1988

A Faster Way: A Recommendation to Machinery and Equipment Appraisers

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A Culminating Project to the Faculty of the Graduate School of the Lindenwood Colleges in Partial Fulfillment of the Requirements for the Degree of Master of Science

1988

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ACKNOWLEDGMENTS

Acknowledgments for this project are sincerely offered to my family especially to:

My son, Donald, for his technological chemical engineering assistance.

My sons, Patrick and Robert, for their tireless typing efforts.

My wife, Claudine, for everything.

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INTRODUCTION

INTRODUCTION

A Faster Way

> 'Tis hard to say, if greater want of skill
> Appear writing or in judging ill;
> But, of the two, less dang'rous is th' offence
> To tire our patience, than mislead our sense.
> Some few in that, but numbers err in this,
> Ten censure wrong for one who writes amiss (POPE)

Several years ago I made a career change from being an estimator/cost engineer to being a machinery and equipment appraiser. Since becoming an appraiser, I have successfully used many of the skills and more efficient techniques that I learned over the span of that previous career. As a consequence of this transferability, I have often wondered why machinery and equipment appraisers have not pressed for the professional adoption and universal use of some of the "tools-of-the-trade" which have been widely accepted in the cost engineering profession. As many of us are aware, the costs of appraisals are continually increasing; as a consequence, clients are rebelling. Clients are becoming increasingly vocal in their concerns that appraisal fees are getting exorbitant. However, we in the appraisal profession seem to blindly cling to many of the old ways. Unquestionably, it is therefore in the best interest of all of us to look for new and faster methods. [1]

This paper will discuss some of the real or perceived "standards of methodology and technique" which have evolved over the years for the appraisal of machinery and equipment. It will also discuss some of the aspects of these practices which the writer believes to be outdated and should therefore be updated and/or discarded. [2]

The professional society that best serves appraisers engaged in the valuation of machinery and equipment is the American Society of Appraisers. (ASA) In much the same fashion, there is another professional society known as the American Association of Cost Engineers (AACE) whose members perform many tasks similar to those of machinery and equipment appraisers. To advance the points addressed herein, several parallels will be shown between the practice of the members of these two organizations. [3]

To illustrate the technical aspects of the similarities, as well as to support the premise of viable, more efficient methods and techniques, some sample estimates based upon a hypothetical chemical process plant will be given. Some of the pros and cons of this type of estimating will be discussed. The hypothetical appraisal/estimate performed herein will serve to prove that the more efficient methods and techniques outlined are indeed valid and can be adopted by machinery and equipment

appraisers without a significant sacrifice to credibility or accuracy. Under some circumstances, an accuracy trade-off may or may not be made. Over the past five years, the writer has successfully used these concepts for at least ten different process plant machinery and equipment appraisals. In his opinion, the results from these new concepts do not differ appreciably from those obtained through the older methods. Some of the shortcomings in the proposed methodology will be pointed out. However, the knowledgeable reader should easily see that, regardless of these few shortcomings, there still exist some very valid principles that can be readily adapted to the appraisal of machinery and equipment. Especially noteworthy are those that will be discussed pertaining to factor and exponential pricing/estimating.

In summary, if machinery and equipment appraisers are open-minded and willing to use new, or different, methodology and techniques such as that elaborated upon, then they will indeed be able to perform some of their appraisals faster. Hopefully, the time saved will result in more efficient appraisal methodology and techniques which will translate into better, and most likely less expensive, appraisals. The writer feels that all of these changes and subsequent gains can easily be accomplished without violating any of the appraisal code-of-ethics.

II A. Background:

> For Fools rush in where Angels fear to tread.
> Distrustful sense with modest caution speaks,
> It still looks home, and short excursions makes;
> But rattling nonsense in full volleys breaks.
> (Pope)

The reader may ultimately elect to call this work a crusade, a plea, a whim, or even a rebellion. However, regardless of the chosen conclusion, it will still remain the attempt on the part of, perhaps, a "fool" to improve the efficiency of the machinery and equipment appraiser. We who are engaged in this discipline are hampered by a general lack of development and growth. More specifically, there definitely exists a shortage of a wide range of published works dedicated to our discipline. If all of the published information pertaining to the appraisal of real estate were gathered in one place, it would, conservatively speaking, take a fairly large library to house them. Admittedly, much of this published work contains a large amount of repetitive or duplication of subject matter. However, if we could effectively prune the works to eliminate this duplicity, the remaining material would still constitute a very large library of published reference information dedicated to the appraisal of real estate. Not so for the machinery and equipment appraisal discipline. One notable published work for machinery and equipment is the American Society of

Appraisers' (ASA) Monograph #2. [3] Its introduction also points out this lack of information:

> The complexity of the "M & E" concept and practice is emphasized by the fact that so little definitive information is readily available to the student; few concept-presentations are accessible to the practitioner. (ASA 2:3)

Perhaps the discussion here will take a few steps towards remedying this deficiency.

It seems that the discipline of appraising machinery and equipment has not progressed very far from the methodology and techniques that were used many years ago. At least, in the writer's opinion, this progress has not gone as far as it should have. Recent reviews by the writer of numerous machinery and equipment appraisals prepared by others have shown that field inventories, regardless of the nature of the property being appraised, are still being performed and recorded in infinite detail. It is also apparent that the subsequent pricing and valuing step of a machinery and equipment appraisal based upon the very detailed listing is still being carried out in tedious steps. Finally, as a somewhat natural consequence, the written appraisal reports emanating from all of this detail are still being produced in exhaustive and lengthy formats. However, the writer is not completely convinced that all of the detail that has been demanded in the past is still required in today's

business and appraisal environment. It is exactly to this point that this paper is addressed. The appraisal profession in general, and more specifically the machinery and equipment appraisal profession, must seek out more efficient methods without sacrificing accuracy or its professional ethics. To accomplish changes of this nature, the profession must be willing to accept some drastic revisions in its methodology and mode of thinking if it is to answer the challenge of a faster paced world and ever changing economy.

In an effort to advance the progress of the machinery and equipment appraisal discipline, this paper will discuss some of the contrasts between the machinery and equipment appraisal profession and that of the profession of cost engineering. Some of the faster techniques used by the cost engineering profession will be shown. Through this approach, machinery and equipment appraisers will be introduced to some faster techniques which the writer feels to be easily adaptable to machinery and equipment appraisals. The writer has successfully applied these concepts to several appraisals and is therefore of the opinion that the adoption of such methods and techniques will yield to the machinery and equipment appraiser answers which are essentially the same as those derived through the use of present appraisal practices. As a means to emphasize these points, we

will assume that we have before us an appraisal assignment to establish a market value for the machinery and equipment of a chemical process plant facility. To better illustrate the principles, we will use the Cost Approach in the appraisal. The Cost Approach is "... a set of procedures in which an appraiser derives a value indication by estimating the current cost to reproduce or replace the structure..." and "The first step in using the Cost Approach as an avenue to Market Value is the establishment of the proper Reproduction Cost New." (ASA 2 13) The discussion of the Cost Approach will concentrate on the aspect of "estimating the current cost to reproduce". We will not explore the realm of depreciated reproduction cost as a means to establish the appraised market value.

II B. The Present Appraisal Climate:

> Much was believed, but little understood,
> And to be dull was construed to be good;
> A second deluge Learning thus o'er-run,
> And the Monks finished what the Goths begun.
> (POPE)

The pace of the business world, not to mention most other aspects of life, is becoming faster and faster. With the ever-increasing use of computers, speed is becoming more and more the norm. But with the demand for speed, there is also an increased demand for accuracy. These norms are also becoming predominant in the

appraisal profession. Almost one hundred percent of the writer's most recent machinery and equipment appraisal assignments suggest that clients are not willing to accept antiquated, or lengthy, appraisals, not to mention large appraisal fees. More and more clients are indicating that they see no useful purpose in an appraisal that reiterates and regurgitates their accounting records back to them in a different format. In their view, a simple, and if possible, one line description is often as good as, if not better than, very lengthy descriptions. Regarding machinery and equipment descriptions, clients contend that their third party readers and users of the appraisal do not comprehend such technical details. Many clients have further indicated that the detail provided by these elaborate and exorbitant listings only tend to confuse these third party readers and users of the appraisal. They also believe that this confusion has been at the heart of a multitude of problems for them. The writer agrees that we in the machinery and equipment appraisal profession must ultimately be the judges of what is and is not to be included in an appraisal report. Our profession would unquestionably go downhill if we left such decisions solely to the discretion of our clients.

On the other hand, we must also be aware of the needs of our clients. Emphasis by clients and third

party users of appraisals is increasingly moving towards the importance of the number, estimate or value, while moving away from the desire for long and elaborately detailed appraisal reports. This should not be misconstrued to mean that clients, third party users of appraisals, as well as professional appraisal organizations do not expect very good appraisals. On the contrary, there still remains a demand for accuracy and credibility. According to Standard 2 of the Uniform Standards of Professional Appraisal Practice (USOP) of the recently established Appraisal Foundation:

> Each written or oral ... appraisal report must:
>
> a) clearly and accurately set forth the appraisal in a manner that will not be misleading.

The comment regarding this standard further explains the standard as follows:

> Since most reports are used and relied upon by third parties, communications considered adequate by the appraiser's client may not be sufficient. An appraiser must take extreme care to make certain that his or her reports will be not misleading in the marketplace or to the public. (USOP 5)

The writer is of the opinion that while the above standard provides guidelines for the appraiser, it does not necessarily demand length or volume. While long,

elaborate and extremely detailed appraisal listings may tend to enhance the appraisal's credibility factor, they do not necessarily guarantee accuracy. So how can we in the appraisal profession solve this dilemma? What can we do to be more efficient without compromising our professional appraisal standards?

What do many of us do when we need help or guidance to solve a given problem? A common approach is to look elsewhere to see if anyone else has had a similar problem. We try to see what others have done and how they solved the problem that they had before them. I'm sure that every machinery and equipment appraiser has had the need to research the "how-to's" of an appraisal of uncommon or unique pieces of machinery and equipment that they have never before appraised. We try to discover a solution to our problem through someone else's experience. Perhaps we can similarly find a correlation somewhere.

It can be said that an appraisal is just another form of an estimate. Webster defines estimate to be:

> 1. The act of appraising or valuing...
> 2a. To judge tentatively or approximately the value, worth, or significance of
> 2b. To determine roughly the size, extent or nature of
> 2c. To produce a statement of the approximate cost of (WEB 391).

Since this is true, we may be able to find some assistance with our problem here by looking at other organizations or societies that deal with estimates. We will

find that there are several societies or professions outside of the appraisal field that engage in the practice of providing estimates. Architects and construction contractors routinely provide estimates for a vast array of structures. Our research will also reveal the organization known as the American Association of Cost Engineers. (AACE) [3] This organization was also confronted with estimate problems which were not totally unlike those now facing the appraisal professions. The AACE long ago recognized the need to produce a reliable estimate, faster and at less cost. C. Arthur Miller succinctly addressed the scope of this matter for the AACE by indicating that:

> In today's dynamic economy, the accent is on shortcuts and speed. Not only is the speed required, but there must be a high degree of confidence in the reliability of the figures. Such refinements have come from a more scientific study of the anatomy of capital costs, breaking them down into like components, and finding cost patterns that reflect their individual behavior. (MILLER 1)

In view of these remarks, it would seem that this organization may be able to give us some direction and guidance towards the solution of the appraisal dilemma posed. Therefore, let's take a closer look at it.

For those who are not familiar with the AACE, it is a professional organization much the same as the ASA. The ASA is a multi-discipline organization that, among

others, serves the discipline of machinery and equipment appraisals. The AACE is also a multi-discipline organization that, among others, serves the discipline of cost engineers/estimators. The discipline of cost engineering may be best described by reference to the Constitution and By-Laws of the AACE which state:

> Cost Engineering is defined as that area of engineering practice where engineering judgement and experience are utilized in the application of scientific principles and techniques to problems of cost estimation; cost control; business planning and management science; profitability analysis; and project management, planning and scheduling. (AACE-1)

We can find a further expansion of the skills and knowledge required of a cost engineer in the AACE Cost Engineers Notebook. (AACE-2). More specifically, the skills of cost engineering that are most analogous to those of a machinery and equipment appraiser are those pertaining to cost estimation and which are also defined by the AACE to comprise:

> The determination of quantity and the predicting of forecasting, within a defined scope, of the costs required to construct and equip a facility, to manufacture goods, or to furnish a service. Costs are determined using experience and calculating and forecasting the future costs of resources, methods, and management within a scheduled time frame. Included in these costs are assessments and an evaluation of the risks and uncertainties. Cost estimation provides the basis for project management, business

> planning, budget preparation, and cost and schedule control. (AACE-1)

The writer believes that embodied in the above definition is an understanding that you can feasibly substitute the word "estimate" for the word "determine" without destroying the meaning of the definition as stated. This interchangeableness is also borne out by Webster's definition of estimate as offered earlier. (WEB 391) With this assumption, the similarities to the discipline of machinery and equipment appraisal which are embodied in the above definition should be readily apparent to those of us engaged in the appraisal profession. Both use engineering judgement and experience in the application of scientific principles and techniques to problems of cost estimation and business planning and management science. Both determine quantities and predict costs through a variety of methods. In other words, cost engineers and machinery and equipment appraisers can, in many respects, be considered as parallel to each other. While the two disciplines do indeed have many similarities, they do have one significant difference. This being that they as a general rule, but not always, operate in the framework of two different time periods dictated by, and related to the subject property under consideration. Where cost engineering estimating generally applies to pricing of proposed facilities, appraising

generally applies to pricing and valuing facilities that are already in existence. In their very complete discussion of Capital Investment Cost Estimation, Nelson, Kharbanda, Janda and Black more fully explain the character of cost estimating by their emphasis that:

> Capital cost estimating is essentially an intuitive process which attempts to predict the final outcome of a future capital expenditure program even though not all parameters and conditions concerning a project are known or not fully defined when the cost estimate is prepared. (NELSON 322) 9.

Simply, the cost engineer must, and usually with less than complete information, accurately estimate the cost-to-build a chemical process facility. Similarly, when an appraiser prepares an estimate of the reproduction cost of an existing chemical process facility, he is also estimating the cost-to-build a facility. [4] [5] The element of time differences as already mentioned causes another difference between these disciplines. The main difference between the two types of estimates being prepared primarily rests in the fact that the cost engineer must, through experience and limited information, visualize the proposed chemical process facility. The appraiser, on the other hand, under most normal circumstances, can see the actual plant facility before him. The cost engineer may be working from sketchy and incomplete design information, details and specifications. He may

also, if he's fortunate, have a scale model to assist his visualization of the completed process plant facility. The appraiser, being able to actually see the completed process plant facility, has an advantage over the cost engineer. He can see all of the nuances of complexity, space, size and configuration that have negative and positive impacts on project costs. Even with the subject before him, the appraiser must also bring to bear a great deal of experience and visualization in order to estimate the cost-to-build or reproduction cost. This advantage, all other things being equal, should enable the machinery and equipment appraiser to establish a more accurate cost-to-build estimate than that prepared by a cost engineer.

The differences attributable to time also establishes another distinction between appraisal and cost engineering estimate amounts. Obviously, escalation is a factor of concern for both professions. [4] The cost engineer, dealing with projects that are to be completed at some point in the future must make allowances for escalation. Many years can elapse between inception and completion of proposed chemical process plant projects. To account for this anticipated increase in cost, the cost engineer is forced to make allowances for escalation based upon credible predictions of the future. This

makes the prediction of future costs particularly difficult for the cost engineer. The accuracy of the entire estimate can rest entirely in this single factor.

When the machinery and equipment appraiser makes his estimated reproduction cost, he is, or should be, using pricing manuals, price lists, and quotations that reflect "to-day's" costs. This process provides for the absorption of all of the escalation costs. Therefore, the machinery and equipment appraiser is not usually confronted with the same problem of escalation that confronted the cost engineer. The machinery and equipment appraiser is faced with a somewhat different time-related estimating problem, namely the need to estimate depreciation. Here he must make deductions or allowances for all forms of depreciation. Not unlike the cost engineer, the accuracy of the entire appraisal may rest in this single item. (The writer does not wish to give the impression that either of these differences are unimportant or insignificant. For simplicity, these have only been interjected herein to reveal that they are indeed differences that must be accounted for.) Therefore, by excluding from our discussion the appraiser's need to establish depreciation as well as the common need to adjust for differences in time, i.e. future vs. present, it can be seen that the two professions are both working toward the same number, namely the total cost-to-build, or in

appraisal terms, the reproduction cost. [6]

Furthermore, cost engineering and machinery and equipment appraising can both apply to a wide spectrum of projects which require many different skills. To fulfill the demands imposed by such a wide realm of project estimates based upon varying amounts of information, the cost engineering profession has, over time, developed different estimate categories. These estimate categories have come to be known as Conceptual, Budget, Detail and Control. Each of these has a generally accepted level of required detail to be used as a basis and each carries with it a generally accepted level of accuracy. [4] (NELSON)

It should also be noted that due to assorted needs and demands of the client, both of the professions may be working with what may be considered to be less than adequate information. Very seldom are all of the plans, specifications, details, etc. available to the cost engineer. For a vast variety of reasons, the appraiser is also often confronted with much the same problem. For example, the appraiser is often faced with problems such as lost or unavailable plans and specifications, and/or undocumented modifications and changes made during and after construction. Also, when the rare "exception" does occur, and <u>all</u> of the pertinent data is accessible to the appraiser, it is usually unlikely that there is enough

time, not to mention fees, available to conduct an in-depth, item-by-item detail pricing. Unfortunately, the appraisal is often the very last element needed to consummate financing, a sale or an acquisition. Depending on the property, an item-by-item, detailed appraisal could take several months to complete. Time is usually very critical and a method must be established which will yield an appraisal that is still acceptable under the appraisal code of ethics. Therefore, to better facilitate such demands and constraints, it is the writer's contention that the appraisal profession, especially the machinery and equipment discipline, should also develop different appraisal categories or types. These could include different categories with level of detail requirements somewhat similar to the Conceptual, Budget and Detail presently being used by the AACE. The establishment of such levels would enable the machinery and equipment appraiser to function better, as well as interact more intelligibly, in the present day business environment.

The writer further believes that the adoption of these levels would still provide an acceptable foundation for conformity among various appraisals. As an expansion of this new system there should be a built-in restructuring of appraisal philosophy that would encourage the use of stating a range of values as opposed to providing a

single value. The acceptance of such new policies and philosophies would enable the machinery and equipment appraisal profession to cast off some of its perceived outmoded methodology. Also, the void caused by this approach would enable the profession to easily integrate into its thinking and use some of the techniques of the cost engineering profession. This could be accomplished while still satisfying the joint needs of the appraisal client, third party readers, and acceptable appraisal standards.

Standard #7 of USOP is dedicated to the appraisal of personal property which includes machinery and equipment. This standard indicates that:

> In developing a personal property appraisal, an appraiser must be aware of, understand, and correctly employ those recognized methods and techniques that are necessary to produce a credible appraisal. (USOP 5)

The writer does not wish to give the impression that he is advocating changing the Uniform Standards of Professional Appraisal Practice. However, the standards do not dictate that the "recognized methods and techniques" of the past must remain the same forever. Things change and what was once considered to be good and acceptable may no longer be attractive. A "credible appraisal" should be our primary goal and the recognized methods and techniques may need to change to obtain the ultimate goal.

II C. Old And Present Appraisal Methods:

> Those Rules of old discovered, not devised,
> Are Nature still, but Nature methodized;
> Nature, like Liberty, is but restrained
> By the same Laws which first herself ordained.
> (POPE)

It seems that the factors that contribute to the reluctance to accept new and faster appraisal methods emanates from what has apparently been handed down for generations. More specifically, the difficulties arise from the need to rigidly define what exactly constitutes an acceptable machinery and equipment appraisal listing. Numerous writings have discussed the appraisal report itself of which the field inventory, or listing, section is a portion. For example, in his work The Appraisal Report, John J. Hulten broadly indicates that a good appraisal report must have the following characteristics:

> 1. The report must consider all pertinent data.
> 2. The report must relate the information set forth in it to the estimate of value.
> 3. The report must be intelligible to the client, whether he is a layman or a professional.
>
> An appraisal report that meets these requisites will be acceptable and will carry weight not only with the client but, in case of dispute, with assessors, right-of-way agents, and even opposing counsel in pre-trial hearings. [7] (HULTEN 197)

These points seem simple enough, yet in practice they can often become a barrier to new outlooks, approaches and

methods. Such barriers indirectly pyramid countless formalities and structures on the appraisal process. Excessive restraints tend to put the appraiser in a constant overload situation. This is especially true when they take on the nature of exhaustive exercises emanating out of real or perceived standard methods of operation. Leonard M. Cowley has shown particularly good insight into this matter. When addressing the composition of an appraisal and the situation of the appraiser assigned to perform the appraisal Mr. Cowley indicated that:

> ... the appraiser more often than not, when he receives an important assignment is caught "flat-footed." He has to start from scratch. He thinks of the detailed investigations involved, the tremendous amount of paper work, the long hours of mathematical computations, and he is overwhelmed. He may sometimes feel that he is confronted with a high wall which he must ascend without the aid of rope or ladder. Thus, he embarks on the assembling and processing of his data concerned more with the prodigious amount of paper work which lies ahead of him than with the problems of valuation itself. (COWLEY 27,28)

The writer believes that it really does not need to be this way. We can take steps to change our methods to eliminate such misdirection of efforts. The question is, what steps can we, or should we, take?

For a variety of reasons including time, money, perceived simplicity, etc., we often push for standardization and conformity. We become comfortable and at

ease with the familiar. We begin making each of our appraisals look like all of the others and like those of everyone else. It becomes easier to conform than to strike out on a new and untried approach. Over ten years ago Frederick M. Babcock appealed to appraisers to change the standards of education as well as their outlook relative to conformity. In the following, he very clearly stresses the need to eliminate the routine approach to appraising:

> Appraisers seem to be hungry for specific special education. Unfortunately the training function tends to be absorbed into either on-job training or informal classes conducted by practitioners. The result is reliance on forms and rigid directions that nullify the appraiser's own thinking and tend to stylize and standardize procedures to a degree that stagnates technical progress. I implore you to avoid ritualism in our profession and to throw your weight into real high-level formal appraisal education.
>
> ... Rote methods will often completely miss the goal. There is no single correct way to appraise. Any logical line of reasoning properly related to the purpose of the appraisal is a correct method.
>
> ... Primary interest is in the correctness of the estimate rather than compliance with a standard process, presentation of adequate documentation or performance as a good and convincing witness. (VAL22 9-11)

Based on the writer's personal experience, the Valuation Sciences curriculum of Lindenwood College has admirably undertaken the charge to find a solution to the educational question posed by Mr. F. Babcock. In the

Valuation Sciences curriculum the student is exposed to the thought processes and other numerous aspects that need to be considered when performing an appraisal. The student is taught to understand how changes in many things as well as the economy and the environment can impact the appraisal and the valuation process. Therefore, the logic of the appraisal process is acquired rather than only learning structured mathematical approaches.

Unfortunately, as mentioned earlier, the writer's review of several recent appraisals indicate that in the practicing machinery and equipment appraisal environment, we have not heeded his call to avoid emphasis on the routine. It seems that over the years, the machinery and equipment segment of the appraisal profession has allowed itself, or the evolution of the recognized methods and techniques, to become too structured. Such structuring gives the impression, right or wrong, that the machinery and equipment appraisal profession is no longer interested in devoting the proper time to the valuation process. Instead, individuals in and out of the machinery and equipment profession have expressed their concern to the writer that they believe that the profession has become more concerned with the detail and "beauty" of a long and exhaustive listing process. They contend that the advent of increased use of computers, and especially word processing programs, have fostered the use of longer and

longer appraisal reports containing more and more superfluous data. With some reservations, the writer is inclined to agree with these contentions. Let's look at a few other precepts that form the basis of such an opinion.

According to standard #S.R. 7-2-a of the USOP:

> In developing a personal property appraisal, an appraiser must ... adequately identify the object(s) to be valued ... (USOP 20)

In what may be considered as an expansion of the USOP standard, the ASA has listed some suggested minimum appraisal standards. Noteworthy as being applicable to the discussion at hand are the following:

> Machinery and Equipment---The identification criteria involved in M/E appraisals include:
> (a) Machine Unit data: manufacturer's name, location, specifications, permanent identification number; number, size, capacity or type; machine name, identification; standard or extra auxiliaries, attachments; drive arrangement type.
> (b) Prime Mover data: electric, hydraulic, pneumatic, steam.
> (c) Installation data: controls, millwright work; foundations.
> (d) Owner's Identification: Inventory.
> (e) Record data: physical, functional, economic. (VAL. XXX 60-64)

In addition to these minimum standards, it has been the writer's experience that the most renowned, cited and accepted published appraisal work for machinery and equipment is ASA Monograph #2. If you talk to anyone

knowledgeable about the ASA standards as well as about the practice of appraisal of machinery and equipment, they will invariably be familiar with this monograph. In it the proper methodology for listing machinery and equipment is explained as follows:

> The appraiser should describe each item of machinery in such manner that will prove understandable to the average reader of the report. The description should include:
> A. Name of item.
> B. Manufacturer's name.
> C. Model number or style number.
> Type.
> Size and/or capacity.
> Serial Number.
> E. Type of motor drive - H. P. - Class - Phase - Speed (explosion proof motors should be so noted).
> F. Modifications, attachments, accessories.
> G. Controls - Local Wiring - Local Piping. (ASA-2:12) [8]

While this is an excellent work, in the writer's opinion, it falls very short of the needs of a wide variety of machinery and equipment appraisals.

We can further see how the infinite detail listings continue to be expounded. About six years after the above, i. e. in 1975, when discussing insurance values, Francis L. Gorka stated:

> To obtain replacement costs on equipment, it will again be necessary to prepare a detailed survey. This will involve listing each piece of equipment with sufficient information as to manufacturer, type, model numbers, serial numbers, capacity, etc. Information must also be obtained on the installation costs of equipment. ...

> In some cases, the survey will include each foot of pipe or wire installed, but in other cases only, the major pieces of equipment will be detailed ... (VAL 22-13). [9]

Gorka's work is mainly addressed to appraisal methodology as it applies to insurance appraisals. The writer will concede that under certain circumstances, many of which are strictly limited to insurance appraisals, there is the possibility of a need to list "each foot of pipe or wire." We are not however discussing insurance appraisals here. We can, on the other hand, draw a conclusion from the remarks about insurance appraisal methodology. From them we can easily see how such detailed listings have evolved to a point where they are the commonly recognized and accepted methods of practice for all appraisals. However, the writer is not convinced that the adoption of such exhaustive listing policies have significantly improved the appraisal process. What appraiser, in today's fast-paced business and appraisal mode could actually physically measure "each foot of pipe ..." or harder yet, "each foot of ... wire" in a chemical process plant facility?

Certainly, the writer does not assume to be more knowledgeable or experienced than many of his predecessors. However, his research has failed to uncover any resources that have specifically addressed the different appraisal needs of a process plant listing and the

subsequent estimation and valuation founded upon such a listing. To the contrary, the research did reveal that the old methods of detail listings continue on and on, ad infinitum. For example, in his very recent discussion of "Cost Estimation for M & E", Dr. Richard Rickert has restated the above as follows:

> The essential steps in estimating the cost of machinery and equipment are four:
> 1. List all individual items, including the systems or production "trains" in which they function;
> 2. Establish their prices or costs, whether buyer's reproduction, or replacement cost;
> 3. Calculate the percentage of depreciation and then the effect on value for each item;
> 4. Add the estimated costs of each item, for a total.

So far, so good. This four step process appears to be general enough to allow a great deal of maneuverability. But, reader beware. Here we go again. As the listing process is expanded upon by Dr. Rickert we see another repetition of all the prior standards and methods. His expansion of the above further informs us that:

> Listing includes identifying and stating the essential description of the property: the generic and manufacturer's name; model and owner's tag number; type, size and capacity; type of power or drive; accessories and controls; foundation; the assets of any associated system in which the property functions; age and condition (see ASA2 33-43) ... (VAL9 38-39). [10]

A quick reading could render the opinion that the

expanded version may be considered to be generic enough to possibly apply to a vast array of machinery and equipment appraisals. However, closer scrutiny and interpretation reveals that the expanded version merely restates all of the older concepts. It doesn't offer any specific guidance to apply to the broad field of machinery and equipment that continually confronts many machinery and equipment appraisers. Perhaps Step 1, i.e. "List all individual items, including the systems or production 'trains' in which they function" could be relied upon as being broad enough to cover such a chemical process plant facility. However, the expansion of Step 1 is, in the writer's opinion, too restrictive to apply to a fast paced appraisal mode. A machinery and equipment appraiser has a very difficult task to "list all individual items ..." and still be able to provide a proper and timely response to the needs of the client. For this reason, therefore, the writer has concluded that he can find nothing new here that could easily and rapidly be applied to the estimation of the chemical process plant facility situation as posed herein. Finding this avenue also somewhat lacking, the writer has therefore felt it necessary to continue the search for help.

Where else could we look for guidance? Let's look back at the ASA minimum standards presented earlier. Perhaps, the machinery and equipment appraiser faced with

the task of appraising a chemical process facility could probably stretch these ASA minimum standard guidelines. Through a loose interpretation, it is possible to build upon the line in the ASA guidelines which reads, "The appraiser should describe each item that will prove understandable to the average reader of the report." Here we have a guideline that has enough flexibility in it to allow us to accomplish the desired result. Here we also have a guideline that would agree with USOP. For example, if we had the task of presenting a lathe in a simplified appraisal report, the "average reader of the report" probably could relate to the generic mention of a lathe but may have no point of reference or understanding for a vast assortment of additional technical data and facts such as swing, distance between centers, etc. Similarly, in a process plant facility a reactor is easily associated by its generic description as a reactor but any further details such as material flow, design pressure, etc. may only tend to confuse the <u>average</u> reader. Thus we need a simplified approach. An abbreviated methodology allows for simplification while still providing an easily understandable appraisal report. Admittedly, it does not provide an appraisal report that fulfills all of the details indicated to be required by all of the other presently existing machinery and equipment guidelines. It does however fall within the standards of the

USOP and a loose interpretation of the ASA minimum guidelines.

The point that continues to be stressed here is that there seems to be no recognized and accepted methods for the appraisal listings of machinery and equipment other than those in the works cited in the body of this report. This statement by the writer could be construed to indicate that he is advocating the adoption of another standard method and technique and that by so doing is asking for something that is exactly what he has been opposing. This certainly is not the case. To the contrary, what is being asked is that the appraisal profession reexamine its methods and techniques in such a way to accommodate a more open thinking environment. The thinking, or creative, appraiser should not be unduly criticized for employing different methods or techniques of arriving at his answer merely because these methods have not been formally accepted or recognized by the appraisal profession. Likewise, he should not be chastised when the use of these methods does not, by the nature of their assemblage, always yield an appraisal report that mirrors or conforms to some predetermined or generally accepted standardization. Rather, the profession should strive to achieve the USOP charge to produce a "credible appraisal" while embracing Mr. F. Babcock's theory as cited earlier which indicates that "... any logical reasoning properly

related to the purpose of the appraisal is a correct method." (VAL22 9-11)

II D. An Example:

> Who to a friend his faults can freely show,
> And gladly praise the merit of a foe?
> Blest with a taste exact, yet unconfined;
> A knowledge both of books and human kind:
> Gen'rous converse; a soul exempt from pride;
> And love to praise, with reason on his side?
> (POPE)

The merits of some of the heretofore accepted methodology or techniques as being appropriate for a given unique piece of machinery such as a milling machine have already been conceded by the writer. In conjunction therewith, the writer has also attempted to illustrate the shortcomings in these methodologies and techniques. The critique has been especially hard regarding the deficiency of some of the recognized methods and techniques of not lending themselves very well to other classifications. More specifically, these methodological deficiencies are dramatically exemplified in the listing of a chemical process plant facility which is made up of countless specialty pieces of custom designed pieces of machinery and equipment all interlocked by a maze of piping, electrical, instrumentation, and controls. The writer was unable to uncover any recognized method or technique that would concisely, yet clearly, describe such a facility. There has to be another way to

accomplish a clear, yet brief, listing of a chemical process facility without jeopardizing the professional standards.

To expand on this belief, let's hypothesize that we have been asked to appraise the machinery and equipment of such a chemical process plant facility. Let's also assume that, irrespective of the client's purpose of the appraisal, we have concluded that the objective of the appraisal is to establish the market value. [4] As a consequence of the appraisal objective analysis, we have decided to use the Cost Approach to value. Therefore, as mentioned earlier, the first amount that we need to establish is the cost-to-build or, in appraisal terms, the reproduction cost. If we were to follow most of the generally accepted present machinery and equipment appraisal listing methods and techniques as described earlier, we would list in detail all machinery and equipment, foundations, piping by lines and sizes, instrumentation, and electrical complete with conduit, wire, and switches, etc. It is the writer's contention that these old list-listing methods and techniques are not always necessary. To substantiate this contention, the writer will endeavor to show how acceptable results can be obtained by machinery and equipment appraisers through the use of some of the cost engineering tools explained herein.

To demonstrate and further explain the basic cost

engineering principles which could be used by appraisers to estimate the reproduction costs, a hypothetical dodecylbenzene chemical process plant facility has been chosen and is further reflected in Exhibit II. A dodecylbenzene chemical process plant is a fluid process type facility which produces the main product which is used as an ingredient in soap. For purposes of our example discussion here, and in the interest of brevity and clarity, we will only discuss that portion of the process which may be considered as being battery limits. That is, the battery limits "generally refers to the processing area and includes all process equipment and excludes such other facilities as storage, utilities, administration buildings or auxiliary ..." . [4] The writer will concede that to totally estimate the cost of this facility it would also be necessary to estimate not only the process area but also other support units such as field storage, utilities and administrative buildings normally considered to be outside of the battery limits and which are usually known as offsites. [4] Under most such machinery and equipment appraisals for such facilities these support units would also be included in the considerations and calculations. These could definitely be estimated, valued and included by the use of some of the same cost engineering methodology and techniques herein explained for the battery limits portions of the

facility. However, such a further discourse in the writer's opinion is unnecessary. The reader, once aware of the battery limits concepts, may chose at his discretion to explore in depth the applicability to the support units and offsites.

The cost engineering profession, like most of the engineering professions, has a wealth of published literature concerning a wide scope of technical and non-technical writings. Part of the challenge of this paper was to find a method to convey to the casual reader the many pertinent technical facts that would be used as a basis to support the argument presented herein. One of the most complete works addressed specifically to the subject at hand is the work by Nelson, Kharbanda, Janda, and Black entitled Capital Investment Cost Estimation. It contains a vast amount of information some relevant and some not so relevant here. It was felt that the review of the complete work of Nelson et al. was too large and complex to totally apply to our discussion. Therefore, an attempt was made to simplify their discussion and to concentrate the effort for the reader. As a result, it was felt that only those parts that were deemed by the writer to be particularly applicable to the discussion should be presented. The Nelson et al. work now appears for the reader in Exhibit I in a single condensed version. This method of presentation should

enable the reader, should he choose so, to absorb those parts of background information as a separate entity without disturbing the flow of the primary thoughts and techniques which are the subject being discussed here in the main body.

With the background information in hand, let's return to our hypothetical chemical process plant facility. Very minimal design data is reflected in Exhibits II-A through II-E (pages II-4 through II-16). After its review, many of the "old dog" machinery and equipment appraisers may contend that the minimal data is insufficient to serve as a basis of a meaningful appraisal. However, it will be shown that this minimal information is indeed sufficient to render, in the writer's opinion, an intelligent appraisal decision. To reveal how this is possible, we will briefly walk through the steps of the methodology that may be used to accomplish the task.

Let's also assume that, as a course of this appraisal assignment, we have had the opportunity to visit the plant site as dictated by most appraisals. (The attentive reader will later correctly conclude on his own that the appraisal under worse cases could have also been performed without the benefit of the field visit). While at the site, we are given the one-line process flow sheet (Exhibit II-A) and a listing of major pieces of machinery and equipment. (Exhibit II-E). Note that the process

flow sheet only depicts the major pieces of machinery and equipment. This document also reflects the relationship of the major pieces of machinery and equipment to the process flow as well as their relationship to each other in the process flow. The process flow sheet does not reflect such things as foundations and support structures, distances between pieces, sizes of pieces, interconnecting piping, electrical and instrumentation. In addition, note that the major pieces of equipment that occur on the flow sheet are also listed and briefly described on the major equipment listing. Here too we can see all of the key design parameters for each piece of equipment. The technical data beyond the scope of the key parameters such as welding or bolting specifications, location of manways, type of piping connections, etc, that may or may not have some impact on cost are not listed nor are they needed for our purposes.

While at the plant site we may also make note of some of the other things that may affect the project costs. Among these are such things as complexity and layout congestion, degree of electrical and instrument sophistication, mass of foundations, etc. (In addition, for the depreciation analysis portion of the appraisal we would make notes for all forms of depreciation. Here we would record things like complexity, lay-out congestion, general condition, and other forms of technological,

functional or economic depreciation.) For example, while a spread out or spacious process plant facility will generally require more materials, these additional costs may be offset by savings realized in labor costs. Tight quarters almost always entail more labor costs than those normally experienced for open areas. Productivity increases dramatically in spacious areas and decreases rapidly when workmen are in cramped areas. In addition, complex or what is sometimes termed "spaghetti" piping requires a great deal of expensive field fabrication costs. On the other hand, larger and less complex piping can be fabricated in fabrication specialty shops and its field labor is usually cheaper than the field fabricated piping.

Another factor of growing importance and increasing costs in process plant facilities concerns the degree of electrical and instrumentation, especially computer controlled process instrumentation. This one factor alone is becoming a greater percentage of total project costs. During our field visit, instead of counting and listing all of the piping, electronics, etc. we merely need to note the items by degrees of occurrence such as very complex, highly congested, moderate instrumentation, etc. Such a brief field survey and inventory process should take considerably less time than we would incur if we had listed all of the numerous specific items and details

pertaining to the chemical process facility. The old listing methods which call for recording all items by size and type such as each piece of 2" stainless steel pipe, each reinforced 20' x 20' x 36" foundation, each piece of MCM electrical conduit, etc. would no longer be required.

Now, back in our offices, we can proceed to the estimating of the costs of each of the major pieces of equipment. According to Dr. Rickert:

> ... Where possible, confirmed new prices should be used as a base. There are numerous manufacturer's and seller's catalogs and price lists, plus written and direct quotations of prices, price guides for specific industries, invoices, trade and industry publications, appraisal libraries and other electronic data basis (See Marston et al. 110-138). (VAL9 42)

The writer is in agreement with the above in theory. However, in practice, an appraiser may have many difficulties along these lines. First, as has already been mentioned, the confirmation of all of the prices is very, very time consuming. Second, Dr. Rickert's "Where possible" usually becomes impossible when the task of equipment pricing involves a chemical process plant facility. With the type of machinery and equipment used in a process facility it is highly likely that very little of the above-mentioned resources will be available to the appraiser. Incomplete data alone will cause most vendors

to be hesitant to provide quotations. If, on the other hand, we were fortunate enough to have all of the pertinent design data for each piece of machinery and equipment, most of the vendors would still be reluctant to quote. They are understandably rebellious about misusing their time to make quotations on items that they have no chance of ever turning into a future sale. Along these same lines, the pricing difficulties are further compounded by the fact that published consumer or end user price lists are almost non-existant. The nature of the machinery and equipment in a chemical process plant facility is such that it does not lend itself to published price lists. The machinery and equipment design parameters vary too much from one piece to another. Design pressure, size, function, materials of construction etc. all come into play to make the situation even more complex. For example, just try to find a published consumers' price list for pieces of machinery and equipment such as reactors, heat exchangers or distillation columns. All of these variable factors cause machinery and equipment of this type to take on a nature of custom items which are difficult to price in any industry.

In order to survive, a machinery and equipment appraiser is usually a saver of all sorts of pricing information. Hopefully, through experience and with a certain amount of good luck, he may have accumulated some

of the necessary pricing information in his library. However, such a library is difficult to accumulate for all of the assorted sizes and configurations that occur in the realm of chemical process industries. Through the years the machinery and equipment appraiser may have amassed some pricing data for a limited number of unique pieces such as reactors, heat exchangers or distillation columns. This pricing will probably only be for a very narrow range of specifications which may or may not be exactly like the ones being appraised. Sometimes, adjustments to account for differences are possible. Sometimes, the differences are too great to be feasibly accounted for purely through gross adjustment allowances. With the help of personal contacts that he's acquired through the years combined with some good luck, he may find a way out of his pricing problems. Ultimately, however, he will have to rely on several different sources and many different libraries. After all of this, it is very likely that he still will have obtained only a very small portion of the necessary confirmed machinery and equipment pricing information. Faced with these problems, where do we go from here?

Fortunately, armed with only an equipment list similar to that as described in Exhibit II we can still proceed to perform our own pricing. Numerous cost-capacity curves are available for this purpose. Some of these are

included here as Exhibits II-F through II-M and these serve as the basis for this example. By interpolation we can establish all of the prices of the various major pieces of equipment. If we use old or non-current cost-capacity curves, as we have done here, we can escalate the values through the generally accepted use of cost indexes. [4] [11] [12] (NELSON). The pricing that we have established for our hypothetical chemical process plant facility from the cost-capacity curves is reflected in Exhibit II-N (page II-25). After we have this pricing sector finished, we can press on.

The remaining components that need to be priced include such direct cost items as site preparation, foundations, piping, electrical, instrumentation, process structures and installation. To these we must add allowances for indirect cost items such as field and/or home office overheads, engineering and start-up costs. [4] Current generally recognized machinery and equipment methods and techniques dictate that all of these items be detailed, itemized and individually priced. However, the writer is recommending a change to, or expansion of, these recognized methods and techniques. In the procedure that we are using, all of this laborious effort will not be required. In lieu thereof we will rely solely on some of the factor estimating methods that are discussed in Exhibit I.

When the factor estimating method is used, the pricing of the major pieces of machinery and equipment serves as the basis to establish all of the other prices of the process plant facility. That is, all of the components of a process plant facility that are not included in the pricing of the major pieces of machinery and equipment is accounted for in a factor which is established as a percentage or multiple of the major pieces of machinery and equipment. This should not be misconstrued as a so-called fudge-factor. To the contrary, these factors have been established through historical costs in much the same manner as all of the other direct cost factors. Miller's work cited earlier emphasized the development of such costs. In it he explained:

> ... refinements have come from a more scientific study of the anatomy of capital costs, breaking them down into like components, and finding cost patterns that reflect their individual behavior. (MILLER 1)

Therefore, the underlying principle of factor estimating lies in the fact that all of the ancillary components of a process facility are directly related to the size and mix of the major pieces of machinery and equipment. Furthermore, the pieces of machinery and equipment are in themselves related to the product and design capacity of the subject process plant facility. For example, as a tank or pump gets larger and larger, so too does the

other direct cost components such as foundations, interconnecting piping and electrical. In the same manner, the indirect costs trend along with the direct costs. However, this relationship is not one of a straight-line. Instead, the costs occur in an exponential pattern. For example, a 5000 gallon capacity tank may require a 24" thick reinforced concrete foundation but a 10,000 gallon capacity tank does not generally require a foundation that is two times that of the 5000 gallon tank. Instead of a 48" thick foundation, or two times 24", the required foundation for the 10,000 gallon tank may only be 36". 36" is thus a factor increase of only 50%, not 100% as would be reflected if the increase was strictly on a straight-line basis. Likewise, as design capacities increase, the machinery and equipment size parameters also increase.

As we would now expect, these machinery and equipment increases, as well as their direct costs, also follow exponential patterns. These relationships are generally reflected in cost-capacity curves which are plotted on log-log graph paper. Examples of such curves may be found in Exhibit II. It also follows that as the machinery and equipment design capacities increase, the direct costs for foundations, piping and electrical also increase. Likewise, all of the related indirect costs that service this machinery and equipment increases.

These increases, like all of the others, are also exponential.

There are volumes of published data pertaining to factor estimating. Exhibit I as included here will serve the casual reader well as a primer. As mentioned earlier, it simplifies not only the discussion about how to use factor estimating but it also briefly discusses some of the pros and cons of each method. The reader will readily see from the information in Exhibit I that each method approaches the problem of insufficient or minimal data in a somewhat different way. For the purpose of our example, we have arbitrarily chosen three different factor estimating methods. The calculations for each method are reflected in Exhibit II-O through II-Q which are summarized in the narrative portion of Exhibit II.

As we can see in the summary of Exhibit II, the three values established through the use of these factor estimating methods vary by less than 10%. To verify the accuracy of these total estimated amounts we would need to have much more information and/or do a considerable amount of work. One manner of checking would be to have all of the actual costs that had been incurred to construct the same facility. Another method could be used if we were fortunate enough to have all of the detail information available. From this degree of detail we could prepare an item by item estimated cost to

construct. However, neither of these options would result in an answer that was 100% accurate. Through some rather sad lessons, the writer's experience with construction costs has taught him the unfortunate fact that even so-called actual costs are often misleading. Many recorded and unrecorded things happen during the construction phase of all projects that can have enormous impacts on the costs incurred. As to the estimation of all of the individual pieces, the result may render a number that may or may not be more accurate and/or it may even fit within a smaller range. However, we must remember that the rendered number is still only an estimate. The estimation or forecasting of actual costs of so many items can still yield an erroneous answer. This is due to the fact that in this type of estimating it is necessary to properly apply estimated costs for all of the pieces and categories of work. All items must be properly addressed by type, size, and material of construction. This could include many different types of work such as machinery and equipment, foundations, framework and structures, piping, insulation, electrical, and instrumentation. For example, the task of estimating the field electrical work for a chemical process facility equipment could include consideration and pricing of all of the components as shown in the following Table No. 1.

Table No. 1

COMPARISON OF INSTALLATION TIME---1 1/2-IN. CONDUIT SINGLE VS PARALLEL RUN

Operation	HOURS PER 100 FT. Single Conduit	Parallel Run
1. Study Time, Ordering, & Checking	.40	.15
2. Unload and Deliver to Storage.....	.40	.35
3. Moving from Storage to Point of Installation	.40	.35
4. Laying Out Runs and Measuring for Nipples	.90	.50
5. Setting Up and Handling Tools	.30	.10
6. Cutting Conduit -- Incl. Measuring 3 cuts per 100 Ft.	.80	.70
7. Threading -- Incl. Necessary Cleaning 5 Threads per 100 Ft.	2.40	2.20
8. Installing Conduit (not including ells & offsets)	2.50	2.00
9. Installation Elbows and Couplings 2 per 100 Ft.	.80	.70
10. Offsets -- Making and Installing	1.75	1.40
11. Connections at Pull Box or Cabinets , 2 per 100 Ft.	.35	.30
TOTAL	11.00	8.75

Source: ELEC 36.

The procedure to estimate all of the infinite component

details as exemplified in Table No. 1, like all estimating procedures, could still yield totals that differ significantly from the actual costs that were incurred.

The writer felt the need to experiment with the adaptability of factored estimating to the appraisal of machinery and equipment in a chemical process facility. Therefore, in spite of the many pitfalls cited, five major and five minor appraisals of chemical process and process related facilities were tested using both the detailed and factored estimating methods. The result of this test is shown in Table No. 2.

Table No. 2:

Facility Type	Estimated RCN (Millions $)		$ Delta	% Delta
	By Factors	By Details		
Ammonia	17.0	16.5	-.5	- 3
Toluene	8.0	7.6	-.4	- 5
Formaldehyde	6.1	6.7	+.6	+10
Fatty Acids	4.5	4.8	+.3	+ 7
Nitric Acid	3.3	3.6	+.3	+ 9
Gas Absorp.	2.0	2.2	+.2	+10
Solvent Rec.	1.5	1.6	+.1	+ 6
Bulk Storage	1.2	1.3	+.1	+ 8
Blending	1.0	1.1	+.1	+10
Total	44.6	45.4	+.8	+ 2

Note: All amounts rounded.

While this may not be a very large sample for a test of this nature, the writer believes that it was ample to yield a positive conclusion. The detailed estimate and the factored estimate results varied from each other by approximately plus 10% or minus 5% . The detailed estimates generally yielded higher numbers while the factored estimates generally yielded lower numbers. It is felt that this sample was performed under "normal" estimating and appraisal conditions in that all of the pertinent detail was not available. The writer wishes to emphasize that this sampling has not been offered as a scientific example. It had not been tested from the viewpoint of rigorous scientific sampling methods and techniques. The writer believes that the variety of facilities included in the sample do implicitly reflect the adaptability of the method being recommended to other types of process facility machinery and equipment appraisals. The writer also believes that the samples that he has executed are sound enough to justify the recommendation to use ranges as an appraisal value in lieu of one specific amount. The uses of ranges will be discussed later.

We can see from Exhibit I some of the ranges of accuracy that may be expected from the use of factor estimating techniques. We could refine this estimating process somewhat by also initiating some computer

simulations to ascertain the degree of risk in our estimated amounts. In risk analysis:

> The user of a risk analysis program can assign probability distributions to most any function which could be quantified. These functions might represent the cost of concrete, the cost of labor, the rental of construction equipment, the cost of fuel etc. Risk analysis programs offer a way to evaluate the accuracy of estimates for new projects ... (DOYLE 93-96)

The writer has had the opportunity to use such risk analysis in the past. In some cases it has been immensely successful while others have been disastrous. Just like all other tools, risk analysis can be misused and abused. Users and interpreters of risk analysis programs need to keep one important thought before them, this being that it is only a tool that combines a combination of art and science. It is difficult to statistically and accurately predict the confidence of an estimate which is itself an educated guess or opinion. In light of the experiences of the writer, risk analysis can have too many subtleties and ramifications to include in this report. The writer has therefore chosen to exclude any further ventures down this path. This choice was made also after seriously considering the ability to prepare a valid risk analysis study based on the information presently before us. This problem was compounded by the lack of access to a suitable computer and related computer risk analysis program.

Based upon experience and the results of the test mentioned above, the writer is of the opinion that the exclusion of such a risk analysis study does not become a serious shortcoming nor does it seriously affect or detract from the points being emphasized herein.

II E. Recommendations Based Upon The Sample:

> Alike fantastic, it too new, or old:
> Be not the first by whom the new are tried
> Not yet the last to lay the old aside. (POPE)

Now one might ask how the procedures and techniques described affect the recognized appraisal methods and techniques that has evolved over time. The writer believes that there are several significant points that could be adapted to further the machinery and equipment appraisal discipline.

First, and probably the most obvious, is the need to change, or expand, the recognized methods and techniques for appraisal listings. A simple appraisal listing for the chemical process plant facility described herein could read as follows:

> One (1) Dodecylbenzene process facility with a design capacity of 100,000 tons/year located at Anywhere, U.S.A. and including those major pieces of machinery and equipment listed in Exhibit II E.

This description fully describes the facility and

conforms to the USOP requirements to "adequately identify the objects to be valued." A 100,000 tons/year dodecylbenzene process facility fully describes the machinery and equipment required to make the product. By further stating the plant location the machinery and equipment appraised becomes unique by product, design capacity and location. In addition, the major equipment listing that is presently included here as Exhibit II-E could be included in the exhibit section of the appraisal report as is or, if so desired, even in a more abbreviated version. To further the description, a copy of the process flow sheet and, if available, a copy of the site layout could also be included in the report. In the writer's opinion, this sort of listing fulfills all of the needs of an appraisal report and conforms to the USOP standards even though it doesn't conform to the minimum requirements of the ASA as cited earlier. To further elaborate and describe all of the other components such as each piece of pipe, each motor by number, each instrument etc. ad infinitum serves no useful purpose. As mentioned earlier, clients generally don't need, nor do they want, such reports. The recommended description as indicated above therefore better accomplishes the USOP standards that the report not be misleading in the marketplace or to the public.

Second, the writer believes that the acceptance of

cost engineering techniques as described herein will enable the appraiser to spend more time considering the value of the process machinery and equipment instead of the countless hours that are now required to price all of the assorted individual components. If we strive toward the acceptance of some of the cost engineering techniques, then our machinery and equipment appraisal reports would merely need to state that the reproduction cost was established through such methods. The reports will still be required to meet the professional standards of practice which state:

> Each written or oral ... appraisal report must:
>
> b) contain sufficient information to enable the person(s) who receives or relies on the report to understand it properly;
>
> h) set forth the information considered, the appraisal procedures followed and the reasoning that supports the analysis, opinions, and conclusions. (USOP 5 and 6)

To fulfill these requirements machinery and equipment appraisers will need to find clear and explicit language to explain the cost engineering techniques that have been used in the appraisal. In time, the appraisal profession and its readers would come to fully understand the meaning and limitations of such methods and practices. As a logical consequence, eventually certain simplified and

concise explanations would evolve. These would succinctly impart to the appraisal report reader the underlying principles which were employed in the preparation of the appraisal.

II F. Opposing Views:

> Avoid Extremes; and shun the fault of such,
> Who still are pleased too little or too much.
> At every trifle scorn to take offence,
> That always shows great pride, or little sense;
> Those heads, as stomachs, are not sure the best,
> Which nauseate all, and nothing can digest.
> Yet let not each gay Turn thy rapture move;
> For fools admire, but men of sense approve:
> As things seem large which we through mists descry
> Dulness is ever apt to magnify. (POPE)

One point of disagreement may arise from those appraisers who object to the differences in appraisals that will occur through the use of different techniques and methodologies. Inevitably there will be individuals who resist change merely because it is a change. Others will claim that their clients have grown accustomed to lengthy and detailed reports. Others will object to the factors as being less than accurate. Still others will completely dismiss the possibility of reporting appraisal values as ranges as opposed to one amount.

In rebuttal the writer asks the following question of all appraisers. What is it that compels appraisers (and here we are not only talking about machinery and equipment appraisers) to believe that we are so accurate

that we can exactly predict one specific estimated price, or even one subsequent value prediction? According to the Code-of-Ethics of the ASA:

> ... it is the appraiser's obligation to determine the appropriate and applicable numerical results with as high a degree of accuracy as the particular objectives of the appraisal necessitate.
>
> The procedure and method for determining the particular value in question is a matter for the appraiser himself to determine - he cannot be held responsible for the result unless he has a free hand in selecting the process by which that result is to be obtained. However, good appraisal practice requires that the method selected be adequate for the purpose, embrace consideration of all the factors that have a bearing on the value, and be presented in a clear and logical manner.
>
> Some appraisal engagements call for the determination of a probable range of value or estimated cost, either with or without a collateral statement of the most probable figure within that range. It is entirely within the scope of good appraisal practice to give a range of value of estimated cost.
>
> Inasmuch as the appraiser's determination of the amount of a value or an estimated cost cannot, by its very nature, be exact, it is good appraisal practice to append to such numerical results a statement as to the degree of reliability to be accorded thereto. Such reliability estimates are usually expressed as plus and minus percentages. (COE 3, 7, 9)

Unquestionably, the above permits the practice of using ranges when it is deemed necessary or appropriate. Their use is already built into the ethics by which we are all to abide. Still, they are almost never used. But, as the writer has endeavored to point out, they should

probably be used more often. If we would begin to use a range of values, with stated expected accuracy limits, then our clients would also begin to accept this as a legitimate approach to appraising.

So what have we proven? We can accomplish several important things through the use of factor estimates. One gain is that we can arrange the presentation of our work in more easily read and better understood fashion for our clients and other readers. Here we have shown how our newly recommended report listing can be used without jeopardizing our professional standards and code-of-ethics. The other gain, and maybe more important, is that we can, through the use of factor estimating, or similar more efficient methods and techniques, still arrive at mathematically acceptable prices. We have shown in Exhibit II that the more efficient methods and techniques work in an acceptable manner. We can also see from the information provided in Table #1 that the more efficient methods and techniques work on other projects as well. Here we must be careful to not misconstrue "more efficient" as a negative approach. Instead, we have a positive gain in the fact that the time saved through the use of such more efficient methods and techniques can then be redirected to better ends. The more efficient approach enables us to allot additional time to the more important task of establishing the values

through the assorted methods of estimating depreciation, searching for possible market sales, etc. In any case, there has to be something of merit in either or both of these advantages. The proof will only come through time and the continued use and experimentation of the principles in conjunction with actual appraisals.

II G. Summary and Conclusion:

> Be sure yourself and your own reach to know,
> How far your genius taste, and learning go;
> Launch not beyond your depth, but be discreet,
> And mark that point where sense and dulness meet.
> (POPE)

In summary, the author recommends that appraisers be more aggressive in their thinking. The comments offered have not been lodged disparagingly against the appraisal profession. Instead they were intended by the writer to assist the advancement of the appraisal profession. The writer intends to continue to press for the use of any means that will further the cause. Hopefully the material offered herein has brought to the forefront some of the problems that the writer believes to currently exist in machinery and equipment appraisals. We in the appraisal profession must act in some fashion on our own. If we do not, pressure from clients and other third parties will cause the appraisal profession to react in a manner that may not be entirely acceptable. The

suggestions and alternatives offered here could help defuse this situation.

The material offered herein has attempted to reveal what the writer considers to be new, yet acceptable, methods and techniques for estimating and establishing the reproduction costs of certain types of machinery and equipment. In addition, new procedures have been recommended for machinery and equipment appraisal report listings. To further cite Frederick M. Babcock:

> Appraisal techniques, like the techniques in any profession, change from time to time. Currently there is much reexamination of appraisal methods and questioning of outmoded techniques. An appraiser should be encouraged to develop and use methods that are inherently logical and should avoid adherence to rote appraisal methods. (VAL 22, 12).

These words, although over ten years old, are still appropriate today. Hopefully this paper will reflect the writer's personal desire to question outmoded techniques and to further the adoption of new and more logical methods instead of merely using the old rote appraisal methods.

> Nature affords at least a glimm'ring light;
> The lines, though touched but faintly, are drawn
>
> And still the more we give, the more required;
> Whose fame with pains we guard, but lose with ease,
> Sure some to vex, but never all to please;
> 'Tis what the vicious fear, the virtuous shun,
> By fools 'tis hard and by knaves undone! (POPE)

NOTES

1. It is necessary to preface this paper with the fact that the writer has indirectly learned that a new Machinery and Equipment text is presently being written. The writer has not been fortunate enough to be made privy to any of its contents. Hopefully, it will contain many of the points discussed herein and will subsequently make mute the subject of this paper.

2. American Society of Appraisers' (ASA) Monograph #2 suggests the following definition for machinery and equipment:

> ... the physical facilities available for production, including the installation and service facilities appurtenant, together with all other equipment designed for or necessary to its manufacturing and industrial purposes, regardless of method of installation, and not excluding those items of furniture and fixtures necessary for the administration and proper operation of the enterprise. (ASA 2:3)

Richard Rickert in Valuation offers us more clarity to this definition. His expansion states:

> There are other definitions of machinery and equipment to which the reader can defer (3). The above definition is in current use by appraisers doing corporate-industrial valuations. "M & E", to use the common phrase, includes the following classifications:
> - Production tools and tooling of all kinds
> - Office furniture and fixtures
> - Data processing equipment, such as

computers, printers, and graphic display components
- Substations, transformers, bussing, conduits, ducts, switches and wiring for electrical power systems
- Plumbing lines and equipment
- Piping for production processes
- Laboratory and test equipment
- Motor vehicles, including non-licensed plant vehicles - Construction components in progress, with facilities
- Concrete foundations for machinery, slabs, and fencing
- Engineering drawings, patterns
- Other general plant and office equipment. (VAL 9:40-41)

Current appraisal assignments for machinery and equipment generally do indeed include many of the items covered by the expanded listing as described by Rickert. The writer prefers to accept the definition as expanded as it is more current, more all-inclusive and helps to clarify for the reader the vast realm and broad scope of machinery and equipment.

3. These two professional organizations, i.e. The American Association of Cost Engineers (AACE) and The American Society of Appraisers (ASA) will be mentioned repeatedly throughout this paper and will subsequently be listed in their abbreviated form. The headquarters of each of these are as follows:

- American Association of Cost Engineers, 308 Monongahela Building, Morgantown , WV. 26505-5468

- American Society of Appraisers, P.O. Box 17265, Washington, D.C. 20041

4. The following relating to various terminology and definitions are offered to assist the reader who may not be familiar with all of them and also to add clarity and understanding.

On March 11, 1984 the American Society of Appraisers Machinery and Equipment Committee voted unanimously to adapt the following definitions to be used and taught to machinery and equipment appraisers:

- Reproduction Cost: Is the current cost of duplicating an identical new item. (See additional comments at Note #5)

- Replacement Cost New: Is the current cost of a similar new item having the nearest equivalent utility as the property being appraised. (See additional comments at Note #5)

- Fair Market Value: Is the amount expressed in terms of money that may reasonably be expected to exchange between a willing buyer and a willing seller with equity to both, neither under any compulsion to buy or sell, and both fully aware of all relevant facts, as of a certain date.

- Fair Market Value in Place: (in use) Is the Fair Market Value of an item including installation and the contribution of the item to the operating facility.

- Fair Market Value in Place: (not in use) Is the fair market value of the item installed, not in operation, but capable of being used.

- Liquidation Value: The estimated gross dollar amount which could be typically realized at a properly advertised and

conducted public auction held under forced sale conditions, and under present day economic trends.

- Orderly Liquidation Value: The amount of gross proceeds which could be expected from the sale of the appraised assets, held under forced, orderly sale conditions, given a reasonable period of time in which a purchaser(s) considering a completed sale of all assets, as is and where is, with all sales made free and clear of all liens and encumbrances.
- Liquidation Value in Place: An amount of money which is projected to be obtainable, considering the present marketplace, assuming that the entire facility would be sold intact along with all related equipment necessary to make it viable. It further considers that FMV as normally defined, could not be obtained due to restrictions of time and probable condition of the business under forced sale conditions.
- Insurable Replacement Cost: Is the replacement cost new of the item after deducting the cost of the items specifically excluded in the policy, if any.

The following terminology which is mostly used by the AACE has also been used herein:

BATTERY LIMIT- comprises one or more geographic boundaries imaginary or real, enclosing a plant or unit being engineered and/or erected, established for the purpose of providing a means of specifically identifying certain portions of the plant, related groups of equipment or associated facilities. Generally refers to the processing area and includes all process equipment, and excludes such other facilities as storage, utilities, administration buildings or auxiliary, unless so specified.

BURDEN - In construction, the cost of maintaining an office with staff other than operating personnel. Includes also federal, state and local taxes, fringe benefits and other union contract obligations. In manufacturing, burden sometimes denotes overhead.

CAPITAL, COST OF - The weighted average of (1) the after-tax cost of long term debt, (2) the yield on any outstanding preferred stock, and (3) the cost of common equity capital. Usually expressed as a percent.

CAPITAL, FIXED - The total original value of physical asset which are not carried as a current expense on the books of account and for which depreciation is allowed by the Federal Government. It includes plant equipment, building, furniture and fixtures, transportation equipment used directly in the production of a product or service. It includes all costs incident to getting the property in place and in operating condition, including legal costs, purchased patents and paid-up licenses. Land, which is not depreciated, is often included. Characteristically it cannot be converted readily into cash.

CAPITAL, DIRECT - Cost of all material and labor involved in the fabrication, installation and erection of facilities.

CAPITAL, INDIRECT - Costs associated with construction but not directly related to fabrication, installation and erection of facilities. Can be broken down into field costs (temporary structures, field supervision) and office costs (engineering, drafting, purchasing and office overhead expenses).

CONTINGENCIES - Specific provision for unforeseeable elements of cost within the defined project scope; particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur. If an

allowance for escalation is included in the contingency it should be as a separate item, determined to fit expected escalation conditions of the project.

CONSTRUCTION COST - The sum of all costs, direct or indirect, inherent in converting a design plan for material and equipment into a project ready for operation, i.e., sum of field labor, supervision, administration, tools, field office expense and field purchased material costs.

COST ENGINEER - An engineer whose judgement and experience are utilized in the application of scientific principles and techniques to problems of cost estimation, cost control, business planning and management science.

COST INDEX (PRICE INDEX) - A number which relates the cost of an item at a specific time to the corresponding cost at some arbitrarily specified time in the past.

ESCALATION - The provision in actual or estimated costs for the increase in the cost of equipment, material, labor, etc. over those specified in the contract, due to continuing price level changes over time.

ESTIMATE - An evaluation of all the cost of the elements of a project or effort as defined by an agreed-upon scope. Three specific types based on degree of definition of a Process Industry Plant are:

1. Order of Magnitude Estimate - An appropriate estimate made without detailed engineering data. Some examples would be: an estimate from cost capacity curves, an estimate using scale-up or down factors, and an approximate ratio estimate. It is normally expected that an estimate of this type would be accurate within plus 50 per cent or minus 30 per cent.

2. Budget Estimate - Budget in this case applies to the Owner's Budget and not to the Budget as a

project control document. A budget estimate is prepared with the use of flow sheets, layouts and equipment details. It is normally expected that an estimate of this type would be accurate within plus 30 per cent or minus 15 per cent.

3. Definitive Estimate - As the name implies, this is an estimate prepared from very defined engineering data. The engineering includes as a minimum, fairly complete plot plans and elevations, piping and instrument diagrams, one line electrical diagrams, equipment data sheets and quotations, structural sketches, soil data and sketches of major foundations, building sketches and a complete set of specifications. This category of estimate covers all types from the minimum described above to the maximum definitive type which would be made from "Approved for Construction" drawings and specifications. It is expected that an estimate of this type would be accurate within plus 15 per cent and minus 5 per cent.

INDIRECT COSTS - (1) In construction, all costs which do not become a final part of the installation, but which are required for the orderly completion of the installation and may include, but are not limited to, field administration, direct supervision, capital tools, start-up costs, contractor's fees, insurance, taxes, etc. (2) In manufacturing, costs not directly assignable to the end product or process, such as overhead and general purpose labor, or costs of outside operations, such as transportation and distribution. Indirect manufacturing cost sometimes include insurance, property taxes, maintenance, depreciation, packaging, warehousing and loading. In government contracts, indirect cost is also calculated as a fixed percent of direct payroll cost.

IN-PLACE VALUE - A value of physical property, i.e., market value plus costs of transportation to site and installation.

LABOR COST, MANUAL - The salary plus all fringe benefits of construction craftsmen and general labor on construction projects and labor crews in manufacturing and processing areas which can be definitely assigned to one product or process area or cost center.

LABOR COST, NON-MANUAL - In construction, normally refers to field personnel other than craftsmen and includes Field Administration and Field Engineering.

LABOR FACTOR - The ratio between the manhours actually required to perform a task under project conditions and the manhours required to perform an identical task under standard conditions.

OFFSITES - General facilities outside the battery limits of process units, such as field storage, utilities and administrative buildings.

OVERHEAD - A cost of expense inherent in the performing of an operation, i.e., engineering, construction, operating or manufacturing which cannot be charged to or identified with a part of the work, product and asset and, therefore, must be allocated on some arbitrary base believed to be equitable, or handled as a business expense independent of the volume of construction. Plant overhead is also called factory expense.

VALUATION OR APPRAISAL - The art of estimating the fair-exchange value of specific properties. (AACE-Terms)

The following definitions are offered in addition to the above.

COST APPROACH - A set of procedures in which an appraiser derives a value indication by estimating the current cost to

reproduce or replace the existing structure, deducting for all accrued depreciation in the property, and adding the estimated land value. (DIC 75)

MARKET VALUE -The most probable price as of a specified date, in cash, or in terms equivalent to cash, or in other precisely revealed terms, for which the specified property rights should sell after reasonable exposure in a competitive market under all conditions requisite to fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self-interest, and assuming that neither is under undue duress. Fundamental assumptions and conditions presumed in this definition are:

1. Buyer and seller are motivated by self interest.
2. Buyer and seller are well informed and are acting prudently.
3. The property is exposed for a reasonable time on the open market.
4. Payment is made in cash, its equivalent, or in specified financing terms.
5. Specified financing, if any, may be the financing actually in place or on terms generally available for the property type in its locale on the effective appraisal date.
6. The effect, if any, on the amount of market value of atypical financing, services, or fees shall be clearly and precisely revealed in the appraisal report.

[American Institute of Real Estate Appraisers, The Appraisal of Real Estate, 9th ed. (Chicago: American Institute of Real Estate Appraisers, 1987), 17.]

The Dictionary of Real Estate Appraisal also indicates: Persons performing appraisal services which may be subject to litigation are cautioned to seek the exact definition of market value in the jurisdiction in which the services are being performed. (DIC 194, 195)

5. It is the writer's opinion that the use of the terms "Replacement Cost" and "Reproduction Cost" are often confusing. The following is offered as an attempt to help clarify this confusion:

> It should be noted here that among most Machinery and Equipment Appraisers, the terms Reproduction Cost and Replacement Cost are synonymous. The difference between the two terms, as most Real Estate Appraisers use them, does not exist for the Machinery and Equipment Appraiser. The reason for this is the fact that many items of Machinery and Equipment cannot be reproduced; they can only be replaced. In order to establish the Reproduction Cost New of an item of machinery and equipment, the appraiser must go to the "Market Place"; that is, he must secure from the manufacturer the present day cost of replacing the appraised item or its nearest equivalent model. (ASA 2:13)

In a recent glossary draft Dr. R. Rickert includes these terms with explanations as follows:

> REPLACEMENT COST:
>
> THE COST OF A SUBSTITUTE, EQUIVALENT IN UTILITY, FUNCTION, DESIGN AND MATERIALS. IN OTHER WORDS, THE COST OF A PROPERTY AS GOOD AS, BUT NO BETTER THAN THE PROPERTY REPLACED. (Babcock 145)
>
> The replacement might be a duplicate or an equally good substitute. If the replacement comes from and is representative of market, this cost should be the same as market value. This type of cost is found in appraisals for insurance purposes. The replacement cost might be constructed or purchased on the market.

REPRODUCTION COST:

THE COST OF PRODUCING AN IDENTICAL SUBSTITUTE, IDENTICAL IN FUNCTION, UTILITY, DESIGN AND MATERIALS.

This type of value is needed in event of a loss of a property or of constructing it new. (RR 56)

For purposes of the discussions here, the writer has chosen to discuss the theories presented from the standpoint of reproduction cost. That is, the costs that will be estimated are the "costs of constructing it new." It may be possible, but not likely, to be able to assemble a given chemical process plant facility from the market place. Therefore, this report relies on the ASA definition which discounts any difference between the two definitions as it pertains to machinery and equipment appraisals. This discounting also sets up a free interchangeableness of the two terms. Thus, the writer asks the reader to consider all use of the terms reproduction or replacement cost to apply to the cost of constructing an item new.

6. Substantiation of the reasoning for not delving deeply into the complex discussion of depreciation can be found in numerous works. The writer has chosen to rely upon works already cited. For example ASA Monogram #2 states:

No matter what method the appraiser chooses for estimating cost, and assuming a reasonably proper application of the