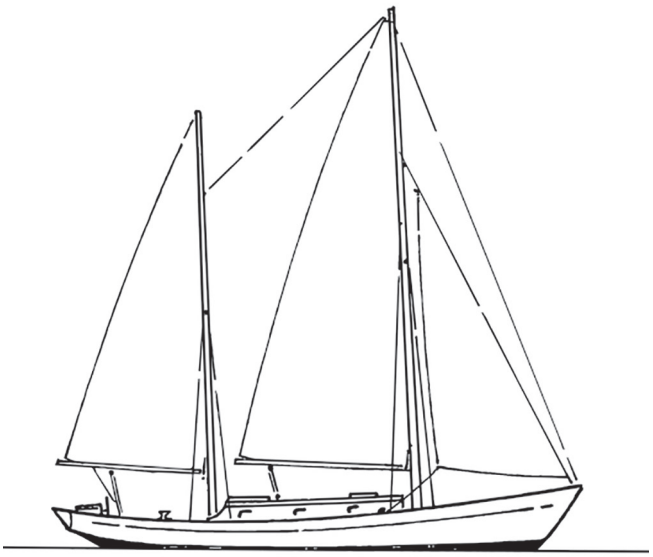

Figure 18: *Ketch*

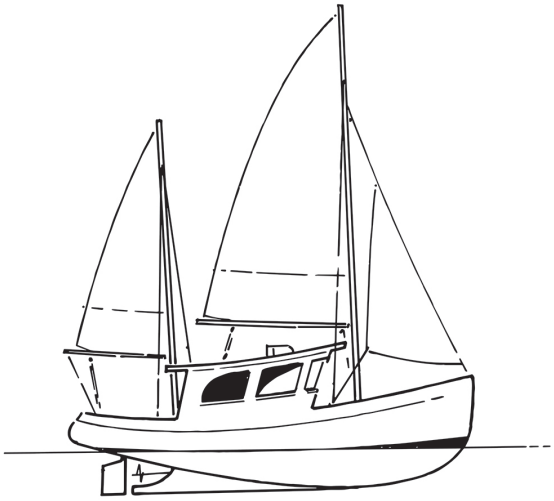

Figure 19: *Motorsailer*

(continued on next page)

Vessel Particulars

There are several sources of information about a given boat's particulars such as length, beam, and draft.

The *BUC Used Boat Price Guide* lists basic dimensional information. For more details, try the following:

Mauch's Sailboat Guide, Ian Mauch, 1991, out of print

PowerBoat Guide, McKnew, American Marine Publishing, Inc., www.powerboatguide.com (sample pages, ordering information only)

Hull Identification Numbers

Each boat is assigned a unique Hull Identification Number (HIN) by the builder. Similar to a VIN (vehicle identification number) for a car, a HIN gives the reader information critical to the identification of the vessel. A HIN has twelve characters, in three groups. The first three characters are the Manufacturer's Identification Code (MIC) and identify the boat builder. The next five are assigned by the boat builder and can be any series of numbers or letters. The ninth character is the month of manufacture. The tenth is the last digit of the year of manufacture. The last two are the model year of the boat. The HIN is found on the boat's transom, in the upper right corner, and is the primary way to identify a specific boat.

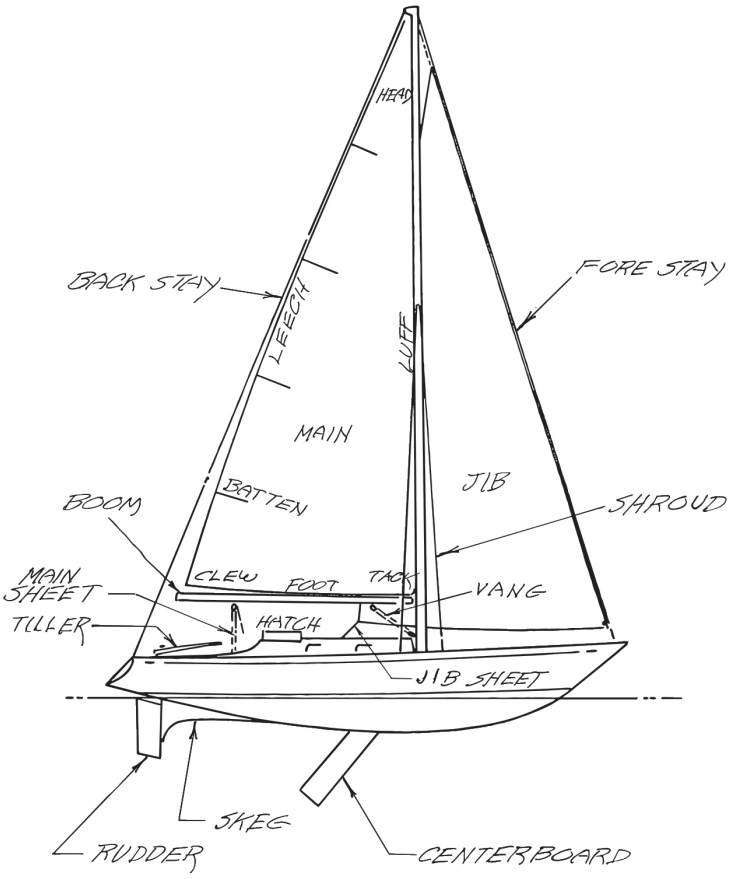

Figure 20: *Sailboat terminology*

Because the HIN is so important in recovering stolen boats, marine appraisers should be sure that the correct HIN is provided by the vessel owner and referenced in any report. During inspection, it's useful to verify the number.

Registration Numbers

Boats must be registered in one of two ways. Smaller boats are titled and registered with the state. Not all states title boats but state-registered boats will carry a state registration number on the bow.

Boats larger than about 25 feet can be state titled and registered or Coast Guard documented. Documentation is the Coast Guard equivalent of state titling. A documented boat is issued an Official Number (six or seven numerals) that is marked inside the hull. The Official Number is not marked on the outside of the boat. Documented boats must be named, and the name must be put on the transom.

Valuation of Boats

Marine surveys reports are regularly required for insurance, lending, or buy/sell purposes.[2] The marine survey business, however, is completely unregulated, and so the quality of appraisal reports varies tremendously. The two organizations that certify marine surveyors (the National Association of Marine Surveyors and the Society of Accredited Marine Surveyors) provide their members with voluntary standards about report content. These standards list the information the groups recommend be included in the reports, but do not specify the format. As a result, almost everyone uses a different format.

The Appraisals Standards Board of the Appraisal Foundation publishes *Uniform Standards of Professional Appraisal Practice* (USPAP). The standards apply to all types of valuation, be it real estate or boats.

ASA has only 13 marine surveyor specialists in the MTS discipline. Of those, 4 are yacht appraisers and the others are commercial vessel appraisers.

Defining a Boat's Value

It is important to know exactly what you mean when you discuss a boat's value. The usual term is current market value. The simple definition is the price a willing buyer would pay a willing seller, with neither being under undue pressure to buy or sell, and both being fully informed about the market and the condition of the property.

There really is only one true value for a boat—that is the price the boat would bring on the open market. Some surveyors and boat owners talk about appraisal value, insurance value, donation value, or other such terms, but these are really all the same value (or at least they should be).

(continued on next page)

Replacement Cost

One other concept worth discussion is replacement cost. Replacement cost is the cost to purchase a new identical or functionally similar boat, in today's market, priced in today's dollars. Determining replacement cost for a production boat is relatively easy. Even if that particular model is no longer made, there is probably a builder making a comparable boat. It becomes more difficult to determine replacement cost with unusual boats—large custom-built boats or wooden boats, for example.

Market Guides

Various guides are available to predict what a boat will sell for in the open market. The three most common are the following:

BUC Used Boat Price Guide, BUC International, www.bucvalu.com. Subscription service, on-line plus a printed guide published twice a year.

ABOS Marine Blue Book. Published by Price Digests, www.pricedigests.com. Excellent reference for trailerable boats and outboard engines. Used by many dealers to value that size boat. Subscription service, on-line only, updated four times a year.

NADA Marine Appraisal Guide. J.D. Power, www.jdpower.com/boats. Subscription service, on-line only.

Comparable Sales

For boats from about 30 feet (9m) up, YachtWorld is a web-based source of sales data that offers public and subscription-only data. Public information includes listings of all boats offered for sale by yacht dealers; these listings includes thousands of boats. The subscribers-only portion of the site provides data for all listed boats that were sold. In mid-2002, YachtWorld.com agreed to allow marine surveyors to subscribe and have access to the full site, including the listings of boats that have sold. It is a great source of comparable sales! Marine surveyors must be a member of an marine surveyor organization—SAMS or NAMS—to subscribe.

Brokers are also a good source of recent comparable sales. If you will be appraising a lot of boats, cultivate a network of dealers who sell a variety of boat types. The information they provide can be invaluable. Make sure you return the favor to them, though. When you are in a position to do so, refer listing business or potential buyers to the brokers you call on for help.

Boats for Sale

Listings of boats for sale can be used to help determine a boat's value. Remember, though, that you are looking at asking prices. Selling prices will invariably be different. If you call about a boat listed, ask how long it's been on the market and how many offers the seller has had. A boat that's been for sale for months with no offers is probably overpriced.

In addition to numerous websites, listings for boat sales can be found in your local newspaper and regional or national boating magazines.

About the Author

Stephen Knox, ASA, is owner and principal marine surveyor/appraiser of Knox Marine Consultants, in Richmond VA. Stephen has been a marine surveyor and appraiser since 1987. He is one of four accredited yacht appraisers in the ASA. Most of his appraisal assignments involve value disputes in litigation. He has qualified as an expert on yacht appraisal in several federal and state courts.
Email sknox@knoxmarine.com.

[1] Knox, Stephen, *Boat Basics,* Knox Marine Consultants (Richmond VA, 2004)

[2] For a more thorough discussion of yacht appraisal, see Knox, Stephen, "Appraising Yachts," The MTS Journal, Vol. 38, Issue 1, 2022, p. 72.

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Site Value and Utility-Scale Wind Projects

Richard K. Ellsworth, ASA

Richard K. Ellsworth

Abstract: *Governmental renewable energy standards designed to promote the purchase of electricity from renewable sources, including utility-scale wind projects, and advances in wind turbine technology present wind project owners with project redevelopment opportunities for existing wind project sites. When considering wind project redevelopment opportunities, site value and the existing value attributable to project infrastructure are important elements. This article provides a brief overview of the position of wind projects in the renewable energy industry and discusses the importance of site value in the decision-making process for redevelopment of existing utility-scale wind projects.*

Renewable Energy Industry Overview

The renewable energy industry has been undergoing significant transformation as broader consumer awareness of environmental issues associated with electricity produced from conventional generation sources has led to greater demand for energy from renewable sources. Renewable electricity standards are policies designed to increase the use of renewable energy sources such as wind for the production of electricity. Technological advancements, increased efficiency, and reductions in construction costs for utility-scale wind projects have played a major role in this transformation.

Wind Energy Resources

The major types of renewable energy generation capacity currently being developed are utility-scale wind and solar projects. A wind project is comprised of wind turbines grouped together to take advantage of operational efficiencies and economies of scale. A wind project generates electricity from rotating turbine blades that cause the rotors to spin and turn generators to produce electricity, with electrical output being a function of wind speed. In recent years, wind turbine designs have been modified to improve the capture of the wind's kinetic energy and improve the capacity factors achieved during operation. In addition, blade diameters have lengthened and tower heights increased to provide better access to available wind resources. Wind projects are situated to take advantage of quality wind resources, and geographical location and site selection are important elements in maximizing electricity production and project economics.

Wind Project Redevelopment

Wind project redevelopment opportunities are occurring with increasing frequency as existing wind projects reach the end of their life expectancy and wind turbine technological improvements have improved project economics. Redevelopment possibilities for a utility-scale wind project site range from project repowering to redevelopment of the project site.

Repowering involves replacing aging wind turbines or other components with new equipment to qualify for the production tax credit in older wind projects. Wind project repowering can range from a partial repowering that involves replacement of some wind turbines or replacing select components of the turbines to a full repowering that involves decommissioning and removing existing turbines and replacing them with new turbines.

Wind Project Site Attributes

Site value reflects the value attributable to existing wind project elements, such as a proven wind resource, land leases, legal permits, environmental approvals, transmission grid interconnection, and other infrastructure assets. The continued availability and utility of these site elements makes the existing wind project site desirable for redevelopment or repowering.

Wind Conditions

Energy production at a wind project site is a function of the wind speed, with output varying in proportion with the cube of the increase in wind speed, such that small deviations in wind speed can significantly influence project economics. Wind projects are sited at locations that possess favorable wind conditions to maximize the electric production during their operational lifetime and have been previously evaluated with respect to the quality of the wind resource. The historical data with respect to electric generation at the site also provides reliable information regarding the quantity of energy expected to be produced at the wind project site. For a wind project site that has been in service for a number of years, the characteristics of the wind resource are well known and will continue to have value for the purposes of site redevelopment.

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Land Leases

Land lease contracts with the landowners for the use of the land occupied by the wind project are a necessary component of the development of a wind project. A land lease is an agreement between a landowner and the wind project operator that grants the necessary rights to develop and operate the wind project at a specified location. As part of the land lease agreement, the landowner receives lease payments for a specified time period for use of the land by the wind project. Typically, contracts covering the lease of the wind development rights and wind turbine construction at the wind project site specify a base lease term and include options to extend or renew the contract for a defined number of years. If a landowner has historically accommodated wind turbines on their property for many years and is accustomed to receiving lease payments, the landowner is likely to agree to a new lease if the existing wind project is repowered or the site is redeveloped, because either development option would extend the period of operation of a wind project at the site and the corresponding term for receiving lease payments.

Permits

Securing the permits needed to construct a wind project can be a challenging undertaking, requiring an understanding of the applicable regulatory structure and the allocation of responsibility between federal, state, and local government agencies in securing the necessary permits for project development. The number of agencies and the level of government involvement is dependent on factors such as applicable existing laws and regulations, wind project location including associated support facilities and equipment, need for transmission lines and access roads, size of the wind project, and land ownership. An existing wind project has previously obtained permits, approvals, and consultations needed for operation from the various levels of government for operation of the wind project. The local community along with conservation and environmental groups are accustomed to an operational wind project at the site location so that if any new permits or modifications of existing permits are required for a repowered or replacement project, the approval processes required from community officials and representatives of various interests are likely to be quicker and easier to secure relative to a greenfield wind project.

Environmental Review

Operating wind projects have the potential to negatively impact habitat for wildlife, fish, and plants as well as pose a threat to airborne wildlife like birds and bats from spinning turbine blades. Due to the potential negative impact of a wind project on wildlife, environmental impact studies work to mitigate adverse effects on wildlife and their habitats and minimize siting and permitting issues associated with a wind project. An existing operational wind project has previously addressed and resolved the environmental issues relating to siting, operations, and management, resulting in an attractive site for repowering or redevelopment.

Electric Grid Agreements

An agreement to connect the project to the electric grid is characteristically one of the more significant development costs associated with a wind project. Interconnecting a wind project to the transmission grid can be a long and complicated process with uncertainty concerning the timing and likelihood of success. The interconnecting utility is generally responsible for performing the work necessary to modify the electric transmission grid to accept power from a wind project, but the wind project is typically responsible for the costs associated with the upgrade modifications. A completed transmission interconnection between the wind project and the transmission grid usually includes completion of activities such as an interconnection application, a feasibility study, a system impact study, and a project study before the regional transmission operator approves the interconnection agreement.

Other Considerations

Wind project infrastructure incorporates the civil and electrical works that support the operation of the wind project, including site preparation and road construction to provide site access along with access to each turbine. Wind projects also frequently have an operations and maintenance building for storing trucks, service equipment, spare parts, and other supplies. In addition, the wind project site has undergone site preparation for the existing wind project: the land has been surveyed and cleared and a storm-water management system is in place. The site-related infrastructure typically possesses utility beyond the life expectancy of the wind turbines, and a purchaser of the existing wind project recognizes the value attributable to these elements when purchasing an existing wind project for repowering or redevelopment.

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Site Value

Wind project site value represents the value attributable to the assemblage of a proven wind resource, land leases, legal permits, environmental approvals, transmission grid interconnection, and other assets considered valuable when considering the repowering of an existing wind project or construction of a replacement wind project after the existing wind project reaches the end of its life.

The value of a wind project site recognizes the industry, competitive environment, and location-specific factors associated with a site that influence its value. Wind project repowering studies recognize the value associated with existing project infrastructure when considering a partial or full repowering of an existing wind project. The National Renewable Energy Laboratory (NREL) examined the financial attractiveness of wind project repowering, including the benefits from the ability to reuse or repurpose existing wind project infrastructure. The ability to reuse or repurpose existing infrastructure was recognized to result in cost savings relative to a greenfield site of 5–15% of wind project costs.[1] Fully repowered wind projects were considered to have slightly lower cost savings relative to partial repowering because partial repowering had the ability to reuse existing infrastructure as well as towers and foundations.

Data from wind project construction costs on a cost per kilowatt basis is available to develop wind project site value estimates. Lawrence Berkley National Laboratory research presents data with respect to the 2021 capacity weighted average construction cost by region for new wind projects.[2] Exhibit 1 presents indications of wind project site value based on region-specific construction cost information and cost savings indications of 5–15 % for an existing wind project site relative to a greenfield site.

Exhibit 1
Wind Project
Site Value Estimate

Power Market Region	Cost $/kW	Site Value 5% $/kW	Site Value 15% $/kW
ERCOT	1,349	67	202
West (Non-ISO)	1,384	69	208
PJM	1,396	70	209
SPP	1,504	75	226
MISO	1,600	80	240

Further information with respect to estimating wind project site value is available through the 2021 Cost of Wind Energy Review, which presents a construction cost component breakdown for a land-based reference wind project. The construction cost reference wind project identifies various construction cost categories for the reference wind project, including the balance of systems (BOS) costs. Development cost, site access and staging as well as electrical infrastructure are the cost elements expected to be most closely aligned with wind project site value.

The costs presented for the reference land-based wind project for development, site access and staging, along with electrical infrastructure, were estimated to be 13.4 percent of total wind project cost and provides an indication for elements of site value.[3] From the total cost information for a wind project of $1,501/kW presented in the 2021 Cost of Wind Energy Review, wind project site value is estimated to be $201/kW or 13.4 percent of total wind project cost using development costs (1.6 percent), site access and staging (2.8 percent), and electrical infrastructure (9.0 percent).

The NREL wind project repowering research, wind project construction cost experience, and wind project component cost information shows the benefits associated with the reuse or repurposing of existing infrastructure from an existing wind project.

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Conclusion

Renewable electricity standards designed to increase the amount of electricity coming from renewable sources have resulted in significant growth of installed generation capacity including utility-scale wind projects. Wind projects continue to be developed due to their zero-emissions capabilities, the lack of a fuel source requirement, and ability to assist in meeting renewable portfolio standards. Advances in wind turbine technology provide owners the opportunity to explore new development options and the economic alternatives associated with existing utility-scale wind projects.

The consideration of wind project site value is an important element in the decision-making process surrounding the redevelopment of existing wind project sites. An existing wind project site reflects value attributable to existing project infrastructure because of the ability to reuse or repurpose existing infrastructure in comparison with the cost of developing a greenfield site. Wind project construction cost and market repowering information are important elements when developing an estimate of wind project site value when contemplating wind project redevelopment opportunities.

About the Author

Rick Ellsworth, ASA, PE, CFA, CCP, has over 30 years of global experience in the valuation of power, renewable energy, and infrastructure assets. Rick has performed life expectancy and depreciation studies using Iowa-type survivor curves for a variety of tangible assets and also provides appraisal review services. He is a licensed Professional Engineer (PE), an Accredited Senior Appraiser (ASA), a Chartered Financial Analyst (CFA), and a Certified Cost Professional (CCP).
Email: rickkellsworth@gmail.com.

[1] Lantz, Eric, Michael Leventhal, and Ian Baring-Gould 2013. Wind Power Project Repowering: Financial Feasibility, Decision Drivers, and Supply Chain Effects. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-60535

[2] Wiser, R. and M. Bolinger. 2022. Land-Based Wind Market Report: 2022 Edition. Washington, D.C.: U.S. Department of Energy. DOE/GO-102022-5763. https://www.energy.gov/sites/default/files/2022-08/land_based_wind_market_report_2202.pdf.

[3] Stehly, Tyler, and Philipp Beiter. 2022. 2021 Cost of Wind Energy Review. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5000-84774. https://www.nrel.gov/docs/fy23osti/84774.pdf.

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How Technology Affects the Gear Machine Market: Specifically Gear Hobbers and Shapers

Alec Story, ASA
Vice President of Perfection GIobal LLC

Alec Story

Abstract: *This article briefly describes the history of gears and discusses how newer gear technology lowers values for older technology, especially gear hobbers and shapers. It also discusses some aspects of the new technology that save time and money by eliminating some work transfers.*

The History and Use of Gears

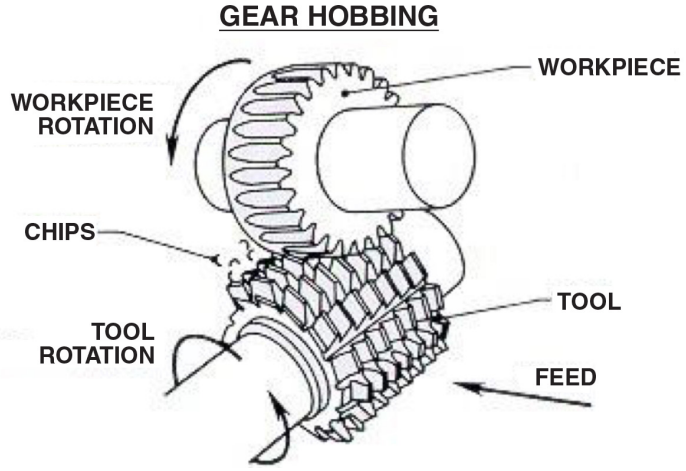
Gears are first thought to have first been made around 2700 BC to help chariots know which way they were going in relation to south. Around 400 BCE, Aristotle described gears as capable of reversing momentum, which remains a use today. Think of a transmission in your car allowing you to go forward or in reverse even though the engine is spinning in only one direction. Almost all power transmission products require some sort of gear to gear or gear to shaft combination to make the power transmission work.

In addition to transportation gears, there are gears in everything, from your traditional watch, to your clothes washing machine, to windmill generator gearboxes. The first production gear hobbing process was patented in 1835.

Gear Hobbing and Shaping

Gear hobbing is the process of generating gear teeth on a blank with a cutting tool or hob. This can be either straight hobbing, which makes a spur gear, or helical hobbing, which makes a helical tooth.

Exhibit 1
Gear hobbing



Gears come in many different varieties such as external, internal, spur, bevel, spiral bevel, and so on. Exhibit 2 shows a spur gear with an internal spline. In the past, this would have taken at least 3 machines to manufacture: a lathe for the blank, then a gear shaper for the internal spline, then a gear hob for the outside gear teeth. For many years, each different type of gear was manufactured by a specific type of machine. Most of those machines made only one type of gear, so having a gear shop or doing gear manufacturing meant you had to have many machines to complete one gear box comprised of the different types of gears.

Exhibit 2
Spur gear with an internal spline

Modern Automobile Gear Manufacturing

The gear manufacturing industry for autos provides a great example of how changes in technology have affected the gear manufacturing market. This market is only one of the major markets for gears in the world, but it is traditionally the market that uses the most gears. This industry has been hit by *three* technology advances related to automotive gears and the machines that make them: machine tool technology, especially computer numerical control (CNN) machines, which creates functional obsolescence; and two factors of economic obsolescence: newer transmission technology, Continuously Variable Transmissions (CVT), and electric automobiles.

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Machine Tool Technology Eliminates some Manufacturing Machines

CNC machine technology is changing gear manufacturing and devaluing old technology. With current CNC technology, the spur gear with spline mentioned earlier can be made on one machine, such as a 5-axis CNC lathe with live tooling. The live tooling process, which allows CNCs to perform various operations while the workpiece remains in orientation to the main spindle, eliminates the need for a gear shaper and a gear hobber in the process, saving the manufacturer costs of capital and floor space. This new technology devalues those unneeded assets.

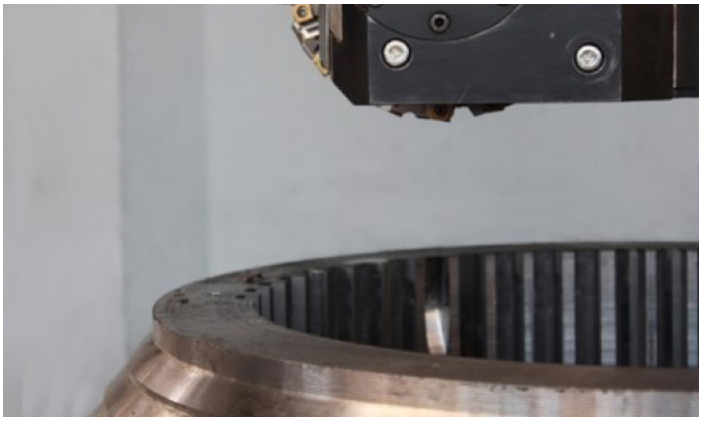
The external feature of the spur gear with spline can now be made with a live tool spindle on a CNC lathe if it has that feature. CNC programming allows the spindle to stop so that the tool, either standard or profiled, can be used to make the outside tooth of the gear. There are also live tool holders that can hold a small gear hobbing cutter as well. External gears can be cut either as spur gears (straight teeth) or helical gears (angular teeth).

Exhibit 3
Special tool on a 5-axis

The internal feature of the gear shown in Exhibit 2 was traditionally made with what is called a gear shaper. Using a timed rotation, this machine cuts the gear in a back-and-forth motion. These internal features can now be produced using specific gashing tools on a CNC lathe with live tooling, as shown in Exhibit 4: Spline Milling Head. This has been the latest in technology from the CNC world advancing gear production on a 5 axis CNC Machine from a traditional gear manufacturing machine.

A process called *broaching* is now being used to make internal splines in higher production runs, where the same part number is manufactured in the thousands or more at a time. Broaching has been available for decades but has really taken off in the past 10 years or so. The capital costs of the machines used in broaching are generally high and the tooling is also costly, so it is only practical for very high demand production.

Exhibit 4
Spline milling head



A CNC machine with live tooling can also replace a gear hobbing machine in some applications. Cutting external teeth is similar to the process used for internal gears: using timed rotational cuts based on the geometry of the gear and the desired gear spacing. Unlike internal gears, external gears are not a good application for broaching. But many more external gears than internal are being produced on live tooling CNC turning centers. It is an easier transition because the work is being done on the outside of a piece rather than internally.

Bevel Gears

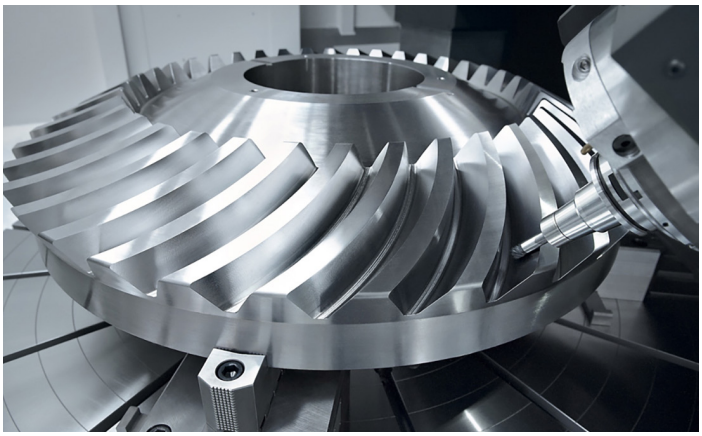
CNC machines can also make bevel gears, as shown with the following picture of a splined shaft with a bevel gear on the end being manufactured in a 5-axis CNC Machine in a single setup as shown in Exhibit 5: Spline with Bevel. The amazing thing about exhibit 5 is that it shows many different styles of gears on the same shaft. There is a helical spline gear, a spur spline gear, a lead screw, and a slight spiral bevel gear. Exhibit 6 represents how a part that in the past would have taken no less than 5 different machines to manufacture can now be made with 1 machine and live tooling.

Exhibit 5
Spline with bevel

(continued on next page)

Large bevel gears are also being made on CNC machines originally designed to manufacture features in large castings and weldments. These machines, once thought to be used only for drilling holes and turning large pieces are now cutting intricate spiral bevel gears with tolerances in the microns as shown in Exhibit 6 from CB Gear in Houston TX.

Exhibit 6
CB bevel



Credit: C-B Gear & Machine, Houston, Texas

In Process Inspection

Much as shaping, hobbing, and bevel gear manufacturing was done only on specially designed machines, process inspection in the past was also only available on machines specially designed to check only gears. Modern multi-functional CNC machines, though, when equipped with the appropriate software and mechanical functionality, can also check parts and produce data required for quality inspections. This is another way a multi-functional machine can save time, space and hence…money.

Changes in Automobile Technology Reduce Need for Gears

While technology advances might be considered functional obsolescence, changes in factors external to the gear manufacturing equipment are contributing to economic obsolescence. These two big changes in automobile manufacturing have reduced the demand for automotive gears, further devaluing gear manufacturing equipment.

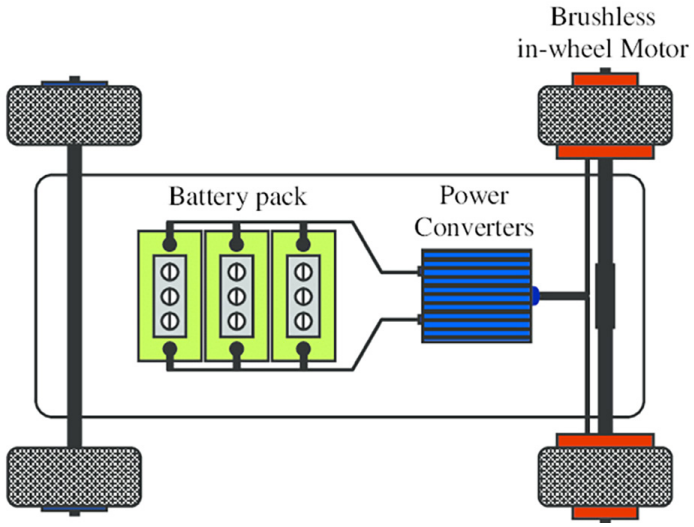
Continuously Variable Transmissions (CVTs)

CVTs are automatic transmissions that can change through a continuous range of gear ratios, using a band that winds up to speed using pulleys and not gears. The higher use of CVTs, starting in the mid-2000s in cars around the world, led to a decrease in the number of gears manufactured. Therefore, fewer gear machines are needed.

Electric Vehicles (EVs)

Most EVs do not use transmissions, further reducing the number of gears in automobiles. They use variable speed motors that are either direct drive or coupled with planetary gearboxes that rely less on multiple gears.

Exhibit 7
EV diagram



Loss of Value for Gear Manufacturing Machines

These changes in gear manufacturing technology, along with the increase in CVTS and EVs, have resulted in a loss of value for most production-based gear manufacturing machines. Operational gear shapers such as a Fellows 20-4 that used to bring over $100,000 on the used market, without being rebuilt, are now selling for $20–25,000. Rebuildable carcasses that used to bring $40–50,000, are frequently scrapped due to the expense of removal and shipping. Gleason, the standard in bevel gear manufacturing until recently, has adapted with new CNC technology, but their older machines that used to resell for $60–80,000.00 are now being sold for scrap or a little above. Barber Colman Horizontal Gear Hobs, the standard in spline hobbing, are being sold for 10–20% of what they were bringing less than 15 years ago. As the technology of manufacturing gears changes, manufacturers like CMZ, DMG Mori, Grob, Heller, Ingersoll, Mazak, and Okuma are leading the way with machines that are multi-functional, leaving older, less universal machines with lower demand and therefore lesser value.

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The Specialization of Gear Machines

Gear machines have always taken up a specialized lane in manufacturing machinery and that market is not going away, just rapidly narrowing. The market has changed dramatically in the past 10 years and will probably continue to change because of EVs and changing manufacturing technology.

For instance, many of the gears being moved to multi-axis CNC lathes are lower grades of gears, such as those for ag tractors and implements, and are not as precise as the higher grades, such as helicopter gear boxes. This is because the current multi-axis CNC lathes do not yet have the tolerances and tightness needed to deliver the higher-grade gears in a production setting. With the expected advances in tooling and machine technology, improved accuracies will result in more gears being made on multi-axis CNC machines, further affecting the market and value for all CNC machines. Experienced and careful appraisers should be diligent about researching late market data when valuing any gear manufacturing machines.

About the Author

Alec Story, ASA, is Vice President of Surplus Asset Management with Perfection Global LLC, a global source for used industrial machinery for over 60 years. Alec, who lives in Houston, Texas, is a graduate of SIU, received his ASA in 2012, and is currently a member of the MTS committee. Perfection has offices in the United States, Canada, Mexico, Belgium, and Indonesia and averages an auction every week. Our daily clients include Caterpillar, Halliburton, John Deere, Reliance Companies and so on.
Alec's email is alec@perfectionglobal.com.

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Deductive versus Inductive Reasoning in Equipment Appraisal

Charlie Dixon, ASA
Principal/Owner, CD Valuation Services

Charlie Dixon

Abstract: *How might MTS appraisers use or consider deductive or inductive reasoning in an appraisal review assignment? Appraisals depend upon logical arguments, which often involve deductive and inductive reasoning. Deductive and inductive reasoning can be susceptible to inaccuracies or overgeneralizations and bias of beliefs or facts. This article discusses how to identify the differences in these two types of reasoning, how to recognize the validity of deductive and inductive reasoning in logical arguments, and how to determine the appropriateness of each in an appraisal assignment.*

Appraisal Reasoning

Reasoning is a critical process in appraisal development and report writing. An appraiser or reviewer developing and then communicating an opinion is ultimately writing a reasonable story which is independent, impartial, and objective. It is a story meant to convince the reader (client/intended user) that the opinions are logical and defensible, and hence credible and meaningful. The appraisal is a story containing clear and concise arguments to support the appraiser's opinions. These arguments are most appropriately based on logical arguments. Of course, the appraiser is an advocate only for his or her own opinion, not for the intention of a predetermined value or direction that favors the cause of the client.

What's the Difference?

The terms inductive and deductive in reference to reasoning and logic are often confused—and not only by appraisers or reviewers.[1] It is not easy to remember that deductive involves making references going from a general idea to specific conclusions and that inductive is the opposite: starting with specific examples that progress to a general concept.

The Appraisal Review and Management (ARM) Committee of ASA[2] states:

> **Deductive reasoning** applies general rules to make conclusions about specific cases.
>
> **Inductive reasoning** observes patterns in specific cases to infer conclusions about general rules.

Definitions from Scibber.com[3] are similar:

> **Deductive reasoning** is a logical approach where you progress from general ideas to specific conclusions. Deductive reasoning is also called deductive logic or top-down reasoning.
>
> **Inductive reasoning** is a method of drawing conclusions by going from the specific to the general. Inductive reasoning is also called inductive logic or bottom-up reasoning.

These methods of reasoning are also referred to as deduction and induction.

Deductive Reasoning

A simple description of deductive reasoning is "reasoning from principle." Deductive reasoning, which develops from generalities to more specifics, can be used to reach a logical, true conclusion. Deductive reasoning moves from a general assumption and draws conclusions that must be true if the assumptions are true.

Important considerations when using or reviewing deductive reasoning is determining whether the initial principle is valid and credible, whether the assumptions based on that principle are reasonable, valid, and credible, and whether the conclusions are reasonable, valid, and credible. One drawback of deductive reasoning is that it can be subject to subtle bias. For example, an appraiser who is using a rule-of-thumb for determining obsolescence factors may dismiss market data that does not support the expected values. This bias can creep into the original principle or the assumptions, leading to a conclusion that is not reasonable or supportable.

Syllogism

Another way to understand deductive reasoning is through the structure of syllogism: a three-sentence argument composed of a major premise (a generalization or principle that is accepted as true), a minor premise (an example of the major premise), and a conclusion. This conclusion must be true if the major and minor premise are true; it logically follows from the first two statements.

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Syllogism is a logical flow of facts. A typical syllogistic form is "All A is C; all B is A; therefore, all B is C." as illustrated with this common example you may have seen before:

- **Major premise:** something everyone already agrees on

  All men are mortal.
- **Minor premise:** an example taken from the major premise

  Socrates is a man.
- **Conclusion:** the only conclusion that can be drawn from the first two sentences

  Socrates is mortal.

Here is another example, which illustrates how a syllogism can be flawed if you happen to know a hairless chihuahua named Spot:

- **Major:** All dogs have fur.
- **Minor:** Spot is a dog.
- **Conclusion:** Spot has fur.

IRAC/CRAC: Syllogistic Models for Report Organization

Candidates for ASA Appraisal Review and Management (ARM) designation learn two version of the syllogistic writing process taught in law schools to develop and present analysis. While both of these methodologies—IRAC (Issue, Rule, Analysis, Conclusion) and CRAC (Conclusion, Rule, Analysis, Conclusion)—are particularly useful for organizing appraisal review assignments and reports, they can be just as useful in any equipment appraisal assignment. IRAC and CRAC provide a straightforward structural guide to creating reports that help intended users easily follow the appraisal analysis.[4]

A simplified example of IRAC in an MTS appraisal report might look something like this:

- **Issue:** Tomato processing equipment is subject to excessive wear and tear due to the acidity of the product.
- **Rule:** Food processing equipment is generally appraised using a [stated] normal useful life.
- **Analysis:** Because of the physical deterioration caused by operating conditions, this equipment must be replaced more frequently than expected for food processing equipment.
- **Conclusion:** The NUL for this tomato processing equipment is less than for other food processing equipment.

Inductive Reasoning

Inductive reasoning may be the form most used on a regular basis. It is sometimes called the scientific method though it is not always correct and precise, nor does one need to be a scientist to use it.

Inductive reasoning arrives at a general conclusion based on specific observations or observed patterns. Its logical process starts with premises based mainly on experience or evidence and uses those premises to form a general conclusion. In the process of moving from specifics to broader generalizations, the conclusion is inevitably a probability.

Inductive logic may be best illustrated as a process of specific observation, pattern recognition, and general conclusion:

- Spot is a black dog that barks a lot.
- Every black dog I've met barks a lot.
- All black dogs bark a lot.

Another example would be:

- This equipment has outlived its normal useful life.
- Market data includes numerous examples of similar equipment of this age that sold for considerably less than similar but newer equipment.
- This equipment is worth less than it was worth when new.

As shown in these examples, even when an original premise is true, the conclusion is not always true. Important considerations when using or reviewing inductive reasoning are determining whether the initial principle is valid and credible, whether the particular pattern observations are reasonable, valid, and credible, and whether the conclusions are reasonable, valid, and credible. If the initial specific observations are credible and the pattern observations presented in the report are reasonable and valid, an appraisal conclusion based on inductive reasoning may be considered valid, reasonable, and credible.

Conclusion

Logical arguments must be supported by extensive research and practical evidence and lead to factual conclusions. Depending upon the intended use and other criteria of a particular appraisal assignment, either inductive or deductive logic may provide a credible and reasonable basis for a logical argument.

Inductive reasoning arrives at a possible general conclusion based on specific observations or observed patterns. Deductive reasoning moves from a general assumption to draw conclusions that must be true if the assumptions are true.

It is important in preparing an appraisal report to understand the differences between these two reasoning processes and to be aware of their problems and strengths in order to determine the validity of the reasoning and the credibility of any conclusions based upon the reasoning.

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Both inductive and deductive reasoning are susceptible to inaccuracies or overgeneralizations and bias of beliefs or facts. Their validity is dependent upon several factors—most notably the reasonableness or credibility of the information provided. A deductive conclusion is likely to be true if the major and minor premises are true. An inductive conclusion cannot be considered true in the same sense but may be considered reliable and credible if the specific observation, pattern recognition, and general conclusion are all reasonable and accurate.

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About the Author

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[2] ARM POV 201, SM p. 37, Task 12

[3] Bhandari, P. *What Is Deductive Reasoning? | Explanation & Examples.* Scribbr. Retrieved December 5, 2022, from https://www.scribbr.com/methodology/deductive-reasoning/

[4] Appraisal Review and Management Committee of ASA, *ARM 201 Principals of Valuation Course Student Manual,* ASA (Herndon, Virginia: 2020), August 2019 revision, p. 68-72 (Task 22: How to Use IRAC & CRAC).

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USPAP Myths and Realities

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Tim Roy

Abstract: *Feeling overwhelmed by Uniform Standards of Professional Appraisal Practice (USPAP)? This article discusses the importance of approaching and appreciating USPAP on its own terms, without being browbeaten by the USPAP Police or daunted by the apparent complexity of this important document. It further addresses and illustrates how USPAP provides appraisers with clarity, common-sense guidance, and protection, and how careful reading guides appraisers in operating with flexibility to meet the practical needs of their clients and their practices.*

What's the Problem with USPAP?

Through years of attending M&E appraisal conferences and courses, one comes to grasp that two topics cause a disproportionate amount of weeping and confusion among our colleagues: Fair Value Measurement and USPAP.

These two topics have commonalities which have brought them to this esteemed position:

- both are centered on jargon-dense publications (ASC and USPAP) which most appraisal users are not likely to ever read, and which most appraisers don't read until they have to;
- neither publication is written by nor primarily targeted to MTS appraisers, yet we have to rely on them to interface with appraisal users and other professionals;
- both publications use variants of terms such as *value* and *market*, which can have several practical meanings depending on the situation;
- both publishers (FASB and ASB) are government-sponsored organizations, which creates a fear that users will be doing something illegal if they misunderstand the documents;
- neither publisher has an enforcement arm,[1] nor consistent regulation regarding the use of the documents, allowing common abuses and misconceptions to fester;
- both publications are frequently amended.

This article will focus on a few common USPAP misconceptions, and references to the publication which may provide clarity. (Not having a daily interaction with Fair Value Measurement, I will leave that topic to a future ~~sucker~~ contributor.)

Considering All Three Approaches to Value

In my experience, absolute statements that remove the appraiser's judgment do not stem from USPAP. If anything, USPAP generally supports the appraiser's flexibility to do whatever they deem ethical and practical in any situation, only requiring honest communication with clients and users.

A common misperceived restrictive statement involves the three approaches to value. For generalist MTS appraisers like myself, the majority of our valuations will rely on the cost approach, the sales comparison approach, or some combination thereof. Yet we often hear our colleagues say, "USPAP says you must consider all three approaches!"

This should raise a red flag. USPAP doesn't require appraisers to be impractical, and it would bely common sense for appraisers to expend time, effort, or words in considering the income approach if it is not applicable to their assignments.

The following excerpts are from Standard 7: Personal Property Appraisal, Development[2] and Standard 8, Personal Property Appraisal, Reporting.[3]

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Exhibit 1
Standard 7

STANDARDS RULE 7-4, APPROACHES TO VALUE
In developing a personal property appraisal, an appraiser must collect, verify, and analyze all information necessary for credible assignment results.

(a) When a sales comparison approach is necessary for credible assignment results, an appraiser must analyze such comparable sales data as are available to indicate a value conclusion.

(b) When a cost approach is necessary for credible assignment results, an appraiser must:

(i) analyze such comparable cost data as are available to estimate the cost new of the property; and

(ii) analyze such comparable data as are available to estimate the difference between cost new and the present worth of the property (depreciation).

(c) When an income approach is necessary for credible assignment results, an appraiser must:

(i) analyze such comparable data as are available to estimate the market income of the property;

(ii) analyze such comparable operating expense data as are available to estimate the operating expenses of the property;

(iii) analyze such comparable data as are available to estimate rates of capitalization and/or rates of discount; and

(iv) base projections of future income and expenses on reasonably clear and appropriate evidence.

Comment: An appraiser must, in developing income and expense statements and cash flow projections, weigh historical information and trends, current supply and demand factors affecting such trends, and competition.

Exhibit 2
Standard 8

(x) provide sufficient information to indicate that the appraiser complied with the requirements of STANDARD 7 by:

(1) summarizing the appraisal methods or techniques employed;

(2) stating the reasons for excluding the sales comparison, cost, or income approach(es) if any have not been developed;

As usual, USPAP makes sense. Each approach needs to be considered only when it is necessary for credible assignment results.

What if an Approach Isn't Necessary?

If an appraiser isn't relying on the income approach, USPAP does not require a flowery paragraph which obfuscates the fact that trying to isolate the present value of future benefits of ownership of an individual machine out of a complex business enterprise is generally unnecessary because more reliable data is able to be found in replacement cost or marketplace information.

As with most things USPAP-related, the K.I.S.S. rule applies here: a simple communication of the appraiser's actions and reasoning is usually the best way to address this matter. A straightforward statement that says the other approaches produced credible results with less conjecture is enough to support the decision to exclude any of the approaches to value.

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Lack of Competency

Our profession does not have a traditional post-secondary educational path, nor any licensing, meaning there is no standard career pathway. It is easy for new appraisers to feel intimidated and afraid of stepping out of bounds as they carve their path to success, especially if they do not have the support structure of a larger firm around them.

Early in my career as a young MTS appraiser, fear of crossing USPAP's competency rule inhibited my decisions about which assignments to accept.

I took my first appraisal course from the National Auctioneers Association through their GPPA certification program. The instructors knew they had to tamp down the risk-taking eagerness that is ingrained in the auction industry. A typical sentiment was, "Stay in your lane—don't appraise something if you don't work in that marketplace."

Shortly after, I began to attend ASA conferences and hear from presenters who were bona fide experts in a particular type of asset or assignment. This reiterated to me that I should be conservative when accepting assignments—I knew nothing compared to these people!

My mentality began to change as I finished up my ASA POV courses. My ME204 instructor (Rick Berkemeier) enjoyed presenting ethical dilemmas regarding appraisal assignments and asking the class how we would handle them. We inevitably gave risk-averse responses, saying that we would turn away the given assignments and "leave it to the pros" rather than walk ethical tightropes by attempting a new challenge.

Rick's response was usually something like this: "Yeah, well that's all good and proper—but when you hang your shingle and the wolf is at the door, you better find a way to get it done and do it right, or you'll be in the bread line."

Around this same time in my career, I had two former bosses who further emphasized the practical concerns of turning away work. One put it nicely: "The client called us for help and I'm paying you to figure it out for them." The other put it more effectively: "Get a contract from them or I'm replacing your a--."

I realized that by trying to turn down assignments in the name of risk aversion, I was hurting not only my own professional advancement and the businesses that employed me, but also not providing necessary services to clients who needed my help. I decided to follow these gentlemen's advice and am glad to have done so. I came to realize that the learn-as-you-go approach was not only ethically acceptable when handled according to USPAP, but that many clients had no issue with my learning on the job.

Addressing and Acquiring Competency

USPAP doesn't tell appraisers that they have to turn down business, or that they can't appraise an asset they've never seen before. Instead, it states that the appraiser must discuss their concern with the client and—if the client decides to engage—gain the required competence for the assignment. As usual, USPAP encourages honest communication and common sense in appraisal practice.

The following is from the Competency Rule:[4]

Exhibit 3
Competency Rule

ACQUIRING COMPETENCY

If an appraiser determines he or she is not competent prior to agreeing to perform an assignment, the appraiser must:

1. **disclose the lack of knowledge and/or experience to the client before agreeing to perform the assignment;**
2. **take all steps necessary or appropriate to complete the assignment competently; and**
3. **describe, in the report, the lack of knowledge and/or experience and the steps taken to complete the assignment competently.**

Comment: Competency can be acquired in various ways, including, but not limited to, personal study by the appraiser, association with an appraiser reasonably believed to have the necessary knowledge and/or experience, or retention of others who possess the necessary knowledge and/or experience.

In an assignment where geographic competency is necessary, an appraiser who is not familiar with the relevant market characteristics must acquire an understanding necessary to produce credible assignment results for the specific property type and market involved.

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Consider the private equity buyer of an aerospace machine shop who called our firm. Through our initial phone conversation, I learned that the client would need the following from their equipment appraiser:

1. Be an expert in in the market value of used electron beam welders;
2. Submit documentation to become an approved vendor for their lender;
3. Complete a USPAP-compliant collateral appraisal;
4. Understand purchase price allocation and its implications;
5. Complete a GAAP-compliant purchase price allocation appraisal;
6. Converse intelligently with their team, including CPA and attorney, as well as the seller and the seller's team; and
7. Be available to start in the next 30 days.

I was competent and confident in Requirements #2-#7. Should I have turned away the assignment solely because I was Googling "What is electron beam welding?" while on the phone with the client?

Early in my career, I may have mistakenly thought that was the case. The USPAP Police had instilled me with self-doubt. Further, inexperienced appraisers without a mentorship structure (as I was) often believe that asset and/or market knowledge is the determining factor for every client.

In some cases that may be true, but in many cases the client has higher priorities than asset expertise. Further, the theoretical appraiser who would meet all of these assignment requirements *often does not exist*.

For niche assets in particular (such as electron beam welders), the only true market experts are often dealers—who may not be interested in conducting appraisals unless the assets are available to be acquired or liquidated, and who may not be competent to meet the requirements of the lender, CPA, or other parties.

As is clear from the USPAP excerpt above, the appraiser does not have to already be an expert in every potential asset or marketplace involved in an assignment before they start. The appraiser simply needs to have an honest conversation prior to engagement with the client regarding their competency and prior experience, and their plans for gaining the required competency.

False Protection

Even though USPAP encourages clear statements throughout appraisal reports, many appraisers mistakenly believe that vagueness is their friend. This fallacy is often seen in statements of intended use. Some appraisers think they can avoid responsibility for the misuse of assignment results by stating no practical uses at all!

Clients involved in sensitive business matters—perhaps a divorce between co-owners or a corporate acquisition of a family-owned competitor—often attempt to maintain secrecy at every turn. When the appraiser asks, "Why do you need the appraisal?" the client often responds with something like, "We're, ah, just doing some internal planning and want to understand the value of our assets from a liquidation standpoint."

At this, the appraiser's eyeroll should be audible over the phone. Nobody pays consultants thousands of dollars just for fun. The appraiser already suspects two things based on this phone call: 1) somebody is about to make a meaningful business decision which involves the M&E of this business; and 2) the person on the phone would prefer a low M&E value, hence the reference to liquidation.

The appraiser may believe that by blindly delivering an OLV opinion and stating the intended use of the report to be "management planning" or "internal decision-making" they will have made their own lives easier. This is usually a result of an appraiser's misconception that properly following USPAP's guidance regarding intended use would somehow restrict their ability to contract and complete the assignment.

However, as usual, the opposite is true. USPAP's guidance protects the appraiser and brings clarity to the situation, with the result of improving the engagement for both parties.

The Importance of Intended Use

We do not need to excerpt here the dozen relevant areas of USPAP—including the Ethics Rule, Scope of Work Rule, Standards 7 and 8, and Advisory Opinion 36—which make it clear that giving a vague intended use is poor practice.

Instead, one can fall back on the answer to the foundational quiz question found in every POV and USPAP course every MTS appraiser takes: "Who determines the definition of value? The appraiser!"

Allowing the client to dictate the definition of value and stating a vague intended use does not protect the appraiser—it does the opposite by opening the door for blatant misuse of assignment results.

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For example, the caller in the previous example may be intending to use the results to execute a partner buyout agreement with the estate of a recently deceased business partner. If the appraiser completes the appraisal, they may find themselves attempting to explain why they delivered a liquidation value when, upon review, the agreement indicated an in-use value of all company assets.

But the appraiser protests—the intended use was not stated to be for a buyout agreement. Aha! I'm safe!

Not so fast. The attorney responds: Is executing an asset purchase not a "management" decision when the current management is "planning" to take ownership at the lowest price possible? Is the client not completing an "internal decision-making" process when they offer to buy the M&E assets at your appraised value with the help of their legal counsel?

Real protection in this situation would have been offered not in vague language, but in the advice of USPAP to first clearly identify, and then to clearly state, the intended use of the assignment results.

By following this guidance, the appraiser would have discovered the true purpose of the assignment; would have insisted on reviewing the buyout agreement; would have determined the appropriate definition of value; and would have proclaimed in the report that the results were intended to be used solely for negotiating the buyout agreement. The appraiser would have been protected from the misuse of their work and would likely also have gained the (grudging) respect of the client and their counsel.

Conclusion

Readers are advised not to fear the USPAP Police nor malign the publication. In these and countless other examples, USPAP provides appraisers with clarity, common-sense guidance, and protection. Further, USPAP allows appraisers to operate with flexibility to meet the practical needs of their clients and their practices.

About the Author

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[1] There are, in fact, no USPAP Police, except self-appointed ones.

[2] USPAP: 2020-2021 Uniform Standards of Professional Appraisal Practice, The Appraisal Foundation, p. 44. The 2020-2021 edition of USPAP is effective through December 31, 2023.

[3] USPAP: 2020-2021 Uniform Standards of Professional Appraisal Practice, The Appraisal Foundation, p. 47. The 2020-2021 edition of USPAP is effective through December 31, 2023.

[4] USPAP: 2020-2021 Uniform Standards of Professional Appraisal Practice, The Appraisal Foundation, p. 11. The 2020-2021 edition of USPAP is effective through December 31, 2023.

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Best Practices for Economic Obsolescence Measurement Part One

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Robert F. Reilly

Abstract: *This article—the first in a series of four articles on best practices for measuring economic obsolescence—focuses on the identification and measurement of economic obsolescence when using the cost approach to appraise special-purpose industrial and commercial machinery and equipment (M&E). The article addresses the difference between the summation principle and the unit principle, an appraisal methodology used in valuing public utility and utility-type M&E for state and local ad valorem tax purposes. Generally accepted economic obsolescence measurement methods (with particular emphasis on the capitalization of income loss method) are also discussed.*

The second part of this series will describe and illustrates economic obsolescence measurement methods; and the third and fourth will recommend some useful responses to the most typical tax assessor objections to economic obsolescence measurements and other (but still common) assessor objections to economic obsolescence measurements.

Economic Obsolescence

One component of appraising special-purpose industrial and commercial machinery and equipment (M&E) is the identification and measurement of economic obsolescence within the cost approach. This topic is particularly relevant to the unit principle of appraisal—in contrast to the summation principle of appraisal—often used in valuing public utility and utility-type M&E for state and local *ad valorem* tax purposes.

Appraisers who develop unit principle appraisals have to be able to (1) identify and distinguish (qualitatively and quantitatively) the various elements (or types) of depreciation in a cost approach analysis of special-purpose industrial and commercial M&E, (2) explain and apply the generally accepted economic obsolescence measurement methods, (3) report and defend the economic obsolescence measurement analysis in a unit principle property tax appraisal, and (4) respond to typical taxing authority objections related to the proposed economic obsolescence adjustment.

The cost approach is often applied in appraisals of industrial or commercial M&E developed for any purpose and is often the primary approach applied in the appraisal of special-purpose M&E. Most M&E appraisers are particularly skilled at developing the cost measurement and physical depreciation components of the special-purpose M&E appraisal. Many M&E appraisers are less comfortable with developing the economic obsolescence component. Nonetheless, economic obsolescence is an important consideration when appraising M&E based on the premise of value in continued use, as part of an integrated going concern business. Economic obsolescence is also an important consideration in M&E appraisals developed for purposes of appealing (or litigating) the industrial and commercial taxpayer's state or local property tax assessment and is relevant to *ad valorem* tax planning, compliance, and controversy purposes.

The unit principle of property appraisal is applied for complex special-purpose M&E (and real property) that is physically, functionally, and economically integrated. Examples of such properties include electric generation plants, oil and gas refineries, pipelines, gas distribution systems, cable television systems, marinas, mining operations, sports stadiums, telecom systems, railroads, airlines, and many other types of properties.

The identification and measurement of economic obsolescence is one component of every cost approach appraisal. Specifically, this discussion considers the following economic obsolescence measurement topics:

- Unit principle of property appraisal concepts
- Economic obsolescence concepts
- Principles of economic obsolescence measurement
- Generally accepted economic obsolescence measurement methods
- Ten most typical assessor objections to economic obsolescence measurements
- Other typical assessor objections to economic obsolescence measurements
- Assessment authority considerations regarding obsolescence adjustments

Unit Principle and Summation Principle Property Appraisal Concepts

The determination of whether to apply the unit principle or the summation principle of appraisal for a property tax valuation depends in large part on how the M&E operates. Are the assets considered a unit, working together as a specialty installation,

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such as a public utility or an assembly line for manufacturing or food processing, or are the assets a group of general-purpose M&E, such as warehouse equipment, office equipment, over-the-road vehicles?

Special Purpose

In the property tax appraisal of special-purpose industrial and commercial M&E, appraisers (and assessment authorities) often apply the unit principle of property appraisal to appraise a bundle of M&E operating collectively—as a unit or a single collection of property. In the vernacular, appraisers apply the unit principle to appraise the taxpayer's unit from the top down. The generally accepted unit principle property appraisal approaches and methods conclude a single value for the total bundle of M&E. This total unit value may be allocated to the individual property components (such as locations, processing units, or property accounts) within the total taxpayer unit. Such a value allocation procedure may be necessary for a taxpayer property that crosses multiple taxing jurisdictions (such as a pipeline or gas distribution system). This allocation process allows the taxpayer (and the taxing authority) to assign a value to the M&E (and real property) located in each individual taxing jurisdiction.

General Purpose

In the property tax appraisal of general-purpose commercial M&E, appraisers (and assessment authorities) often apply the summation principle of appraisal. Appraisers (and assessment authorities) apply the summation principle to individually appraise each component in the bundle of operating M&E. In the vernacular, appraisers apply the summation principle to appraise the total M&E portfolio from the bottom up. The generally accepted summation principle appraisal approaches and methods conclude an individual value for each M&E item in the total M&E portfolio (for instance, each item in a portfolio of manufacturing equipment, office equipment, transportation equipment, etc.). Those individual values may be summed to conclude the value of the total M&E portfolio.

Applying the Unit Principle

When do appraisers apply the unit principle of appraisal (instead of the summation principle of appraisal)? Particularly with regard to appraisals developed for state and local *ad valorem* taxation purposes, appraisers typically apply the unit principle of appraisal in the following instances:

- When it is required by statute or regulation.
- When the individual M&E components are physically, functionally, and economically integrated.
- When financial or operational data for the individual M&E components are not available.
- When the individual M&E components would be bought or sold collectively—as a unit.

Taxpayers (and other interested parties) often ask if there is a value conclusion impact of applying the unit versus the summation principle. The answer is that the unit principle and the summation principle should conclude approximately the same M&E value if:

- both appraisal principles are applied to exactly the same bundle of M&E,
- both appraisals apply consistent valuation variables, and
- there are no scope restrictions on either appraisal.

Historically, the unit principle of appraisal was called the utility principle of appraisal because it was originally developed to appraise rate-based, regulated public utility equipment. However, today this unit principle of appraisal is frequently applied by state and local tax assessment authorities to value both regulated utility taxpayers and many types of nonregulated utility-type taxpayers.

Unit Principle Approaches and Methods

The following list presents the generally accepted unit principle appraisal approaches and methods:

- Income approach
- Discounted cash flow method (also more generally known as the yield capitalization method)
- Direct capitalization method
- Cost approach
- Historical cost less depreciation method
- Original cost less depreciation method (if historical cost is not available)
- Market approach
- Direct sales comparison method
- Stock and debt method

Appraisers typically consider each of these approaches and methods in the unit principle property appraisal and apply each approach and method for which there are meaningful empirical data available to develop the component valuation variables. In the selection and application of the unit principle approaches and methods, ultimately, appraisers attempt to emulate the analyses of—and the actions of— market participants.

The names of some of these unit principle approaches and methods may sound the same as the names of corresponding summation principle approaches and methods. However, M&E appraisers understand that the particular valuation procedures

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and analyses may be quite different between the two appraisal principles. For example, the reproduction cost new and the replacement cost new cost metrics are rarely applied in a unit principle appraisal. On the other hand, the historical cost and the original cost metrics are rarely applied in a summation principle appraisal.

In addition, the particular valuation variables applied and data sources used may be quite different between the two appraisal principles.

It is noteworthy that, in a unit principle appraisal, the terms "property" and "assets" are not the same. The term "property" is a legal term, generally defined by *Black's Law Dictionary,* but specifically defined by state statutes. The term "asset" is an accounting term, defined by the Financial Accounting Standards Board Statement of Financial Accounting Concepts No. 8. It is noteworthy that not all property may be recorded as an asset on a balance sheet prepared in compliance with U.S. generally accepted accounting principles (GAAP). Similarly, not every asset recorded under GAAP may be legally protected as property in a particular taxing jurisdiction. For purposes of this discussion, however, these two different terms are used interchangeably.

Differences between Unit Principle and Summation Principle

Numerous differences between the unit principle and the summation principle exist in both the appraisal procedures performed and the valuation variable data sources applied. The more significant of these many differences are summarized in Exhibit 1.

Exhibit 1
Differences in Unit Principle Appraisal Procedures versus Summation Principle Appraisal Procedures

	Valuation Variables	Unit Principle Appraisal	Summation Principle Appraisal
Income Approach	Type of income considered	Business operating income from the sale of goods and services	M&E rental income
	Term of income	Perpetuity	Over the M&E useful economic life
	Asset replacement	Perpetual M&E replacements	M&E retirement after its useful economic life
	Discount rate	Extracted from capital market data	Market participant-required rates
	Long-term growth rate	Business income growth from all assets in place	Rental income growth from lease of specific M&E only
	Direct cap rate	Discount rate minus long-term growth rate	Extracted from sales of comparable M&E
Cost Approach	Cost metric	Historical/original cost	Replacement/reproduction cost new
	Physical depreciation	Age/life, total based on taxpayer's continuing property records' accounting data	Observed individually based on effective age/condition
	Functional obsolescence	Aggregate excess capital costs; aggregate capitalized excess operating expenses (in perpetuity)	Individual excess capital costs; individual capitalized excess operating expenses (over the M&E useful economic life)
	Economic obsolescence	Actual versus required business income profit margin or business income return on investment	Location-specific rental income loss capitalized over the M&E useful economic life
Market Approach	Comparables selected	Comparable operating businesses sold; stock and debt securities of "comparable" public companies	Comparable individual M&E items sold
	Adjustments based on	Size, profit margins, return on investment, growth rate	Location and physical characteristics
	Pricing multiples applied	Price/business operating income metric	Price/physical or operational capacity metric

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Without numerous intentional adjustments, the unit principle of appraisal and the summation principle of appraisal will:

1. appraise two fundamentally different bundles of assets and
2. apply two fundamentally different sets of valuation variables/assumptions.

The Unit Principle Property Appraisal Is Not a Business Valuation!

Unit principle appraisals of M&E and business valuation are two different valuation analyses that apply different sets of generally accepted valuation approaches to reach a conclusion of value for two fundamentally different bundles of assets.

The unit principle concludes the value of all M&E operating on a value-in-use basis.

The business valuation concludes the value of business debt and equity securities. That is, the subject of the valuation analysis is a going-concern business enterprise.

An M&E appraisal that includes the value of all assets and liabilities of a business is not equivalent to a business valuation, which would include the benefits of owning the complete enterprise (which includes not just assets and liabilities but also the value of future earnings and opportunities). These two different types of valuation analyses have two fundamentally different objectives and conclude the value of two fundamentally different bundles of assets, as illustrated in Exhibit 2. While a unit principle appraisal strictly focused on M&E would not include intangible assets (or working capital or real estate), an appraisal of the taxpayer unit would include all property types.

PVGO in Business Valuation

In Exhibit 2, the acronym PVGO stands for *present value of growth opportunities*. PVGO is the present value of all future tangible property (M&E and real estate) and all future intangible property that do not yet exist on the valuation date. PVGO includes investor expectations for the subject business enterprise with regard to future M&A transactions, future new products and services, future new territories and innovations, and future expansionary capital expenditures.

The term *intangible investment attributes* includes the following value increments associated with using stock and bond capital market data in the application of the unit principle:

- Value of stock market liquidity (including quick sale, low transaction costs, certain price)
- Value of stock market limited investor liability
- Value of having no capital calls on public securities

Exhibit 2
Unit Principle Appraisal Bundle of Assets Appraised versus Business Valuation Bundle of Assets Appraised

Unit Principle Appraisal Assets Appraised	Business Valuation Assets Appraised
Working capital accounts	Working capital accounts
Real estate	Real estate
M&E	M&E
Intangible assets	Intangible assets
	PVGO
	Intangible investment attributes

- Value of expected investment appreciation (vs. expected investment depreciation)
- Value of having no investment replenishment expenditures (vs. maintenance capital expenditures)
- Value of applying capital gain tax (vs. ordinary income tax on depreciation recapture) on any gain at sale

After a business acquisition, both the PVGO value and the value of intangible investment attributes typically would be recorded as goodwill on a GAAP-basis balance sheet. The PVGO and intangible investment attributes values should not be subject to property tax, because neither PVGO nor intangible investment attributes are not considered to be property.

Fundamentals of Unit Principle Cost Approach

The following formula presents the typical unit principle cost approach:

Historical (may be original) cost
– Physical depreciation
– Functional obsolescence
– Economic obsolescence
= Unit value indication

Each of these four cost approach analysis components (one cost metric and three depreciation metrics) are typically developed in the aggregate—or as a unit. The data regarding the cost metric and the physical depreciation metric are typically extracted from the taxpayer's continuing property record or from a similar property accounting data set.

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Functional Obsolescence

When measuring functional obsolescence in the aggregate, it may be that the unit-level functional obsolescence is caused by one or more individual M&E components within the overall unit (e.g., an inefficiency at one compressor station or one gas processing plant as a component of the total pipeline unit). In the unit principle cost approach, functional obsolescence typically relates to an inadequacy or a superadequacy within the unit.

Functional obsolescence is caused by factors internal to the taxpayer's unit. Functional obsolescence often manifests as an inadequate unit-level return on investment, which . may be caused by either:

1. inadequate profit or
2. superadequate investment.

The inadequate unit-level profit is typically due to excess operating expenses that may relate to the operation of the unit's real estate and/or M&E. The excess operating expense is typically measured as the difference between:

1. the unit's actual expense category (e.g., fuel expense, maintenance expense, etc.) and
2. the corresponding budgeted/projected expense level, historical expense level, industry average expense level, and other benchmark expense levels.

The excess operating expense is typically capitalized as an annuity in perpetuity in order to measure the unit-level functional obsolescence.

The superadequate investment typically relates to excess capital costs that relate to the taxpayer's unit having more (or having more costly) real estate and/or M&E than it needs in order to operate at its current volume. This unit-level functional obsolescence superadequacy is typically measured as the difference between:

3. the actual investment in the actual M&E and
4. the investment needed to buy/build the ideal M&E (e.g., smaller diameter pipeline, fewer/smaller compressor stations, etc.).

A unit can experience both excess operating expenses and excess capital costs. However, the M&E appraiser should be diligent to not double-count the amount of functional obsolescence.

In a unit principle appraisal, an inutility analysis is sometimes applied to measure functional obsolescence. This is because inutility measures the amount of the taxpayer's M&E capacity that is not needed for the current volume of business operations.

Economic Obsolescence

In the unit principle cost approach, all M&E components share the unit-level economic obsolescence, since all M&E components contribute to the economically integrated unit.

Economic obsolescence is caused by factors external to the taxpayer unit property and often manifests as an inadequate unit-level (1) profit margin or (2) return on investment. These economic metrics can be measured many different ways. For example, the unit-level profit margin can be measured in any of the following ways:

- Before or after taxes
- Before or after debt service
- Before or after depreciation expense
- Based on changes in revenue (selling price and/or volume)
- Based on changes in material, labor, or overhead expenses

The unit-level return on investment can be measured in any of these ways:

- Before or after tax
- Before or after debt service
- Before or after depreciation expense
- Based on gross or net investment
- Based on historical investment or current value indication
- Based on changes in expected growth rate

Economic obsolescence can be caused by any factor that is external to the unit's real estate and/or M&E, including the following:

- Changes in technology
- Changes in industry conditions
- Competitor actions
- Property owner management actions
- Regulatory factors
- Income tax rate changes
- Interest rate changes
- Many other factors

In a unit principle property appraisal, the unit-level economic obsolescence is typically measured as either:

1. the amount of economic deficiency capitalized as an annuity in perpetuity or
2. the percentage difference between the unit's actual profit/return metric and a market-required profit/return metric.

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External Obsolescence

Economic obsolescence is often referred to as external obsolescence, but economic obsolescence is a subset of external obsolescence, which also includes locational obsolescence, a term generally used in real estate valuation and typically measured as the capitalization of rental income loss over the property's useful economic life.

Locational obsolescence is a decrease in property value due to location-related or neighborhood factors. Some examples of locational obsolescence include the following:

- A newly constructed structure blocks a high-rise apartment's view of the waterfront
- A budget motel is built next to a luxury hotel
- A trailer park is built next to a country club

Locational obsolescence is typically not a consideration in either a summation principle appraisal or a unit principle appraisal of M&E. Because external obsolescence includes both locational obsolescence and economic obsolescence, the terms economic obsolescence and external obsolescence should not be used as synonyms.

Economic obsolescence—a decrease in value due to any external factors other than location or change in neighborhood—is typically a consideration in a unit principle appraisal and may also be a factor in a summation principle appraisal.

Economic Obsolescence Measurement Principles

There is a difference between (1) identifying the existence of economic obsolescence and (2) measuring the unit-specific amount of economic obsolescence. Appraisers often identify the existence of economic obsolescence in the taxpayer's industry by developing preliminary analyses, analyses of industry-wide data, or analyses of unit data not involving some investment metric.

Economic obsolescence is typically measured on a comparative basis. The economic obsolescence measurement comparison is often simplified as follows: What you have versus what you want. The *what you have* metric is typically the taxpayer unit's actual economic metric. The *what you want* metric is typically the market participants' required or benchmark level of the same economic metric, which should be based on empirical information from industry, public companies, or the taxpayer's historical or prospective data.

The difference between the *what you have* (the actual economic metric) and the *what you want* (benchmark economic metric) can be calculated as a percentage, which can be applied as the economic obsolescence percentage measurement. The difference between these two metrics can also be converted into a dollar-based economic deficiency, which can be capitalized as an annuity in perpetuity in order to conclude an economic obsolescence dollar measurement.

Economic obsolescence can be measured as a deficiency in profit margin or as a deficiency in rate of return (including in the long-term growth rate component of return on investment). The taxpayer unit's profit margin deficiency can be influenced by any factors causing deficiency in the unit-level profits (however measured) and the unit-level revenue (or in related utilization or inutility). The taxpayer unit's rate of return deficiency can be influenced by any factors causing a deficiency in the unit-level profits and an excess in the unit level amount of (or the value of) investment.

The causes of the economic obsolescence should be external to the taxpayer unit's real estate and/or M&E. However, the causes of the economic obsolescence are not necessarily external to the taxpayer unit business enterprise.

As a fundamental principle of both summation principle appraisals and unit principle appraisals, cost is not equal to nor an indication of value. Rather, cost less all forms of depreciation provides an indication of value. Economic obsolescence is not an adjustment from the unit value:

- Economic obsolescence is not subtracted from the unit value; it is an adjustment to the unit cost metric.
- Economic obsolescence is not an adjustment from a final cost approach value indication; it is an adjustment in order to get to a final cost approach value indication.

The economic obsolescence measurement typically involves economic data and economic analyses. M&E appraisers are aware of the following observations:

- Income data are analyzed in all economic analyses.
- The analysis of income data does not convert the cost approach into the income approach.
- The economic analysis measurement can be developed when no income approach analysis is developed and no income approach value is concluded.
- The income approach, the cost approach, and the market approach all consider some measures of the taxpayer unit's income data.

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Summary

Tax assessment authorities often apply the unit principle of appraisal for state and local property tax assessment purposes. The unit principle values all of the taxpayer's M&E as a single unit that is operating collectively, on a value-in-use or going-concern basis. Appraisers and tax assessment authorities often apply the cost approach to value complex, special-purpose M&E. The measurement of economic obsolescence is often an important—and controversial—component of the industrial and commercial M&E appraisal developed for property tax appeal or litigation.

The second part of this series will describe and illustrate generally accepted economic obsolescence measurement methods, while the third and fourth parts will recommend some useful responses to the most typical tax assessor objections to economic obsolescence measurements and other (but still common) assessor objections to economic obsolescence measurements.

About the Author

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