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# Contents

<b>MTS Journal Editorial</b>	<b>5</b>
Brad Hartsburg, ASA, CPPA, CSA	
<b>Governor's Bulletin</b>	<b>7</b>
Richard Berkemeier, ASA and David Crick, ASA, MTS Governors	
<b>Auction Theory, Game Theory, and Appraisal</b>	<b>8</b>
Walter W. O'Connell, M.E., ASA, SCSP	
<b>Royalties and Valuation of Mineral Rights</b>	<b>14</b>
Landy A. Stinnett, ASA, P.E.	
<b>ASA and Embry-Riddle to Offer Courses for Accredited Aircraft Appraisers</b>	<b>18</b>
Alison Ho	
<b>Depreciation of Installation Costs</b>	<b>19</b>
Raymond Springer, ASA	
<b>5th Annual Equipment Valuation Conference in Cleveland</b>	<b>22</b>
Jean Jackson and David Helle, ASA	
<b>ASA Advanced Mining Topics Course Report - September 23- 28, 2016 - Las Vegas, Nevada</b>	<b>27</b>
Charles W. "Bill" Ruth, ASA	
<b>The Value of Mining Equipment Appraisal Education</b>	<b>36</b>
John J. Connolly III, ASA	
<b>Chairman's Corner</b>	<b>37</b>
John J. Connolly III, ASA	
<b>MTS Journal 2016-17 Media Kit</b>	<b>38</b>
American Society of Appraisers	
<b>ASA Appraisal Review and Advanced Course 201</b>	<b>42</b>
Roger Durkin, J.D., M.S., FASA	
<b>Purpose and Intent of IVSC</b>	<b>43</b>
Jack Beckwith, ASA, CEA	
<b>Fair Competition and Fair Gain</b>	<b>47</b>
Peter Bolton King	
<b>2016 Market Overview</b>	<b>49</b>
Mike Clark	
<b>Insurance Valuations and Loss Preparedness</b>	<b>52</b>
Alex Ruden, ASA (M&TS & ARM), CG/GA	
<b>FDIC Rental Value - A Nontraditional Approach</b>	<b>54</b>
Larry L. Perdue, ASA, MVS	
<b>Why Net Book Value Does Not Equal Fair Value</b>	<b>62</b>
J. Fernando Sosa, ASA, MRICS	
<b>Aircraft Residual Value Puzzle</b>	<b>67</b>
Mike McCracken	
<b>Valuing Assets in Extractive Industries</b>	<b>69</b>
Alexander Lopatnikov, ASA, RICS	
<b>American Society of Appraisers Update</b>	<b>73</b>
American Society of Appraisers	

# Auction Theory, Game Theory, and Appraisal

Walter W. O'Connell, M.E., ASA, SCSP



Three appraisers are lost in the desert! They are wandering through the desert, dying of thirst, when they come across a hiker with one bottle of water to spare! Each appraiser reaches into their pocket to see what they can offer the hiker in exchange for the bottle. Appraiser #1 offers 10 dollars from his pocket, Appraiser #2 offers 50 dollars from his pocket and Appraiser #3 offers a crisp new 100-dollar bill. The hiker yells "Sold to Appraiser #3 for 100 dollars"! Appraiser #3 wins and lives to appraise another day.

This short parable, as funny (or tragic) as it seems, is designed to demonstrate that outcomes of an auction are based on the level of trade in which the auction participant deals. In this parable, the level of trade was three appraisers in the desert dying of thirst. If our Appraiser #3, who lived, was given an assignment to value bottled water at a supermarket, days after returning from the desert, would he value each 12-ounce bottle of water at 100 dollars? The answer of course is "No". Less dramatic inflations in the real world can be observed based on the needs of the auction participants and/or the

type of auction in which they are participating.

This article will examine how auction participants and the way an auction is designed and ran by an auctioneer can deliver higher than expected final bids in auctions. Understanding the behavior of auction participants and how an auction is designed and ran, may help the Appraiser reconsider whether auction data should be used, not used, or adjusted before used in an appraisal assignment.

The study of auction data and outcomes is a sub-category of Game Theory. Game Theory, a branch of mathematics and economics, is the study of strategies for dealing with competitive situations where the outcome of a participant's choice of action depends critically on the actions of other participants. Like most games, there are two major factors that determine the outcome of the game (auction): the players and the rules of the game (the auction type).

## The Players

The players in our game are the auction participants. These participants can come from different companies, different states, different countries, and have different ideas of how the property won will be used. If they become the winning bid, will the participant use the property, resell the property, dismantle the property for its sub-components, donate the property, or warehouse the property for future use? Will the property won be used to produce immediate income, create a tax donation, or be held in a private collection? If the intent is to resell the property, will it be sold in the salvage market, wholesale market, retail market, or resold at another auction? Even if we identify the level of trade, let's say "retail", what level within retail level of trade will the property be sold? Will the property be resold at a salvage yard, flea market, discount store, midmarket retail store, or upscale boutique? What I am demonstrating is that there are literally hundreds, if not thousands, of factors that influence how an auction participant bids on an auctioned property!

## Lot Size

Lot size, the quantity of identical or similar property, will influence who the auction participants are. An example demonstrating how lot size influences who the participants can be demonstrated with the three auctions flyers shown below.

**Auction**  
**When: Today**  
**Where: Somewhere,**  
**USA**  
**Time: 10:00 AM**  
**Selling: 1 Used Laptop**  
**Computer**



Winning Bid:  
 \$500 per unit

**Auction**  
**When: Today**  
**Where: Somewhere,**  
**USA**  
**Time: 10:00 AM**  
**Selling: 1 lot of 100**  
**Used Laptop**  
**Computers**



Winning Bid:  
 \$400 per unit

**Auction**  
**When: Today**  
**Where: Somewhere,**  
**USA**  
**Time: 10:00 AM**  
**Selling: 1 lot of 1000**  
**Used Laptop**  
**Computers**



Winning Bid:  
 \$300 per unit

Looking at the above three flyers we could imagine the following participants attending and bidding at each auction:

**Lot of 1 Laptop Computer:** Small Business, Student, Homeowner, or Boutique Computer Shop.

**Lot of 100 Laptop Computers:** Small Chain of Electronic Stores, School or University, Mid-Sized Company.

**Lot of 1000 Laptop Computers:** Large Chain of Retail Stores or National Wholesale Electronic Warehouse Company.

At our 1 Laptop Computer auction we can imagine that small businesses and/or individuals would be the auction participants. We would not expect mid-sized or large institutions to participate in such an auction. The lot size of such an auction would not interest mid-sized and large institutions looking to purchase property at a discounted price, due to the larger quantities they would need to acquire to meet the institution's needs or discount pricing one would expect for higher volume purchases.

At the 100 Laptop Computers auction, lot size becomes too large for small institutions or individuals. Small institutions and individuals lack the resources (\$), distribution network, and/or need for 100 units, even if a savings of \$100 per unit is realized. Due to the quantity purchased participants would expect a discount and pay wholesale pricing due to the economies of scale that would be realized by high volume purchases of such units. Let's call this level of purchasing "Wholesale Pricing".

Our 1000 Laptop Computers auction would likely be restricted to those companies needing 1000 units, or those who have the large scale distribution network. Let's call this level of purchasing "Distributor Pricing".

As you can see, lot size and those participating in an auction will define what market level the winning bid represents. Now imagine an appraiser receives a report stating that used laptop computers recently sold at auction for \$300 per unit, with no additional information detailing lot size or participants, he could conclude in error that \$300 was the market price that small businesses or individuals are paying for used laptop computers.

## Auction Types

While completing my research to write this article I found there are many different styles of auction. I stopped counting when I reached 24 styles. Auctions, like auction participants, are diverse and varied. State run lotteries, like lotto, are a type of auction. Charitable auctions like Chinese and Tricky Tray Auctions combine auction with raffle. There are all types of raffle, outcry, and sealed bid auctions. Bid pricing can start low (\$) and move high (\$), start high (\$) and move low (\$), keep the participants informed, or keep the participants in the dark.

No matter what the name, or style of the auction, all auctions fall into one of four types:

1. **English Auction (outcry):** An auction where bids start at a low price. Buyers call out sequentially higher prices and the participant who bids the most wins the auction.
2. **Dutch Auction (outcry):** An auction where bids start at an extremely high price with the auctioneer calling out successively lower prices until someone accepts the price called.
3. **First Price Auction (sealed bid):** All participants place a sealed bid. The highest bidder wins the auction and pays the bid price.
4. **Vickrey Auction (sealed bid):** All bidders place a private bid. The highest bidder wins the auction, but pays the bid price of the second highest bidder.

Even in an outcry auction, other bidders during the auction do not know the strategy or final bid (\$) that each auction participant is willing to place. One would assume that the final bid, regardless of the type of auction, would be at the top end of the fair market value spectrum based on the level of trade in which the final winning participant participates. What you will see is that the final bid prices have the potential to vary widely based on the strategy employed by the participant and auction type.

## Let's Play a Game

Let's see what the dynamics and outcomes would be if we played a game using consistent bidding strategies from participants in each of the four types of auction.

**Up for Auction:** 2010 Drill Deep Piling Drilling Rig

**Quantity:** 1 unit

**Bids:** The auctioneer has set the bidding in \$5,000 increments.

**Strategy:** Each bidder will look to buy the rig at the lowest possible price and may not exceed the authorized maximum bid authorized by each employer.

### **The Auction Participants:**

**Bidder A** – Wholesaler – Maximum bid authorized: \$30,000 (looking to win bid and resell drill rig in the next 30 days)

**Bidder B** – Wholesaler – Maximum bid authorized: \$35,000 (looking to win bid and resell drill rig in the next 360 days)

**Bidder C** – Retailer – Maximum bid authorized: \$40,000 (looking to win bid and resell drill rig in the next 45 days)

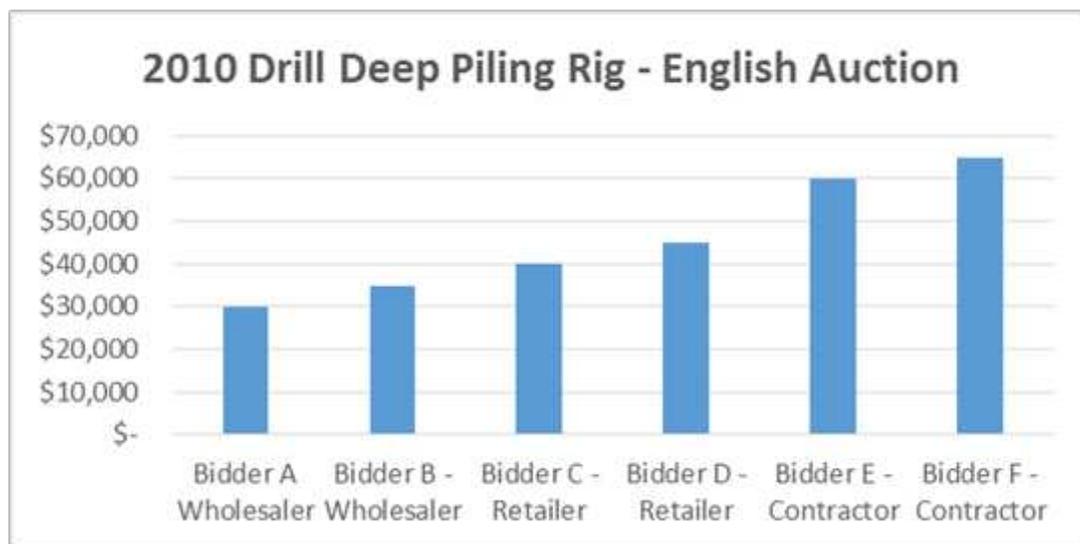
**Bidder D** – Retailer – Maximum bid authorized: \$45,000 (looking to win bid and resell drill rig in the next 180 days)

**Bidder E** – General Contractor – Maximum bid authorized: \$60,000 (The drilling rig they own and use now is beginning to fail and needs to be replaced in the next four to six months)

**Bidder F** – General Contractor – Maximum bid authorized: \$100,000 **(The Company's current Piling Drill Rig broke yesterday! It cannot be repaired! The company is losing \$10,000 a day! The company is in distress! The company does not care what the fair value is, they need to acquire a new Rig before they go out of business!)**

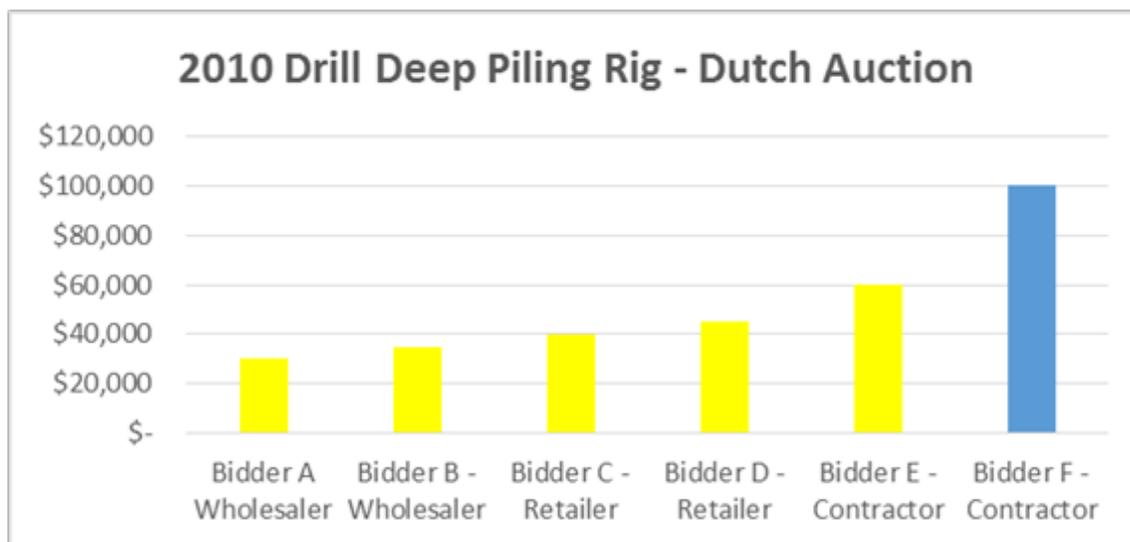
As you can see, Bidders A through E have their maximum bid (\$) at a price level that we would expect to see at the level of trade in which they are participating. Our Wholesalers are bidding low, Retailers are bidding high, Bidder E, as an end user, is willing to pay even more than the retailers who need to buy low and sell high. But look at Bidder F! Bidder F is about to go out of business if they can't acquire this drill rig! Bidder F is in distress! Let's see what happens!

1. **English Auction (outcry):** An auction where bids start at a low price. Buyers call out sequentially higher prices and the participant who bids the most wins the auction.



In the English Auction, with outcry bidding starting low and moving high, our winner; Bidder F, who was authorized to bid as high as \$100,000, only bids and wins at \$65,000 (\$5,000 above Bidder E). Even though Bidder F's business is in **distress**, and could bid as high as \$100,000, he only needed to bid \$65,000 to ensure a winning bid. Our appraiser, **not knowing** Bidder F's company was in distress, could conclude the fair market value (end user) would be at some point in the \$60,000 to \$65,000 range.

2. **Dutch Auction (outcry):** An auction where bids start at an **extremely** high price with the auctioneer calling out lower successively lower prices until someone accepts the price called.



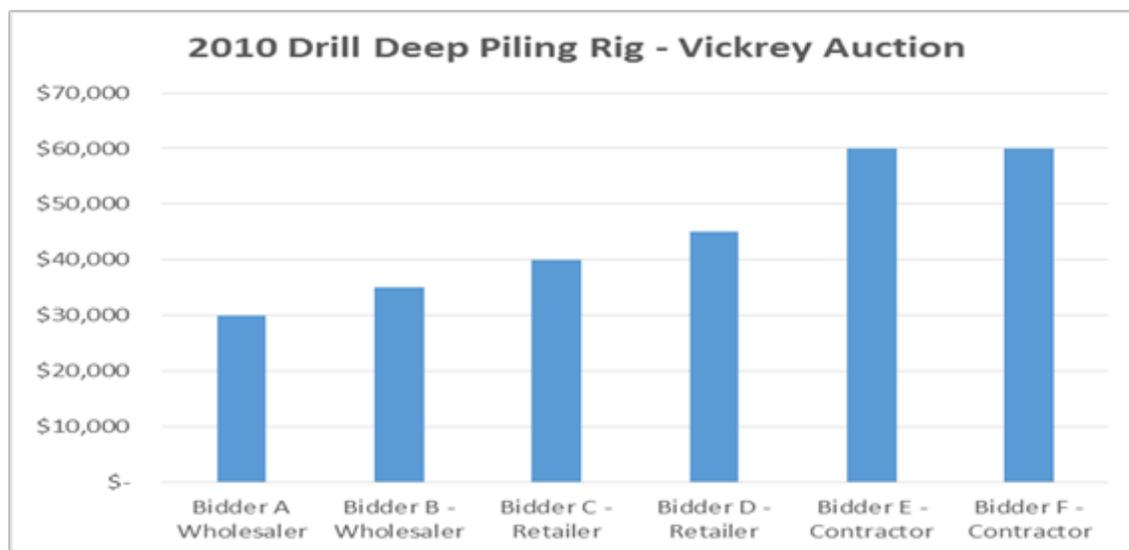
In the Dutch Auction, even with outcry bidding, Bidder F is forced to bid the full \$100,000, not knowing at what price point Bidders A through E will bid. In this system Bidder F's bid is the only bid observed by our appraiser. If not given any additional information, our appraiser could improperly conclude that \$100,000 was the fair market value (end user), greatly above the \$60,000 to \$65,000 range observed in the English Auction.

3. **First Price Auction (sealed bid):** All participants place a sealed bid. The highest bidder wins the auction.



In the First Price Auction, with sealed bidding, Bidder F is forced to bid the full \$100,000, not knowing at what price levels Bidders A through E will bid. In this system non-winning bids are disclosed. Our Appraiser would have an opportunity to observe the spread between Bidder E's \$60,000 and F's \$100,000 winning bid. In this case our Appraiser may conclude that additional research is needed before concluding that the fair market value (end user) is \$100,000.

4. **Vickrey Auction (sealed bid):** All bidders place a private bid. The highest bidder wins the auction, but pays the bid price of the second highest bidder.



In the Vickrey Auction, with sealed bidding, Bidder F will bid the full \$100,000, win the bid, but only pay the next highest bid of \$60,000 offered by Bidder E. Our appraiser, able to see all bids, would conclude that the fair market value (end user) would be \$60,000.

In all auctions, unless a degree of chance (raffle/lottery) is built into the auction, as in a Chinese or Lottery Auction; the highest bidder will always win. But what we have observed is that the “winning bid” can vary dramatically based on the strategy employed by the participant and the type of auction run. The final winning bid of Bidder F can be represented by \$60,000, \$65,000, or \$100,000 based on the type of auction. If we assume that Bidder E’s maximum bid of \$60,000 is the true fair market value (end user) but our appraiser improperly reports \$65,000, an overstatement of 8.333%, such a mistake may never be noticed or may be considered insignificant in our assignment. But a winning bid of \$100,000, an overstatement of 66.666% may cause problems for the client and/or his appraisal practice.

A number of strategies can be employed in dealing with the issue of observed variances in auction data but it is clear that before such strategies can be put in place the type of auction, level of trade, and participants of an auction must be understood and properly analyzed in any appraisal assignment.

## About the Author

**Walter W. O’Connell, ME, ASA, SCSP** is a Senior Consultant with Porto Leone Consulting, LLC (“PLC”) and is responsible for managing cost segregation studies and tangible asset valuations. He has provided these services to clients in a variety of industries for over ten years.

Prior to joining PLC, Walter worked in the manufacturing and distribution sectors as an Inventory Control Manager for Newell Rubbermaid (NYSE:CHX) and Marcolin S.p.A.. While working as an Inventory Control Manager, Walter specialized in Material Requirements Planning (“MRP”) and Manufacturing Resource Planning (“MRP II”), in matters of national and international purchasing, the procurement of production equipment, plant and production design, cost allocation studies, and inventory accounting.

He has performed and managed cost segregation studies on hundreds of properties, including hotels, senior living facilities, manufacturing facilities, research & development facilities, office buildings, hospitals, and retail properties. Walter has experience in tangible asset valuations for tax, book, insurance placement, due diligence, and business planning purposes in the Healthcare, Hospitality, Manufacturing, Chemical, Food Processing, Cable and Telecommunications industries nationally.

Walter holds a Master of Arts degree in Economics from Montclair State University, Bachelor of Science degree in Finance and a Bachelor of Arts degree in Economics from Kean University. He is an Accredited Senior Appraiser (“ASA”) with the American Society of Appraisers, a member of the Association of Production and Inventory Control Supervisors (“APICS”), and is an Accredited Senior Cost Segregation Professional (“SCSP”) with the American Society of Cost Segregation Professionals (“ASCSP”) and is a member of the American Economic Association.