

8. MATERIAL

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8.1 OVERVIEW OF MATERIAL

This chapter addresses the terms, concepts, and issues involved in analyzing and understanding material costs.

Table 8-1 provides a list of terms and definitions of common material items.

Material costs include the costs of such items as raw materials, parts, subassemblies, components, and manufacturing supplies whether purchased or manufactured by the contractor, and may include such collateral items as inbound transportation and in-transit insurance. In computing material costs, consideration should be given to reasonable overruns, spoilage, or defective work (unless otherwise provided in any contract provision relating to inspecting and correcting defective work).

[FAA AMS Toolbox Guidance T3.3.2D.2.23 (Contract Cost Principles)]

Table 8-1. Material Terms

Term	Definition
Raw materials	Materials in a form or state requiring further processing before they can be used.
Parts	Items that when joined with other items are not subject to disassembly without destruction or impairment of use.
Subassemblies	Self-contained units of an assembly that can be removed, replaced, and repaired separately.
Components	Relatively simple hardware items which are listed in the specifications for an assembly, subassembly, or end item
Manufacturing supplies	Items that are required by or in support of the manufacturing process.
Inbound transportation and in-transit insurance	Freight, express, cartage, insurance, and postage for goods purchased, in process, or delivered which can be added to the cost of an item or as an Other Direct Cost (ODC).

8.2 MATERIAL SUBMISSION REQUIREMENTS

Material costs should be the acquisition costs for the material items adjusted for any extra charges, discounts, or credits. When practical, the contractor should charge or credit adjustments directly to the material cost rather than applying the adjustments to an indirect cost pool. As with any accounting policy, a contractor should consistently follow its material costing policy. The Screening Information Request (SIR) should request that the contractor submit a Bill of Materials (BOM) identifying the required material item and showing the source, quantity, price, and the basis for determining the price.

8.2.1 Choosing the Vendor Source

The contractor may choose a vendor source by competitive or noncompetitive methods or may decide to make the item instead of purchasing it. If noncompetitive methods are used, the contracting officer may request cost or pricing data to be submitted if cost analysis will be performed. The contracting officer might set a threshold stating that supporting documentation is requested for all purchases exceeding the threshold. However, when vendors are selected through adequate price competition, cost and pricing data shall not be requested (in accordance with FAA AMS, section 3.2.3.3.1.1). Finally, when an offeror decides to make rather than buy an item, the rationale for this decision should be submitted.

Competitive Source Selection

Contractors will be exempted from providing cost and pricing data if the vendors were selected based on the existence of adequate price competition. When vendor selection is based on price competition, the contracting officer may request that the contractor describe and support the degree of competition and the basis for establishing the source and a reasonable price. The FAA can then determine if a contractor meets the adequate price competition exemption in regards to material purchases. Material vendors may also claim exemption from the requirement to submit cost and pricing data if the proposed prices are 1.) based on catalog or market prices, 2.) set by law or regulation, or 3.) commercial items [FAA AMS, section 3.2.3.3.1.1].

Catalog or Market Price Exemption

Catalog price. To qualify as an established catalog price, the proposed price should be recorded in a form regularly maintained by the vendor. This record should be published or available for inspection and should state the current or most recent prices offered to the general public. Any material item offered should be the same or similar to commercial items with similar terms and conditions regarding quantity, delivery, and quality.

Forms of Catalog Data:

- Catalog
- Price list
- Schedule
- Other verifiable and established record

Market price. The term market price refers to a supply and demand situation in which there are many sellers and many buyers willing to exchange items at a given price. Market prices usually exist for items that are generic in nature and not unique to the seller. For example, when the FAA purchases personal computers, there are dozens of different vendors who can provide essentially the same product. The price offered to the FAA will be fairly consistent from vendor to vendor as a result of an established and competitive marketplace. Before the market price exemption can be allowed, the existence of a market

must be verified. Price quotations from multiple vendors do not demonstrate the existence of a market, i.e., the price should be supported by evidence from sources other than the vendor. There are several sources to verify that a market exists: current advertisements containing the price, trade publications, information supplied by other known users, and vendor furnished purchase orders from other buyers.

NOTE:

Any difference between a proposed material item price and a catalog or market priced commercial item should be identifiable and justifiable using price analysis techniques without resorting to cost analysis.

Commercial items, as defined in FAA AMS, Appendix C (Definitions), may include, but are not limited to:

(A) Any item, other than real property, that is of a type customarily used by the general public or by nongovernmental entities for purposes other than governmental purposes and that has been sold, leased, licensed to the general public; or has been offered for sale, lease, or license to the general public.

(B) Any item that evolved from an item described in paragraph (A) through advances in technology or performance and that is not yet available in the commercial marketplace, but will be available in the commercial marketplace in time to satisfy the delivery requirements under a government solicitation.

(C) Any item that would satisfy a criterion expressed in paragraphs (A) (B) of this definition, but for (i) modifications of a type customarily available in the commercial marketplace; or (ii) modifications of a type not customarily available in the commercial marketplace made to meet Federal government requirements.

(D) Any combination of items meeting the requirements of paragraphs (A), (B), (C), or (E) of this definition that are of a type customarily combined and sold in combination to the general public.

(E) Installation services, maintenance services, repair services, training services, and other services if such services are procured for support of an item referred to in paragraph (A), (B), (C), or (D) of this definition, and if the source of such services (i) offers such services to the general public and the Federal government contemporaneously and under similar terms and conditions; and (ii) offers to use the same work force for providing the Federal government with such services as the source uses for providing such services to the general public.

(F) Services of a type offered and sold competitively in substantial quantities in the commercial marketplace based on established catalog or market prices for

specific tasks performed under standards commercial terms and conditions. This does not include services that are sold based on hourly rates without an established catalog or market price for specific service performed.

(G) Any item, combination of items, or service referred to in paragraphs (A) through (F), notwithstanding the fact that the item, combination of items, or service is transferred between or among separate divisions, subsidiaries, or affiliates of a contract; or

(H) Any item determined by the procuring agency to have been developed exclusively at private expense and sold in substantial quantities, on a competitive basis, to multiple state and local governments.

Prices Set by Law or Regulation

When a contractor bases the claim for exemption on prices set by law or regulation, the contractor should cite the regulating authority and the set price. Utilities are usually governed by local or regional government. State or Federal agencies often regulate freight rates, franchised carriers, and protected commodities. Some areas have local “fair trade” laws. Because the federal government is generally not subject to these fair trade prices, advice of legal counsel may be required when a claimed exemption is based on a “fair trade” law.

The contractor is exempt from submitting cost or pricing data if the laws or regulations directly apply to the procurement being made by the FAA. Even though a vendor may sell its product to regulated customers, the price of the vendor’s product is not considered to be regulated, and the vendor will not be subject to the exemption. The following is an example of a vendor selling to a regulated unit.

EXAMPLE:

The Remington Steel company sells cable to electric companies. The FAA would like to purchase some of these cables. Remington Steel claims that the price of cable is regulated because the Southern Electric Company includes the cost of the cable in justifying its rates. The price of cable is included in a regulated price, but the price of the cable itself is not regulated. Remington Steel will need to provide further information.

Noncompetitive Source Selection

Noncompetitive source selection requires much more scrutiny. In addition to providing the basis for source selection and establishing a reasonable price, the contractor must submit any relevant cost or pricing data for the prospective source when required by the contracting officer.

Any subcontractor required by the solicitation to submit cost or pricing data should submit the information requested as part of the prime offeror's initial proposal. The vendor or subcontractor may submit the data directly to the Government if the company considers the data proprietary. (Subcontractors may be reluctant to submit rate information to the prime contractor.) Vendor or subcontractor cost data should arrive at approximately the same time as the prime offeror's proposal. In addition to submitting vendor or subcontractor cost or pricing data, the prime contractor should perform its own analysis on the subcontractor prices and cost inputs and submit its findings with its own cost or pricing data.

A complete analysis of subcontract cost or pricing data may be required by the Government in addition to the analysis performed by a prime or higher-tier subcontractor. The contracting officer is still responsible for determination of the overall price reasonableness, and as subcontract prices comprise an element of that price, analysis of subcontract data may be required. The following are examples of situations when cost and/or price analysis of the subcontractor proposal may be appropriate:

- The business relationship between the contractor and subcontractor is not conducive to independence and objectivity;
- The contractor is a sole source and the subcontract costs represent a substantial part of the contract;
- The contractor has been denied access to the subcontractor's records; (This is the most common reason for a full Government cost or price analysis of a vendor or subcontract proposal. If a vendor or subcontractor submitted its cost or pricing data separately, then there is a good chance that they will deny access to the prime or higher tier subcontractor.) or
- The contracting officer determines that, because of factors such as the magnitude of the proposed subcontract price, an analysis is integral to the overall detailed analysis of the prime contract proposal.

Make or Buy Decisions

A make or buy decision is when the contractor decides which material items to purchase and which to manufacture. The decision made by the contractor affects contract cost and contract performance. The analyst should review the contractor's make or buy decisions to determine if they are reasonable and result in the lowest cost to the FAA.

Whether the make or buy decision is reasonable depends on the contractor's

policy and the motivation behind the decision. If the contractor has established policies and procedures regarding make or buy decisions, the analyst should determine whether these policies were followed. If not, the analyst should determine why the policies were not followed and whether the deviation from policy is appropriate. Regarding contractor motivation, the analyst should be aware of two considerations, other than lowering FAA cost, that may have influenced the contractor's decision to make an item instead of buying it. One consideration is that the contractor may wish to gain experience in a certain manufacturing process. Another consideration is the use of currently idle facilities. If the analyst notices either of these, the analyst should determine if the decision to make results in any additional costs to the FAA.

To determine if the make or buy decision results in the lowest FAA cost, the analyst should compare the cost of manufacturing the item to the cost of buying the item. The cost of manufacturing the item can be obtained from the contractor's proposal by adding together the cost of raw materials and the labor required to convert those materials to a finished item. The cost of buying the item can be obtained from purchase orders (if the item was purchased in the past), from vendor quotes, or from other sources provided by the contractor. The analyst needs to appropriately build up the costs of the two options, using overhead costs for labor and raw material in the make option and those applicable to purchased material for the buy option. If the cost of making the item is greater than the cost to buy it, the analyst should alert the contracting officer.

Interorganizational Transfers

Interorganizational transfers are materials sold or transferred among a prime contractor's divisions, subsidiaries, or affiliates that are under common control. Interorganizational transfers usually appear in a proposal as part of material costs but may appear as an Other Direct Cost (ODC) or as a distinct cost element.

The Government's preferred method for transferring material within an organization is at cost because this makes pyramiding profits impossible. Pyramiding profits result when a division sells a unit of material inclusive of profit to another division such that the final price is increased and the increase is compounded due to multiple profit applications before final sale to the Government or end user.

Interdivisional transfers at cost are considered the standard, but transfers of commercial work can be at other than cost when it is the contractor's established practice to make transfers at other than cost and the transferred item's price is based on 1.) established catalog or market prices of commercial items or 2.) adequate price competition. The contracting officer may rule that

the resultant price is unreasonable and, therefore, unallowable, if the practice caused the final price to be excessive.

8.2.2 Material Costs

Bill of Materials

The **Bill of Materials (BOM)** is the primary factual tool used for estimating and analyzing the cost of materials. It helps relate the material prices to the proposed effort. The more information included on the BOM, the more useful it is to the analyst. At a minimum, BOMs usually list the individual material items, the number of units, and the unit and extended prices. Sometimes contractors list the basis of the estimate, such as vendor quote or purchase history, on the BOM. How much information a contractor must include on the BOM depends on what is required in the solicitation or what is requested by the contracting officer.

A priced **Bill of Materials (BOM)** is a detailed list of materials which includes the source, the part number and nomenclature, location in which part is used, the quantity, the price, and possibly the scrap allowance factor.

A Bill of Materials is typically arranged in one of three formats: 1.) materials are listed in order by part number; 2.) materials are listed according to the corresponding contract line item; or 3.) materials are listed according to value at an extended price level, from the most expensive item to the least expensive item. There may be separate bills of material for each cost center (engineering, manufacturing etc.) involved in a particular project, or there may be a consolidated Bill of Materials that incorporates all the material costs for the project. A consolidated Bill of Materials listing material items by value is usually preferred by the analyst.

In addition to the basic cost of material items, several miscellaneous costs often accompany a contractor's total material estimate. Miscellaneous costs typically included in contractor proposals are contingency costs in the form of allowances for unknowns, price escalation, scrap and spoilage, and obsolescence. Note that various contractors may have different names for the above factors. If a contractor proposes a factor that is different than those detailed in subsequent paragraphs, consider the following:

- Does the factor make sense in regard to the type and scope of effort? In other words, is the factor reasonable?
- Is there adequate supporting historical data? (sufficient sample of relevant performance data)
- Is the factor computed correctly?
- Are all applicable offsets (such as scrap resale credits) considered?

- Is the contingency that the factor covers likely to occur in the current contract? What is the probability?

Price Escalation

Price escalation is often included in material costs to adjust for inflation or industry-wide increases. There is a more fundamental issue to resolve, however, before analyzing the contractor's escalation calculations. Is the escalation justified? Not all prices increase over time. Inflation varies depending on industry and the product within the industry. For example, computer prices usually decrease over time because a constant influx of new technology renders existing computers obsolete within the span of a few years. Therefore, in this case, escalation may not be reasonable or justified.

If escalation is proposed, the contractor should provide information regarding the basis for the escalation rate. The basis could be a published index, a composite of several indices, or contractor experience. The Producer Price Index (PPI) is an example of a widely used published index. The PPI, which is published by the Bureau of Labor Statistics, lists products by commodity groups and individual items. For each commodity group, subgroup, and individual item, the PPI lists an index number. These index numbers provide a basis for analyzing and comparing the escalation rate used by the contractor. Trade and industry publications are other possible sources for obtaining appropriate data to evaluate proposed escalation rates.

Scrap and Spoilage

Scrap is personal property that has no value except for its basic material content. Scrap items are a byproduct of a normal production process. Spoiled items are a by-product of human error within the normal production process. Depending on the contractor's accounting system, scrap and spoilage can be included as a direct cost, a factor of material cost, or as an indirect cost. Therefore, an allowance for scrap and spoilage may be presented through the use of scrap and spoilage factors (as a percentage of overall materials) or as additional quantities of items to be purchased under the Bill of Materials (BOM). The purpose of scrap and spoilage factors is to create a mechanism for the contractor to cover the expense of replacing parts and materials rendered unusable during the production process.

Independent of scrap's accounting treatment, the contractor should, if possible, physically segregate scrap and spoiled materials from other materials. This makes it easier to identify excessive scrap and spoilage rates. Also, this facilitates proceedings at contract close-out as the contractor can avoid itemizing scrap and spoiled items for close-out inventory schedules if the items have previously been physically separated.

To estimate scrap and spoilage rates, appropriate allowance factors are applied to the overall material cost estimate. An appropriate allowance factor is developed using a **time series chart**, a **scatter chart**, or a **learning curve**. All three methods will track scrap and spoilage over time and show trends which can be used to predict scrap and spoilage costs in the future. Historical costs should support the allowance factor, and the factor should be applied in a method consistent with its calculation.

Time series is a time-ordered data set of observations of a variable taken at successive intervals.

Scatter chart plots values against two numeric scales, e.g., material costs and labor costs.

Learning curve (See section 8.3.1 and Chapter 15, "Quantitative Analysis Techniques".)

When evaluating scrap and spoilage rates, beware of excessive scrap and spoilage or misuse of FAA material. Problems such as these may indicate inefficiencies in the production process. In such instances, analyzing a reasonable scrap and spoilage rate may require input from technical personnel. The FAA is not required to reimburse the contractor for scrap due to a contractor's failure to promptly implement engineering changes or a contractor's failure to suspend production of deficient items. However, it should be realized that very rigid product specifications and frequent design changes will lead to higher spoilage and scrap rates for a given production process.

Also, the FAA should be wary of the contractor buying items from surplus or salvage dealers, especially the repurchase of parts similar to those the contractor has declared as surplus or scrap.

As a means of recovering scrap loss, contractors sell scrap. The FAA should receive credit for any proceeds from the sale of scrap. How scrap is credited depends on how scrap was originally charged. When scrap is charged as a direct cost, proceeds should be credited directly, unless the contractor's disclosed and consistent practice is to charge such amounts to an indirect cost pool. When scrap is an indirect charge, proceeds should be credited indirectly.

Obsolescence

Materials can become obsolete if specification changes or technological advances make their use unnecessary or if the items were purchased in unreasonable quantities. Obsolescence is a factor normally applied to material costs in development type contracts where the material requirements are uncertain and subject to frequent change during the development process. An obsolescence factor will cover the cost of replacing the affected units of material. As with all estimating factors, obsolescence should be based upon past experience and adjusted for nonrecurring or atypical events or costs.

Credit should be given for obsolete material that is returned to productive inventory.

There are several issues to consider when reviewing obsolescence factors and obsolete materials. One issue is potential over-recovery. A contractor that includes an obsolescence factor for engineering changes in its material estimate may over-recover costs if it also includes the cost of obsolete items in an Engineering Change Proposal (ECP). Another issue is that a contractor may either sell the item to a subsidiary or affiliate at a significantly reduced price, or use the item as a no-cost component for commercial work or under a firm-fixed-price or incentive contract. In either case, the FAA would have subsidized the contractor's other work. If either circumstance is discovered, it should be reported immediately to the contracting officer.

When obsolescence costs are proposed, the analyst should determine the following:

- Is there a way for the FAA to recoup all or part of the costs?
- Can the items be used by the contractor on another contract? If so, the contractor should transfer the items at no cost to the FAA.
- Were the obsolete items sold or discarded at a reasonable price, and was the FAA properly credited?

8.3 STANDARD METHODS OF ESTIMATING/ANALYZING DIRECT MATERIAL COSTS

Methods of estimating and analyzing material vary. The selection of a method or combination of methods to use depends on the availability and quality of information. For example, a research and development contract may not have historical data to support the material cost estimate; therefore, the statistical approach would be more appropriate than a priced Bill of Materials. The four basic methods for estimating and analyzing direct materials are:

- The statistical approach,
- Priced Bill of Materials for the procurement,
- Priced Bill of Materials on a preceding item, and
- Projection of average unit material cost on a preceding lot or contract.

8.3.1 The Statistical Approach

The statistical approach may be the only means of projecting material costs when there is little information on which to base the estimate (e.g., in the early stages of research and development). Statistical analysis is usually

employed in one of two forms: a **cost estimating relationship (CER)** or a direct comparison.

Cost Estimating Relationships

The simplest version of the statistical approach is to use CERs to estimate material cost. Evaluating a CER requires determining the validity of the relationship and the data on which the factor and relationship are based. The relationship between material cost and the independent variable should be clear, causal, and supported by historical data drawn from similar situations. In addition, the composition of material being estimated should be similar to that in the historical data used as a basis for the CER.

A **cost estimating relationship** uses a mathematical expression relating cost as the dependent variable to one or more independent cost driving variables. This relationship may be cost-to-cost, such as using manufacturing costs to estimate quality assurance costs, or cost-to-noncost, such as estimating manufacturing costs by the weight (or any other noncost characteristic) of an item.

After a CER is used to estimate material costs for a project and once the project begins production, actual cost data from the project can be utilized to adjust the material cost estimate. Applying actual known costs to an established CER allows the analyst to calibrate a CER to be project specific. The project specific CER will increase the accuracy of subsequent project cost estimates.

A detailed discussion regarding CERs is provided in Chapter 15, "Quantitative Analysis Techniques".

Direct Comparison

Material cost can be estimated using a direct comparison with relevant historical data, e.g., from a previous procurement. The rationale behind a direct comparison is that projects which are similar in effort will also be similar in cost. For a new procurement, an estimator can modify actual costs from a similar project to suit the current situation. For a follow-on procurement, actual costs should be available from earlier work. When using historical costs to project future costs, the estimator needs to ensure that the historical material costs do not contain abnormalities that would skew the estimate. Problems can arise if the new estimate contains errors or variations not present in the original estimate.

In developing a direct comparison, the estimator must establish similarity between the two efforts and note any differences. Improvement in efficiency and differences in complexity may require adjustments to historical data. Improvement exists when an item's per unit cost decreases as more units are produced. Improvement occurs as workers become more familiar with the manufacturing process and perform their jobs more efficiently on later units than on earlier units. This can affect material cost because scrap and spoilage

tend to decrease as the production process improves. Historical information on material cost trends during contract performance can be used to support the development of a **learning (improvement) curve**.

Learning (cost improvement) curve theory states that as the total volume of units produced doubles, the cost per unit decreases by some constant percentage. The constant percentage is the rate of learning and is 100% minus the slope of the curve. Once the slope is known, the curve can project costs into the future.

A detailed discussion of learning curves can be found in Chapter 15, “Quantitative Analysis Techniques”.

A complexity factor attempts to quantitatively measure product differences in relation to the skill, effort, and materials required. Complexity factors can be used to adjust historical costs for such differences in effort. Determining complexity factors generally requires technical support.

8.3.2 Priced Bill of Materials for the Procurement (Grass Roots Approach)

The priced Bill of Materials is used when there is specific information available concerning the parts, quantities, and prices of the materials to be used in a project. It is a commonly used approach, and analysis of quantity and price is usually performed on a sample number of items.

Selecting The Sample

A large proposal may have hundreds of items listed on the Bill of Materials. If the analyst had unlimited time to analyze a proposal and if the value added were sufficient to support the effort, the analyst could scrutinize each item to assess if the proposed quantity and price are reasonable. Since this is usually not the case, statistical sampling becomes a valuable technique. The first task in analyzing a Bill of Materials is to choose between stratified and random sampling.

Stratified sampling involves segregating data into a group that requires 100% analysis and a group or groups that can be analyzed using random sampling. The 100% group may include costs that comprise a substantial portion of the contract’s total material cost (usually 80%) or for high cost items in which an incorrect estimate will have a sizable dollar impact.

Random sampling involves selecting items from a list without regard to the outcome of analysis. Once the analyst decides on the number of items to be selected, a random number table is used to choose the specific items to be analyzed.

See Chapter 15, “Quantitative Analysis Techniques” for a more complete discussion of sampling.

Reviewing The Quantity

Quantity of material items, for all practical purposes, should be a matter of fact. Technical personnel can review engineering drawings and product specifications to verify the material quantities necessary to produce an end item. Proposed material quantities may also include an allowance factor or additional items to account for scrap. Scrap allowance factors may be applied to individual items or to the total bill of material.

Analyzing The Price

Price on a Bill of Materials comes from one of three sources:

- Current vendor price quotes,
- Historical quotes or purchase history for the same item, or
- Inventory value pricing.

Current Vendor Price Quotes

The following key points should be considered when analyzing current quotes:

- **Quotes should reflect the required quantity.** Since vendors often base their price on the number of units being purchased, the quantity on which the quote was based may have an effect on unit price. As a general rule, larger purchases have lower unit prices due to quantity discounts. If the quote does not reflect the required quantity, the analyst should inquire about quantity breaks and should possibly request a quote for the specific quantity.
- **The contractor may negotiate a price reduction.** A current price quote does not mean the contractor will not try to negotiate a lower price for the item. The contractor may have a record of negotiating prices lower than current quotes. Red flags for price reductions are purchase orders for less than quoted prices. If the contractor has negotiated a price reduction, this savings should be passed on to the Government.
- **Terms and conditions of contracts or purchase agreements between the vendors and the prime contractor may result in hidden savings to the contractor.** The prime contractor may receive quantity discount rebates or may have priced options. A priced option is a clause in an existing order allowing the contractor to purchase items at a lower price than the current quote. If this is the situation, the FAA should be charged the lower price. Furthermore, the quoted price may include escalation to adjust for inflation. If escalation is included in the quoted price, the contractor should not

apply any further escalation when pricing the item for the FAA.

- **Commercial prices, historical prices, and Government estimates can be bases for comparison.** Current quoted prices should not differ greatly from previous prices for the same or similar items in similar quantities and under similar terms and conditions.

Historical Quotes

Historical quotes and purchase history are appropriate for a contractor to use when 1.) current inventory cannot be used, 2.) material prices are stable, 3.) there is sufficient lead time to order materials and, 4.) there is not enough time to solicit current quotes. In using historical quotes and purchase history, the contractor has made the assumption that the last price paid was reasonable at the time. If this is an incorrect assumption, the estimated material prices are probably not reasonable. Looking at the contractor's purchasing files may alleviate any doubt as to whether or not historical prices are reasonable.

Also note that historical data from the estimating department may not be as current as the information in the purchasing department. Buyers may have current quotes or prices that the estimator did not use. Since current data are preferable, the analyst should double-check to make sure that current quotes or prices are not available.

The following key points should be considered when analyzing historical quotes:

- **Process changes** may lower the amount of material necessary or may allow the contractor to use less expensive materials.
- **Changes in the contractor's purchasing situation** can lead to variations from past prices. Areas where changes occur are sources, quantities, production or delivery rates, start-up costs, and terms of purchase. A part that was previously purchased from a sole source vendor may now have a lower price due to market competition. Parts that were in production when the last purchase was made may no longer be in production. This may result in additional start-up costs. Or, as experienced in an FAA program, a source that sold parts below cost may have gone bankrupt, and the new source sells the parts at much higher prices. These are only a few examples as to how changes in the contractor's purchasing situation can affect material prices.
- **Changes in the general economic situation** can affect material prices. High inflation or deflation or changes in the industry may dramatically change the price of a product. Often contractors will adjust historical quotes for inflation in their material estimates.

Inventory Value Pricing

Inventory value pricing is used when the required material is held within the contractor's inventory. The use of existing inventory may be preferred because the material cost may be less than current market prices and the material can be used immediately.

8.3.3 Priced Bill of Materials on a Preceding Item (Historical Data)

Rather than developing a Bill of Materials from scratch, the contractor may take a Bill of Materials from a preceding item or project and adjust it to fit the new situation. In addition to the analysis described above, reviewing this type of Bill of Materials requires examining additions, deletions, and adjustments. Factors may be used to adjust for changes in material prices or quantities. The factors should be realistic and should incorporate all possible increases and decreases in material price.

8.3.4 Projection of Average Unit Material Cost on a Preceding Lot or Contract

The final method of estimating material is to use the actual average unit material cost as experienced on a preceding lot or contract. In this case, the contractor will determine the average unit material cost for an item and apply that cost to the number of items to be produced under the current procurement. In developing an estimate, the contractor may utilize a token decrease in material costs to account for improvements in production processes, etc. A learning curve is the best tool to evaluate the realism of the contractor's proposed decrease. Provided that historical material costs are normal, they can be used as the basis for determining the slope of an accurate learning curve. Generally, material learning curves fall within the range of 90% to 100% slope.

8.4 INVENTORY PRICING METHODS

As discussed earlier, inventory costing is an acceptable method of material estimation when the material required for the contract is taken from the contractor's existing inventory. The contractor may use one of the following inventory costing methods to arrive at the proposed material price:

- First-in, first-out (FIFO),
- Last-in, first-out (LIFO),
- Weighted average,
- Moving average, or
- Standard cost.

The method the contractor uses for pricing should be consistent with the method used for accounting. Once a company has established a method of pricing inventory, changing to another method must be formally done through a change in the company's written accounting policies (if fully CAS covered). The requirement for a formal change is to restrict companies from casually switching methods based on what is most advantageous to them given the current situation. For example, during periods of inflation LIFO is the ideal method because the highest cost is charged first, leaving inventory at a lower value. On the other hand, during periods of deflation FIFO is preferred for the same reason. Using a weighted or moving average eliminates some of the effects of price fluctuation, but prices are higher than the market value during deflationary periods and lower than market value during inflationary periods. Finally, with a standard cost method, the contractor needs to have a policy for handling variations from the standard or the FAA may be charged an unreasonable amount given the market price.

The analyst should compare the price in the proposal to the cost of items in inventory to verify the reasonableness of the price given the contractor's disclosed accounting practices.

8.4.1 First-In, First-Out

Under FIFO, the oldest material cost incurred is the first charged to a contract. For accounting purposes, material is deducted from inventory in the same order as it was acquired. How material is physically removed from inventory is left to the contractor's discretion, but the value of material costs charged to a project is that of the first units recorded in inventory.

FIFO EXAMPLE:

The FAA solicitation requires 6 units of part Z. The following are material costs in order of receipt:

1/1/XX 5 units @ \$10 each
2/1/XX 4 units @ \$15 each

The FAA will be charged \$65 (5 units @ \$10 each & 1 unit @ \$15).

8.4.2 Last-In, First-Out

With LIFO, the most recently incurred material cost is the first charged to a contract. Material is charged inversely from the order in which it was acquired.

WEIGHTED AVERAGE EXAMPLE:

The FAA solicitation requires 6 units. The following are material costs:

$$\begin{array}{r} 1/1/XX \text{ 5 units @ } \$10 \text{ each} = \$50 \\ 2/1/XX \text{ 4 units @ } \$15 \text{ each} = \underline{\$60} \\ \hline 9 \qquad \qquad \qquad \$110 \end{array}$$

The FAA will be charged \$73 (6 units @ (\$110/9) = \$12.22 each).

8.4.3 Weighted Average

The weighted average method arrives at the cost per unit by dividing the total cost of all units by the number of units. This is a periodic method of calculating inventory. The unit cost will only be recalculated at designated times regardless of how many units are added or subtracted from inventory during that period.

MOVING AVERAGE EXAMPLE:

Project 1 requires 3 units. The following are the original material costs:

$$\begin{array}{r} 5 \text{ units @ } \$10 \text{ each} = \$50 \\ 4 \text{ units @ } \$15 \text{ each} = \underline{\$60} \\ \hline 9 \qquad \qquad \qquad \$110 \end{array}$$

Project 1 will be charged \$37 (3 units @ (\$110/9) = \$12.22 each). The inventory value is now \$73 (\$110-\$37) for the remaining 6 units.

Project 2 also requires 3 units. Project 2 will be charged \$36 (3 units @ (\$73/6) = \$12.17 each).

8.4.4 Moving Average

Moving averages differ from weighted averages in that every time units are added or removed the average unit price is recalculated to reflect the difference.

MOVING AVERAGE EXAMPLE:

Project 1 requires 3 units. The following are the original material costs:

$$\begin{array}{r} 5 \text{ units @ } \$10 \text{ each} = \$50 \\ \underline{4 \text{ units @ } \$15 \text{ each}} = \underline{\$60} \\ 9 \qquad \qquad \qquad \$110 \end{array}$$

Project 1 will be charged \$37 (3 units @ (\$110/9) = \$12.22 each). The inventory value is now \$73 (\$110-\$37) for the remaining 6 units.

Project 2 also requires 3 units. Project 2 will be charged \$36 (3 units @ (\$73/6) = \$12.17 each).

8.4.5 Standard Cost

When the standard cost method is used, unit costs of material are equal to either the expected price for the period or the prevailing price at the time the standard was set. The difference between the acquisition cost and the standard cost is called the variance. Variance adjustments can be applied to a particular job or to an overhead account. To analyze a standard cost, the analyst should review the contractor's purchasing history. The standard cost, plus or minus the variance, should approximate the amount determined using the weighted average method.

8.4.6 Special Inventory Considerations

There are two special types of inventory that an analyst may have to address (or at least be knowledgeable of) in the specialized cases of contract close-out and contract termination. They are residual inventory and termination inventory.

Residual Inventory

Residual inventory refers to material left over at the conclusion of a contract. For a follow-on procurement, a cost savings may result from using residual inventory from the preceding contract. In analyzing the use of residual inventory, the cost to the new contract depends on who holds the title to the inventory. If the FAA owns the residual material, which is usually the case in most cost reimbursable contracts, the material will be a no-cost component of the new contract. In such a case, the analyst should ensure that the contractor

did not include a price for the residual material in the Bill of Materials. When the contractor holds the title, usually in fixed-price contracts, the residual materials are assessed at the lower of cost or market. The analyst should review the purchase order to obtain the original cost of the item and should request a current quote from the vendor for the same item. The price in the new proposal should be the lower of the two prices (i.e., purchase order or current quote).

Termination Inventory

Termination inventory includes any property purchased, supplied, manufactured, furnished, or otherwise acquired for performance of a contract subsequently terminated and properly allocable to the terminated portion of a contract. At the time of termination, the contracting officer may request help from the analyst in determining who has title to which property and the value of that property. Any property to which the Government has title or the right to take title is subject to disposition after a contract termination. Be aware that disposition may entail transferring Government property (which may include materials) to another contract, thereby reducing the cost of the transferee contract. A terminated contractor may also retain property at or below cost or return the property to suppliers. If so, the analyst needs to ensure that the Government is credited the proper amount, thereby minimizing the cost of the Government's settlement of the terminated contract.

More detail on termination inventory is included in Chapter 17, "Termination".

8.5 COST REALISM AS RELATED TO MATERIAL

Cost realism analysis involves making sure that the costs proposed are in line with the effort required. In other words, the costs proposed should reflect the most probable cost to the Government. Cost analysis of material should be performed with the intention of determining realistic prices. In addition to the issues already mentioned, there are a few basic questions to consider which specifically relate to cost realism.

- **Are the proposed material costs consistent with material as required in the technical proposal?** Material in the cost proposal should meet the requirements of the technical proposal. For example, if the technical proposal claims that the contractor is using an assembly process that requires exactly two screws per panel, the material cost should include only this number per panel.
- **Does the contractor accurately understand the contract requirements?** A contractor's poor understanding of contractual requirements and specifications often results in skewed (significantly higher or lower) proposed material prices and quantities.

8.6 SUMMARY

There are various ways of proposing and accounting for material costs. It is important for the analyst to be familiar with the different approaches for purposes of analyzing material. With the recent shift toward purchasing more commercial material, analysis of proposed material relies heavily on catalog or market prices and vendor quotes as sources of information.

