

NAVAL POSTGRADUATE SCHOOL

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THESIS

THE SPARE PARTS COST CENTER CONCEPT
AS A MEANS OF IMPROVING SPARE PARTS PRICING:
A CASE STUDY

by

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**The Spare Parts Cost Center Concept
as a Means of Improving Spare Parts Pricing:
A Case Study**

by

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ABSTRACT

Spare parts pricing by defense contractors has received considerable attention since 1983 when overpricing cases were widely publicized. Efforts to resolve the overpricing problem focused primarily on requirements determination, technical design, source of supply, and cost allocation methods constrained by existing accounting structures. Other methods of improving spares prices might be identified if accounting structures could be varied. This research examines the accounting structure and spares pricing method of a single defense contractor to determine if establishment of a separate spare parts cost center within the cost accounting structure would improve the spares pricing process.

The research determined that the spares cost center does not correct the inaccuracies in spares pricing introduced by the contractor's accounting structure. An alternative cost center structure, using functional cost centers, does provide a potential means of resolving these problems.

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I. INTRODUCTION

A. BACKGROUND

The spare parts procurement process within the Department of Defense (DOD) came under intense Congressional and public scrutiny and news media exposure beginning early in 1983 with the uncovering of specific instances in which DOD contracting officers bought parts at exorbitant prices. Initial explanations of the causes of the problems and assurances by DOD procurement officials that the problems were isolated cases did not satisfy Congress. As Congressional and news media pressure continued to build, DOD began serious efforts to identify and correct the problems which allowed the overpricing to take place. The cases cited in media and Congressional reports associated the problem with current pricing practices. DOD studies had documented the existence of problems with spare parts pricing, exhibiting the same symptoms, in 1963 [Ref. 1: pp. ii,iii]. DOD-wide programs were introduced as early as November 1964 covering breakout of certain spare parts from major systems contracts in order to buy parts directly from manufacturers to obtain lower prices [Ref. 2: p. 84]. This initiative was revised and expanded in June 1983 as one of the early significant elements of a new major spare parts reform effort by DOD. Shortly afterward, the Secretary of Defense issued first, a ten point plan and then, a twenty-five point plan to deal with continuing spare parts pricing difficulties [Refs. 3,4].

Today, over two years after the Secretary of Defense issued his plans, the basic problem, cited in 1963 and again identified in 1983, of pricing parts consistent with effort expended by manufacturers remains to be solved completely. Despite the close scrutiny of spare parts acquisitions by contracting officers, heads of agency contracting activities, requiring activities, and higher levels of management within DOD, defense auditors and Congressional staffs continue to uncover spare parts pricing irregularities. The application, by contractors, of cost allocation formulas to price contract line items, without regard to whether the resultant prices coincide with the intrinsic values of the items, has been blamed in many cases. Aside from creating a negative public image of the DOD contracting process, the problems still surfacing show that the process is not yet conserving scarce spare parts dollars to the satisfaction of Congress or the public. Preliminary investigation by the researcher indicates that past research of spare parts pricing focused predominantly on allocation of costs constrained by the existing accounting structures of defense contractors studied. Additional means, not previously considered, of improving the accuracy of spare parts pricing methods might be identified if the accounting structure could be changed rather than having it act as a constraint on the cost allocation process.

B. FOCUS OF RESEARCH

Many different pricing methods are used by DOD contractors to price spare parts. The spare parts pricing method used by a major defense contractor was analyzed in light of the corporate

accounting structure to determine the impact that establishment of a separate cost center for spare parts would have on the pricing of spare parts under DOD contracts. This spare parts cost center concept calls for reshaping the corporate accounting structure to segregate the spare parts function as a separate accounting element. The spare parts pricing method currently used by the contractor studied, a form of formula pricing, relies upon rates included in a negotiated forward pricing rate agreement to assign portions of indirect costs to each contract line item being priced. Typically, indirect costs are applied as a percentage of all or part of the direct costs or labor hours used in the manufacturing process for the item. For items which are being sold to DOD by a contractor who is not the manufacturer, indirect costs are applied as a percentage of the price paid to the source which provided the item to the contractor. The cost accounting structure drives historical cost accumulation which forms the basis for negotiating forward pricing rates.

C. OBJECTIVES OF RESEARCH

The principal objective of the study was to determine whether the establishment of a spare parts cost center by DOD contractors could be a means of improving spare parts pricing and the image that Congress and the public have of this subset of Government procurement. The researcher sought to determine whether the spare parts cost center could be used to improve the accuracy of historical cost accumulation, would provide a more accurate method of spare parts pricing which still satisfied government

Cost Accounting Standards, and would generate prices which more correctly reflected intrinsic value than current pricing methods.

D. RESEARCH QUESTIONS

The primary research question was:

Would the establishment of a spare parts cost center within the corporate accounting structure improve the process of pricing spare parts so that the ultimate prices charged would be consistent with the contractor's effort to produce them?

Subsidiary research questions were:

1. Would a spare parts cost center fit into the existing corporate accounting structure of the contractor studied?
2. What are the major obstacles to establishing a spare parts cost center?
3. How would costs associated with manufacturing spare parts under a separate cost center differ from costs determined under the current accounting structure?
4. Would such a cost center comply with Cost Accounting Standards?
5. What incentives might be provided to DOD contractors to motivate them to adopt this accounting structure, if feasible and advantageous?
6. What effect would the establishment of a separate cost center for spare parts have on the contractor's ability to recover overhead costs?
7. Would the establishment of a separate cost center for spare parts lead to any cost efficiencies, such as reductions in total overhead costs?
8. What would be the implications concerning present corporate structure and/or management practices of establishing a separate cost center for spare parts cost accumulation?

E. RESEARCH METHODOLOGY

The literature concerning spare parts pricing was studied to determine what cost elements form the current cost base from which price is derived. Interviews were conducted with, and data

obtained from, appropriate representatives of the Naval Supply Systems Command, a major defense contractor and its associated Navy or Defense Contract Administration Service Plant Representative Office and Defense Contract Audit Agency Resident Auditor, and a second defense contractor which recently had conducted extensive research concerning application of a cost center approach to defense contract pricing. Information and data gathered were used to develop a representative structure for the spare parts cost center. This structure was compared to the existing cost accounting structure and the associated spare parts pricing method for the contractor studied.

F. SCOPE OF THE STUDY

Specific areas investigated were the method used to assign costs to each element of spare parts prices by a major defense contractor, the cost accounting structure of this contractor, major obstacles to establishing a spare parts cost center within this contractor's cost accounting structure, and the usefulness of the spare parts cost center as a means of resolving the spare parts pricing problem.

The study did not encompass all pricing methods for spare parts nor all cost accounting systems currently used by DOD contractors. Rather, the pricing method and cost accounting system used by the contractor studied were used as a representative test bed for application of the spare parts cost center concept.

G. LIMITATIONS

The researcher found that much of the cost and pricing information needed to research fully the spare parts pricing methods used by a specific defense contractor was proprietary. The contractor selected for the case study made necessary information available under specific limitations:

1. The contractor was not to be identified in the study.
2. No information was to be attributed to the contractor or its employees in a manner which would permit identification of the contractor.
3. Information was to be disguised sufficiently to prevent identification of the contractor from the format of the information.

Therefore, the defense contractor studied will be identified simply as "the contractor" throughout this thesis.

The researcher agreed to these limitations in order to gain full access to necessary information. The researcher views the limitations to be facilitators of information flow which do not jeopardize the validity of the information or any conclusions drawn from analysis of it. Preparation of the thesis within the bounds of the limitations provides the benefit of permitting unlimited distribution of the study among appropriate parties within both DOD and the defense industry.

The generalizability of this research may be limited by the use of a case study approach in which a single defense contractor's systems and methods are analyzed. However, a 1985 survey of 15 major defense contractors showed 67% using the same basic system of overhead cost allocation as the contractor studied [Ref. 5].

H. ORGANIZATION OF THE STUDY

Chapter II describes the spare parts pricing system used by the contractor, including the individual elements which make up a spare parts price. Cost flow through the contractor's cost accounting system is described in relation to the spares pricing system. Chapter III defines the cost center concept and discusses the application of the spare parts cost center concept, and then, an alternative cost center concept, to the contractor's cost accounting structure and spares pricing function. Chapter IV provides an analysis of the issues presented. The last chapter draws conclusions and makes specific recommendations resulting from the research effort. Summary answers to the research question and subsidiary questions and recommendations for future study complete this chapter. Definitions useful in understanding terminology used throughout the thesis are listed in Appendix A.

II. THE SPARE PARTS PRICING ENVIRONMENT

A. INTRODUCTION

Spare parts pricing methods used by major defense contractors are a reflection of the complexity of modern defense systems which contain thousands of individual parts [Ref. 6:p. 28]. These parts are aggregated into components, subsystems, and, finally, complete weapon systems. Each part has an estimated service life, usually based upon either observation of the part in previous applications or extensive testing during development of the current system. When these estimates of service life for parts are coupled with the planned useful life of the system, program planners can predict the quantities of each part required as initial spare parts to be acquired with the system. As actual parts usage information is generated, after the system becomes operational, replenishment spare parts are purchased in appropriate quantities to keep the system in the desired operational condition and to maintain spare parts inventories.

A defense contractor may be requested initially to provide spare parts as a portion of the contract for delivery of a complete weapon system. The request may consist of thousands of parts which, in today's environment, must be priced individually in a contract bid or proposal. At the other extreme, the follow-on requests, after the weapon system has been fielded, may be for a small quantity of a single item to meet an immediate operational requirement. Formula pricing has evolved as a means by which

defense contractors can deal with these situations. For multiple-item requests, formula pricing provides a mechanism which will allow a contractor to price a large number of line items without the need for detailed individual estimates of each input to the manufacturing process for each part. This results in reduced manpower costs for the contractor and, ultimately, lower overhead costs for the government. For the immediate, single-line-item requests, formula pricing expedites the process of providing price quotations to the government, thus reducing the total time required to restore operational capability of vital weapon systems. From these perspectives, formula pricing provides a frequently desired benefit to the government, in the form of time savings, when compared with a pricing system which requires individual estimates of each element of price for each line item.

B. THE FORMULA PRICING CONCEPT

Formula pricing is a concept designed to avoid the inefficient, labor-intensive process of cost element detailing, starting with the procurement of material and following the part as it goes through manufacturing, inspection, packaging, and shipping. Formula pricing begins with estimated costs of the direct material and direct manufacturing labor needed to produce a part. Total cost results when other direct expenses incident to manufacturing the product, indirect expenses such as material scrappage and material handling, and manufacturing overhead are included. Profit is added to give a proposed selling price. [Ref. 7:p. 8B9]

The key aspect of formula pricing which makes the concept useful and more efficient than detailed estimating is the application

of previously agreed-to factors or percentages for indirect expenses and profit to the material and labor estimated for each part. These factors or percentages are included as part of forward pricing rate agreements which DOD negotiates with most major defense contractors. If estimates of basic costs--materials and labor--are realistic, formula pricing should produce an accurate total price for a large group of items [Ref. 7:p. 8B10]. However, formula pricing has been criticized for two major reasons:

1. The method is unable to price items individually with sufficient accuracy for the prices to stand alone when indirect costs are distributed in equal amounts to each contract line item.
2. Prices resulting from strict application of formulas do not reflect intrinsic value of the items priced.

In one of the early spare parts overpricing cases, DOD paid \$110 each for two diodes available from the Federal Supply System for 4 cents each. This situation resulted from using formula pricing on a request for two line items, the two diodes and six power supplies, bought from a major defense contractor who was not the manufacturer of the parts [Ref. 6:pp. 28-29]. Table I illustrates the manner in which formula pricing was applied to generate the \$110.34 unit price for the diodes. In Example A of Table I, material handling labor costs were charged based upon a pre-negotiated quantity and rate to be applied in an equal amount to each line item being purchased. Although the prenegotiated quantity and rate may have reflected accurately the historical average material handling costs incurred per purchased line item, the use of average costs distorts the price of the relatively inexpensive diodes for which practically no material handling

TABLE I
THE \$110 DIODE

Example A

Material Handling Labor Cost
Distributed Equally Between Contract Line Items

	Diode	Power Supply
Purchased Parts (2/\$.04)	\$.08	(6/\$100) \$ 600.00
Direct Labor Hours 9.0 @ \$18.00 = \$162.00	81.00	81.00
Overhead 94% of Value Added	76.14	76.14
Total Cost Input	\$157.22	\$ 757.14
G&A @ 21%	33.02	159.00
Total Cost	\$190.24	\$ 916.14
Profit @ 16%	30.44	146.58
Total Price	\$220.68	\$1062.72
	-----	-----
Unit Price	\$110.34	\$ 177.12
	-----	-----
Contract Price	-----	\$1283.40
	-----	-----

Example B

Material Handling Labor Cost
Prorated on Basis of Total Purchased Parts Cost

	Diode	Power Supply
Purchased Parts (2/\$.04)	\$.08	(6/\$100) \$ 600.00
Direct Labor Hours 9.0 @ \$18.00 = \$162.00	.02	161.98
Overhead 94% of Value Added	.02	152.26
Total Cost Input	\$.12	\$ 914.24
G&A @ 21%	.03	191.99
Total Cost	\$.15	\$1106.23
Profit @ 16%	.03	176.99
Total Price	\$.18	\$1283.22
	-----	-----
Unit Price	\$.09	\$ 213.87
	-----	-----
Contract Price	-----	\$1283.40
	-----	-----

effort was expended. A reallocation of the same quantity of material handling labor hours on the basis of total purchased parts cost, as in Example B, results in more reasonable and believable unit prices, although the combined total price for both requested line items is the same in either example. The loss of unit price integrity, as in Example A, has been described as "apparent overpricing" as opposed to "real overpricing" since the contractor was entitled under the Cost Accounting Standards and DOD cost regulations to recover the costs included in the distorted unit price [Ref. 6:p. 27]. However, the perception of Congress and the public that contractors were overcharging the government made application of equal allocation methods in conjunction with formula pricing, which caused the unit price distortions, unacceptable.

In February 1984, DOD established a policy which required use of value based cost allocation and prohibited use of equal allocation methods which assigned indirect costs in equal amounts to each part ordered [Ref. 2:p. 30]. Consistent enforcement of this policy should prevent the recurrence of apparent overpricing as described and restore unit price integrity to spare parts included as line items in DOD contracts.

Another aspect of the \$110 diode case and other spare parts overpricing cases examined point to a more common problem which has not been resolved. When pricing formulas are applied to spare parts which the contractor does not manufacture, but buys from vendors or subcontractors, the resulting prices exceed the intrinsic value of the parts. A reasonable approximation of

intrinsic value is the lowest commercial price or the market price for which an item could be purchased in a competitive environment. The implication is that if DOD could buy a part directly from a manufacturer under competitive conditions, DOD normally would pay a price which approximates intrinsic value. In contrast, if the same part is bought by DOD from a major system contractor such as the contractor being studied, who is not the manufacturer, the allocation of additional costs by the contractor to the part would raise the price to some amount above intrinsic value. This increase in price has been estimated to average about 30 percent over a competitive market price. [Ref. 8:p. 19]. For the contractor, this percentage ranges from 7 percent to 38 percent depending upon the type of contract used to buy the parts--either cost plus a fixed fee or firm-fixed price--and the point of delivery of the parts [Ref. 9].

The highly publicized \$436 hammer is an extreme example which illustrates how a spare part price can become distorted from intrinsic value when a major system contractor applies all allowable and allocable costs to the basic price of the part. Table II shows the price of a common sledge hammer growing from \$7 to \$436 as Gould, Simulation Systems Division, applied its pricing formula [Ref. 10:p. 11]

Gould expended little engineering and no manufacturing effort in providing the hammer to the government. Whether the intrinsic value of the hammer increased as the item passed through the contractor's facility is at the heart of the present spares pricing problem. Members of Congress say that the value of the

TABLE II
THE \$436 HAMMER

Gould, Simulation Systems Division
Pricing Example

----- Cost Element -----	----- Hours -----	----- Amount -----
Direct Material		\$ 7
Material Packaging		1
Material Handling Overhead @ 19.8%		2
Engineering Support:		
Spares/Repair Department	10	
Program Support/Administration	4	
Program Management	10	
Secretarial	2	
Total Engineering Support	----- 26	37
Engineering Overhead @ 110%		41
Manufacturing Support:		
Mechanical Subassembly	3	
Quality Control	9	
Operations Program Management	15	
Program Planning	40	
Manufacturing Project Engineering	10	
Quality Assurance	1	
Total Manufacturing Support	----- 78	93
Manufacturing Overhead @ 110%		102
Total Cost Input		----- 283
General & Administrative (G&A) @ 31.8%		90
Total Cost		----- 373
Fee (Profit)		56
Facilities Capital Cost of Money		7
Total Price		----- \$ 436 -----

hammer is still seven dollars, while defense contractor representatives believe that the value of the hammer has been increased by some amount through Gould's efforts. Gould's contribution to the part's value consisted of accumulating a number of tools, including the hammer, to be provided to the government as a repair kit which supported a major weapon system [Ref. 10:pp. 12-13]. A portion of the price increase can be supported by the company's efforts in identifying what tools to include in the repair kit, purchasing the items, and assembling the repair kit. However, most of the price increase is the result of including some amount of all categories of company costs in the spare parts price, even though the incurrence of the costs in some categories was unrelated to the spare parts order. Although the spare parts breakout initiative was intended to resolve this problem, the military services continue to buy many parts from major system contractors, which are not the manufacturers, for a multitude of reasons including security and quality assurance [Ref. 11].

C. THE CONTRACTOR'S SPARE PARTS PRICING METHOD

Spare parts pricing is accomplished by the contractor using a formula pricing method known as complete factoring [Ref. 7: p. 8B12]. This method simplifies the mechanics of pricing by combining all separate factors into single factors for material, subcontract, and labor. The material factor and the subcontract factor are multiplied by the base materials cost and the subcontract materials cost, respectively. The labor factor, expressed in terms of dollars per hour, is multiplied by the direct manufacturing labor hours. The sum of the three resulting dollar amounts is the

proposed selling price. For parts which are not manufactured by the contractor and which require no additional manufacturing effort or testing upon receipt by the contractor from the supplier, the contractor applies only the materials factor or the subcontract factor to determine the proposed selling price. The pricing factors are negotiated prospectively between the contractor and the government (through the Administrative Contracting Officer) using the past three years' historical cost as the basis for the rates. The negotiated factors are formalized in a forward pricing rate agreement which is revised when new direct labor rates, overhead rates, or other element rates take effect. The factor values, but not the elements of cost, vary according to the type of contract to be used by the government to buy the parts. [Ref. 9]

Table III provides a breakdown of the price factors into cost elements and illustrates how the individual factors are summed to generate the single factors used in the complete factoring method. The cost elements included in spare parts prices vary with the source of the parts and with the point of delivery. The source could be either in-house manufacture by the contractor or purchase from a supplier or subcontractor. The point of delivery for purchased items could be either the contractor's facility or the DOD activity which ordered the parts from the contractor.

The increased emphasis within DOD to buy spare parts directly from manufacturers rather than from major systems contractors under the breakout initiative has reduced the numbers of spare

TABLE III
SPARE PARTS COST ELEMENTS AND FACTORS

Cost Element	Manufacturing Factor*	Material/Subcontract Factor**			
-----	-----	-----	-----	-----	-----
Manufacturing	\$ - M	M	--		PC
Engineering	M	M	PD		PC
Quality Assurance:					
Direct Inspection	M	M	--		PC
Other	M	-	--		--
Remote Site	-	M	PD		PC
Overhead:					
Development	M	M	PD		PC
Production	M	M	--		PC
Remote Services	-	M	PD		PC
G&A Expense	M	M	PD		PC
Other Direct Costs	M	M	PD		PC
Special Tooling / Test Equipment Repairs and Maintenance	M	M	--		PC
Material/Subcontractor	-	M	PD		PC
Procurement Overhead	M	M	PD		PC
Common Minor Material	M	-	--		--
Cost of Money	M	M	PD		PC
Total Cost Factor	\$ xxx.xx		x.xxxx		
Profit	M	M	PD		PC
Total Price Factor	\$ xxx.xx		x.xxxx		
	-----		-----		

M : Item manufactured by the contractor.

PD : Item purchased by the contractor and shipped by the supplier to the DOD activity.

PC : Item purchased by the contractor and shipped by the supplier to the contractor.

* Manufacturing factors are multiplied by the estimated (or actual, if known) total direct manufacturing labor hours for the job to obtain the cost for each element.

** Material / Subcontract factors are multiplied by the total cost of materials / subcontracted items for the job to obtain the cost for each element.

parts being purchased by the contractor for direct resale to DOD. The sole category of parts being bought by the contractor for direct resale is made up of system critical items which are not bought from the manufacturer directly by DOD because of necessary inspection and certification requirements which the DOD major system program office requires the contractor to accomplish. Therefore, the largest portion of the contractor's total spare parts business with DOD consists of parts which the contractor manufactures and parts to which the contractor applies additional manufacturing type effort after obtaining the parts from suppliers. The cost elements included in prices for these spare parts are coded in Table III with the letter "M". Cost elements included in purchased parts are coded "PC" for those shipped by the supplier to the contractor and "PD" for those shipped directly to the DOD activity. [Ref. 9]

The pricing method described does not apply to contract proposals which are over \$100,000 in total proposed price or which are for parts that are obtained through intercompany work transfers (ICWT). These proposals are priced using a direct input method which requires individual detailed estimates for manufacturing, engineering, and quality assurance direct labor hours. These estimated hours are multiplied by a predetermined rate for each function. The products are summed to provide a total labor-based cost to which overheads and G&A expense are added at predetermined rates. Overtime premium, special test equipment costs, procurement burden, subcontract material or ICWT

costs, and Cost of money are added to give total cost. Addition of profit or fee yields a total proposed price. The contractor must provide certified cost and pricing data with all proposals over \$100,000. [Ref. 11]

In 1984, the contractor formed an evaluation committee, which includes the managers of finance and material as members, to review pricing proposals for spare parts. This committee is responsible for ensuring that all aspects of the proposal reflect good business practice and that the proposed prices are fair and reasonable. The formation of the committee was a direct attempt to avoid future cases of alleged spare parts overpricing. [Ref. 9] The perceived necessity for such a committee by the contractor adds credibility to the criticisms of formula pricing listed previously.

D. THE CONTRACTOR'S COST ACCOUNTING SYSTEM

The contractor uses an actual-cost, job-order-oriented system of cost accumulation with each job identified by a unique number. Direct costs are charged to the job as incurred. Most direct labor is charged to cost objectives using individual hours and actual individual rates. Direct labor for direct service centers is allocated to final cost objectives on a weekly basis using the average service center labor rate for that week. Appendix B includes a listing of direct service centers along with the major cost elements and allocation base applicable to each center. Principal classes of materials and service costs which are charged as direct materials are listed in Appendix C.

Indirect costs are distributed to each job on a monthly basis from the cost pools in which indirect costs have been accumulated for the past month. The indirect cost pools used by the contractor, the major cost elements included in each pool and the base for allocating each pool are listed in Appendix D. The contractor has three indirect service centers and a number of overhead service centers which are listed in Appendix B. The costs charged to these service centers are redistributed to other indirect cost pools prior to distribution of costs to jobs. On a weekly basis, the contractor generates a work-in-process ledger which lists detailed charges for each job for the week and cumulative charges for each job. Figure 2.1 illustrates the flow of costs from incurrence through the cost pools and ultimately to the job orders. For the purpose of spare parts pricing, these accumulated historical costs become the basis for future negotiated forward pricing rate agreements.

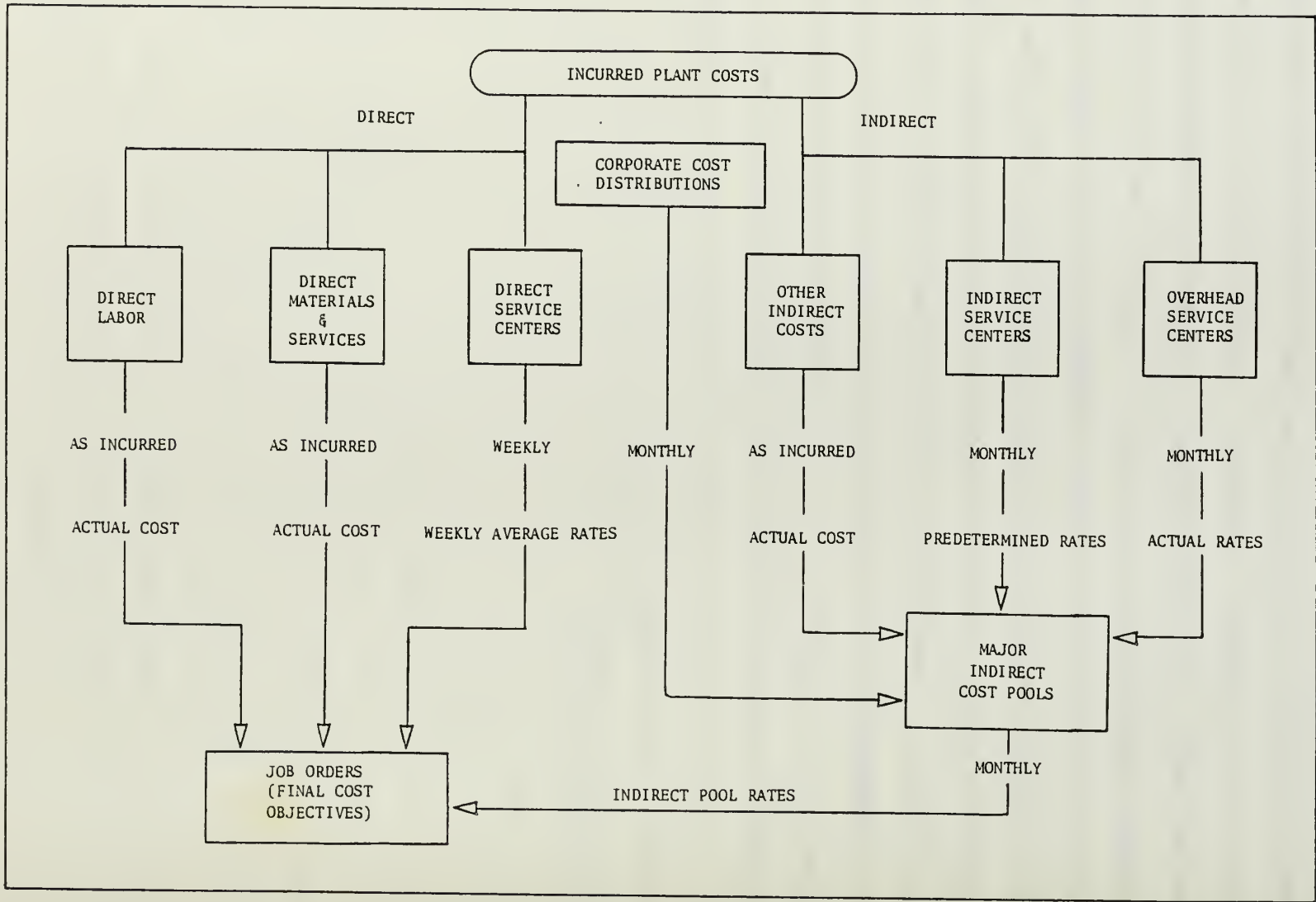


Figure 2.1 The Contractor's Cost Flow

III. THE COST CENTER CONCEPT

A. INTRODUCTION

The cost center, a financial management control structure, is a type of responsibility center. A responsibility center denotes any organization unit that is headed by a responsible manager. It uses inputs--materials, labor, and services--to produce outputs, either goods or services. Normally the transformation of inputs into outputs is facilitated by working capital, equipment, buildings and other assets. The goods and services produced by a responsibility center may become inputs to another responsibility center or may be sold to external customers. [Ref. 12:pp. 194-195]

A cost center, also referred to as an expense center, a cost pool, or, simply, a department, is a responsibility center for which only inputs are measured in monetary terms and the manager is responsible for controlling inputs, that is, costs or expenses. This may be contrasted to a profit center, a type of responsibility center for which both inputs and outputs are measured in monetary terms and the manager is responsible for controlling both costs and revenues. In addition to holding responsibility for cost efficiency, the cost center manager is responsible for the quality of the output and the volume of production. [Ref. 12:pp. 198-199]

The process of dividing a business organization (usually a manufacturing concern) into cost centers or departments to which expenses are charged is referred to generally as departmentalization. Departmentalization is intended to provide more accurate costing

of jobs and products by breaking down company or plant-wide overhead rates into individual departmental overhead rates. Properly established departmental overhead rates avoid distortions to product costs which are introduced when plant-wide average overhead rates are applied. [Ref. 13: p. 171]

The researcher examined two types of cost center arrangements. The first type, consisting of output-oriented cost centers, was based upon the researcher's perception of a spare parts cost center as described by representatives of the Naval Supply Systems Command when the research topic was proposed in February 1985. Under this arrangement, other output-oriented cost centers could be established for the major defense systems as well as any major commercial product lines being produced by the contractor.

The second type of cost center arrangement examined consisted of cost centers categorized by manufacturing method. These cost centers are functionally oriented and coincide with the major methods of manufacturing utilized by a defense contractor. A similar arrangement was proposed in June 1985 by an Air Force Education With Industry team after spending a year with a major defense contractor studying current accounting practices and manufacturing automation [Ref. 14].

B. THE SPARE PARTS COST CENTER STRUCTURE

If operated along conventional lines as described, the spare parts cost center would be the point of accumulation of all costs, both direct and indirect, associated with the production and processing of spare parts. If an assumption is made that the

center is responsible for all spare parts business for the contractor, this center would include three principal categories of spare parts:

1. Parts manufactured by the contractor from raw materials
2. Parts manufactured by subcontractors and then modified by the contractor prior to distribution to customers
3. Parts manufactured by subcontractors and then distributed by the contractor to customers without modification

Figures 3.1 and 3.2 illustrate two possible cost flows for the contractor if cost centers are established within the cost accounting structure according to categories of output, such as major weapon systems and spare parts. Under either of the two structures, direct costs, distributions of service center costs, and most indirect costs (formerly included in indirect cost pools) are accumulated first in the cost centers and then distributed to job orders. For direct costs, actual costs accumulated in each cost center are charged to job orders as incurred. For indirect costs, a set of cost pools, corresponding to those under the current cost accounting system, are needed in each cost center to allow periodic distribution of indirect costs to job orders based upon causal and beneficial relationships between the costs and the final cost objectives. Bases similar to those used in the current accounting system, listed in Appendix D, are suitable for allocating cost center overhead pools to final cost objectives.

A significant feature which distinguishes this cost center structure from the contractor's present accounting structure is the requirement for allocation methods and bases for distributing each category of indirect cost among the cost centers. Developing

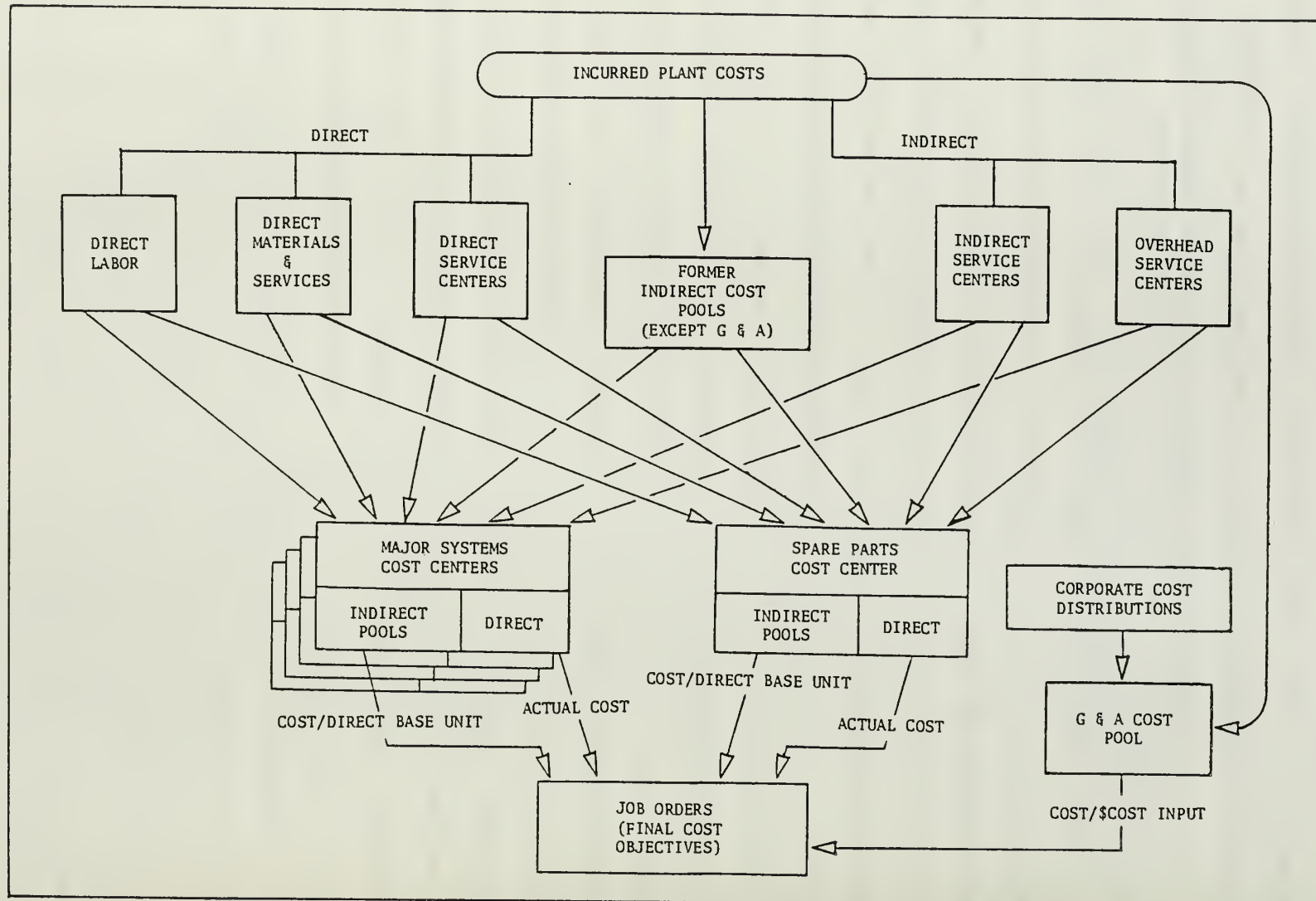


Figure 3.1 Cost Centers Established by Category of Output Within a Single Business Unit

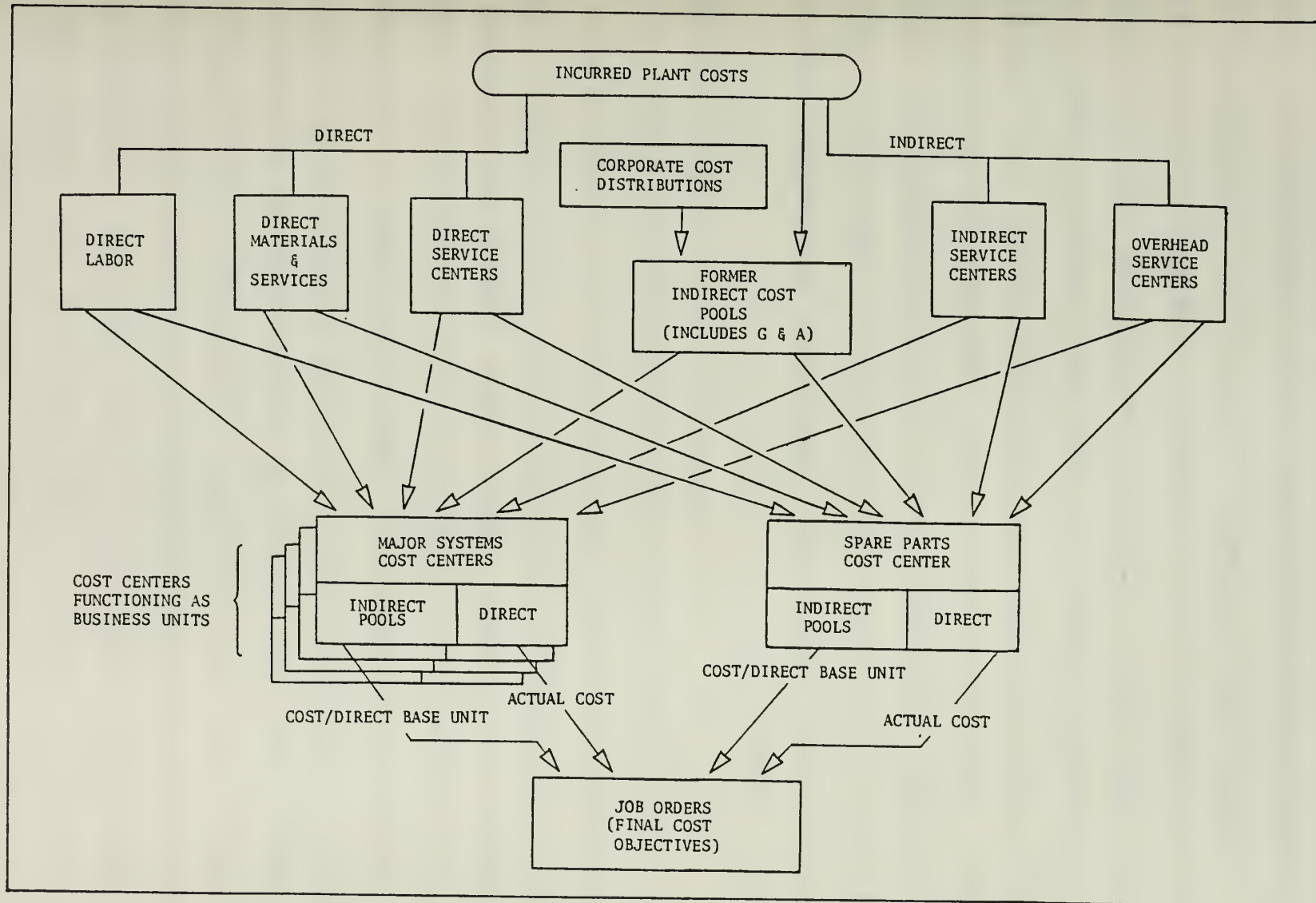


Figure 3.2 Cost Centers Established by Category of Output as Separate Business Units

the allocation method requires the contractor to identify in quantitative terms the causal and beneficial relationships between the categories of indirect costs and the cost centers.

If the contractor's operation is treated as a single business unit as in Figure 3.1, Cost Accounting Standard (CAS) 410 requires that the G&A costs be grouped in a separate indirect cost pool and be allocated directly to final cost objectives [Ref. 15:pp. 205-206]. The G&A costs cannot be distributed first to the cost centers, with each maintaining a separate G&A cost pool, and then, to final cost objectives. As shown in Figure 3.1, the G&A costs will not flow through the cost center, resulting in less than a total accumulation of costs applicable to production output by each cost center.

In figure 3.2, each cost center is treated as a business unit. This structure allows the establishment of a G&A cost pool which complies with CAS 410 within each cost center [Ref. 16]. Under this arrangement, each cost center accumulates all costs of its production output. From a cost accounting perspective, each cost center would function as a separate business. However, for the contractor, physical production and engineering resources such as manufacturing equipment, engineering design teams, and the factory labor force, would be shared by all cost centers, since spare parts business volume is insufficient to support separate facilities and personnel dedicated to spare parts production and processing [Ref. 9].

C. AN ALTERNATIVE COST CENTER STRUCTURE

Figure 3.3 presents an alternative cost center structure in which costs are accumulated in functionally-oriented cost centers which coincide with the contractor's major methods of manufacturing. This structure separates dissimilar manufacturing functions for cost accumulation and allocation purposes. The process of distributing costs to cost centers and service centers, as costs are incurred, remains the same as described for the cost centers established by category of output. Direct costs can be charged to both cost centers and job orders as incurred. Indirect costs can be accumulated, as incurred, in sets of cost pools within each cost center, and periodically allocated to job orders using bases similar to those established for the indirect cost pools under the present accounting system.

The process of distributing indirect costs among cost centers is less complex using the functionally-oriented cost centers than using the output-oriented cost centers. For cost centers established by manufacturing method, many readily identifiable costs do not require allocation to all cost centers. The entire cost is assigned to a single cost center. For example, operating, maintenance, and depreciation costs of an individual piece of production equipment can be accumulated in a single cost center that is the sole user of that equipment. Similarly, the direct labor costs and associated indirect fringe benefits of employees who operate that production equipment will be identified with a single cost center rather than be spread among several cost centers based upon the category of output to which each unit of work applied.

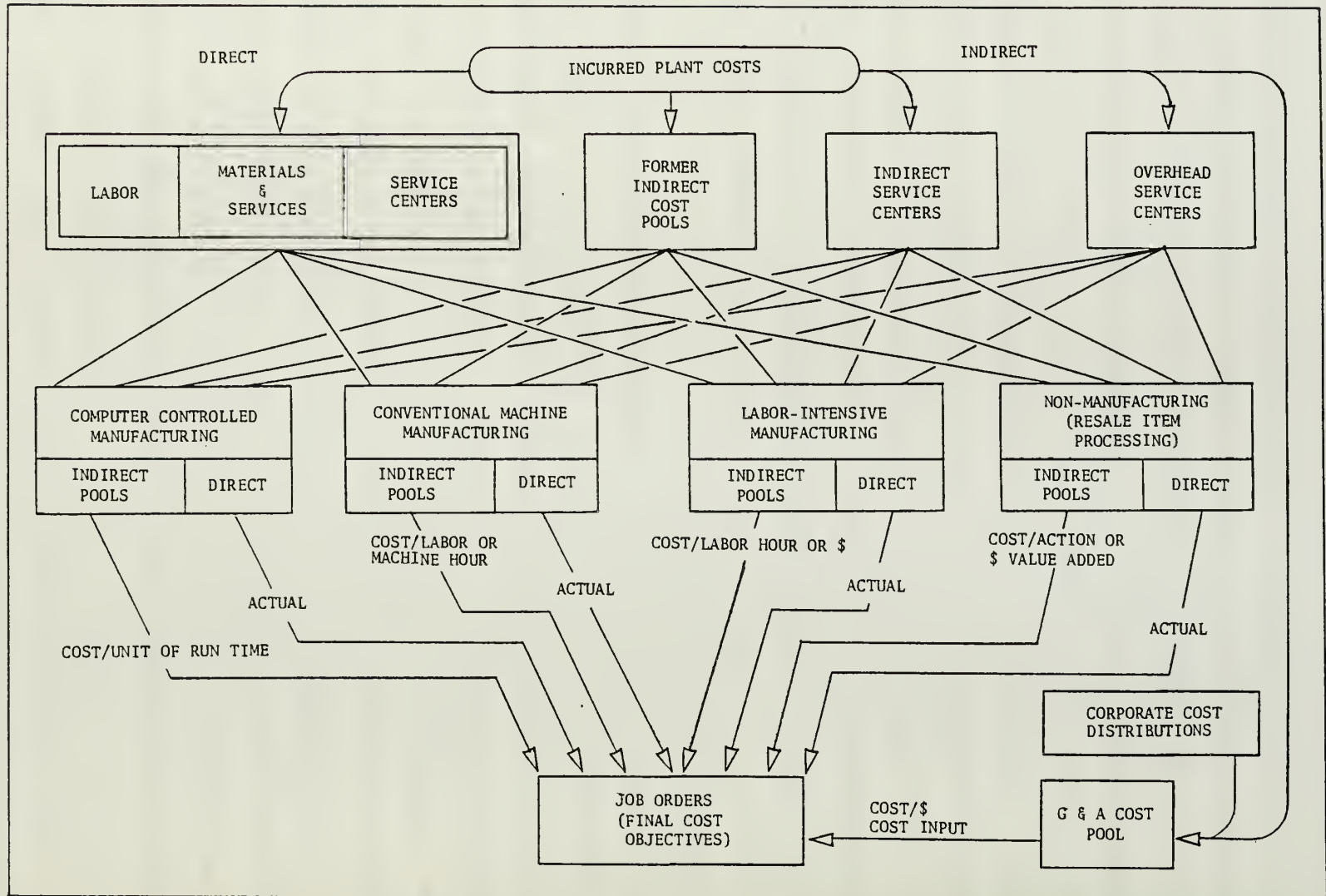


Figure 3.3 Cost Centers Established by Manufacturing Method

The indirect costs of dissimilar manufacturing processes, which formerly had been included in plant-wide indirect cost pools, are separated into sets of homogeneous indirect cost pools [Ref. 17: p. 519]. These homogeneous indirect cost pools within each functional cost center are distributed solely to job orders processed by the cost center. For job orders which require processing by two or more cost centers before complete production output results, the costs incurred by each cost center are accumulated independently. Indirect costs applied by each center are based upon the direct inputs added by each center.

IV. ANALYSIS OF THE ISSUES

A. ACCOUNTING ISSUES RELATED TO SPARE PARTS PRICING

Solutions to many aspects of the multifaceted spare parts pricing problem have come from functional areas of the logistics support field. Improvements related to requirements determination, technical design, and source of supply have reduced the lingering problem areas to those with no clear cut correct solution or over which the parties to the spare parts pricing action--the defense contractor, the DOD contracting officer, the requiring DOD activity, and indirectly, Congress--cannot reach agreement.

The defense industry representatives identify, as the cause of these problems, Cost Accounting Standards and cost regulations which have specified the authorized means of cost accumulation and recovery for DOD contractors. They say that the seemingly high prices result from their compliance with these Standards and regulations. The industry spokesmen say that this same situation produces artificially low prices on other contracts. Their belief is that the total price paid by DOD for all contracts is fair and reasonable with the low prices on some contracts offsetting the high prices on others. [Ref. 18: pp. 73-74]

On the other extreme, Congress charges that the defense contractors are including costs in DOD contracts which should be absorbed by the commercial business in which the contractor is engaged. They contend that some of these costs would not have been incurred in a competitive environment or that they should be

covered by profit and not considered a cost of production for government contracts. In support of this position, Congress is considering legislation to expand and further definitize the list of costs which are expressly unallowable as costs in government contracts [Ref. 19: p. 263].

In the middle of the controversy, the DOD activities are concerned about getting the products they need for mission accomplishment within a constrained budget. Which defense contract is charged a high price is of major consequence to these activities since obtaining additional funds, revising budgets, and justifying cost overruns all require additional unbudgeted time and expense which must be diverted from direct mission accomplishment.

Except for unallowable cost concerns, other remaining unresolved spares pricing issues relate to the systems of cost accumulation and allocation which drive the cost portion of spare parts prices. These cost accounting issues may be divided into two major categories, accuracy of overhead rates and appropriateness of indirect cost elements. The cost center concept offers a means of addressing these issues. By breaking down non-homogeneous, plant-wide, indirect cost pools into homogeneous, indirect cost pools by cost center, the contractor may be able to establish overhead rates which more accurately reflect indirect costs of each subunit within the organization. Cost elements which do not apply to a subunit may be excluded from costs charged to that cost center and spread over only those subunits to which the cost elements contribute.

B. ANALYSIS OF THE SPARE PARTS COST CENTER

1. Accounting/Organization Structure Issues

In the sense of a traditional responsibility center, the spare parts cost center is ineffective and offers no potential improvements in terms of management control. Costs of spare parts production and processing are incurred throughout the contractor's operation and are outside the control of the responsible cost center manager. Without physical plant facilities and labor dedicated to spares production, the spare parts cost center is simply a set of cost accounts into which spare parts costs are funnelled as incurred by the contractor's functional units.

The usefulness of the spare parts cost center for accurate cost accumulation is questionable since new allocation methods and bases are required to distribute indirect costs among cost centers with further allocation required to distribute costs to job orders. This added allocation step increases the probability of introduction of inaccuracies in job order costs.

The objective of establishing cost centers or departments is to improve the accuracy of job or product costing by breaking down plant-wide overhead rates such that the averaging of costs for dissimilar processes is eliminated [Ref. 17: p. 540]. The spare parts cost center does not satisfy this objective. The indirect costs accumulated in each indirect cost pool for the spares cost center are incurred by a multitude of functional activities.

For example, the direct labor which serves as the base for manufacturing overhead for the contractor may have been incurred by machine operators, manual assemblers, computer terminal operators, or product inspectors and testers as shown by item 1 in Appendix D. The resulting manufacturing overhead rate, which is used to apply the indirect costs associated with manufacturing to job orders, continues to be based upon aggregated costs for these dissimilar functions.

2. Spare Parts Pricing Issues

Establishing a spare parts cost center will not solve any of the remaining spare parts pricing problems. It does not resolve either of the accounting issues--accuracy of overhead rates and appropriateness of indirect cost elements. Since indirect costs from all functional units of the contractor's operation are accumulated in a single set of indirect cost pools in the spares cost center, the resultant overhead rates remain an average covering the whole plant and including all indirect cost elements. Providing no improvement to the method of excluding indirect cost elements from parts orders to which the elements do not apply, the spare parts cost center offers no new avenues toward pricing spare parts according to intrinsic value or the level of effort expended by the contractor. The process of allocating indirect costs to cost centers may introduce additional inaccuracies, which are perpetuated in cost allocations to job orders, since the output-oriented cost centers do not match the division of work in the contractor's plant.

Negotiation of overhead rates for forward pricing rate agreements for spares pricing, based upon historical costs accumulated in a spare parts cost center for this contractor, will result in spare parts prices which are distorted in the same way as the average overhead rates used for allocating costs to job orders under the contractor's present system. Workload in negotiating forward pricing rates for spare parts is increased using a spare parts cost center. Rates must be negotiated for each cost element as is done under the present system. However, in addition, the negotiator must ascertain--using DCAA auditors or his pricing staff--that distributions of costs among cost centers have been performed properly and have not introduced inaccuracies into cost center overhead rates.

Introduction of an additional structural layer increases the complexity of the cost accounting system. Under the spares cost center, with an additional accounting structure between cost incurrence and final cost objectives, methods of establishing the historical cost base, upon which spare parts prices are based, are less direct than under the contractor's present system.

C. ANALYSIS OF THE ALTERNATIVE COST CENTER STRUCTURE

1. Accounting/Organization Structure Issues

The functionally-oriented cost center structure in which cost centers are established by major manufacturing method is a useful management control structure. A defined body of production resources can be placed under the control of a single cost center manager who is responsible for cost incurrence as well as the

quality of production output. This type of cost center arrangement matches cost flow with work flow through the major manufacturing processes applicable to the parts order. The cost accounting system accumulates costs on a value added basis by cost center. Indirect costs are accumulated in homogeneous cost pools in each cost center, resulting in rates for allocating costs to job orders which are more accurate in reflecting true costs incurred for job accomplishment than those rates determined under either the present system or the spare parts cost center.

The complexity of the cost accounting system is increased using functionally-oriented cost centers since an additional structural layer is introduced into the system. A scheme of indirect cost distribution among cost centers must be devised. This task is less difficult than setting up a similar system for output-oriented cost centers since a number of costs will apply to only one cost center, while others can be distributed using such bases as headcount, facilities costs, or square footage of work space, which will be more clearly defined for functionally-oriented centers.

2. Spare Parts Pricing Issues

The functionally-oriented cost center structure presents a possible means of correcting the unresolved accounting-related spare parts pricing problems. The accuracy of overhead rates is improved, while indirect cost elements are able to be excluded from cost centers to which they do not apply. Spare parts which are priced using forward pricing rates based upon this more accurate cost accounting structure will come closer to matching

intrinsic value. The value added nature of cost accumulation from cost center to cost center will facilitate tracking of costs by contract auditors.

Breaking down the indirect costs into sets of homogeneous cost pools within functional cost centers removes much of the inaccuracy in cost accumulation which had been introduced through the use of plant-wide average overhead rates. The value added in terms of cost input by each major manufacturing unit for the contractor will be recorded separately in the accounting records and charged separately to job orders. Forward pricing rate agreements negotiated based upon historical costs accumulated in functional cost centers will perpetuate the improved accuracy by establishing overhead rates for each cost center. The negotiation of the rates will be less complex with historical costs accumulated in a logical form matching physical plant arrangement and functional organization structure for major manufacturing processes. Under the present accounting structure, analysis of indirect costs for the purposes of establishing negotiated forward pricing rates involves extensive "spread sheet" breakdowns of historical costs to put costs in a format suitable for determining accurate costs of each function to be priced.

The number of rates which must be negotiated for spares pricing will increase substantially using cost centers with separate sets of indirect cost pools. However, the rates will be applicable to all work performed by the cost center since costs have been accumulated and rates established for the process, not the type of output. Thus, a single rate agreement could be used

to price all DOD contracts with the contractor which involved use of any or all of the functional cost centers.

The difficult audit function, which was a major complication associated with output-oriented cost centers, is still required to determine that distributions of indirect costs among cost centers have been performed properly. The difficulty is reduced for functionally-oriented cost centers since many indirect costs, such as individual equipment operating costs and depreciation, can be applied to a single cost center, rather than allocated to all cost centers as was necessary under the output-oriented cost center structure.

The cost of improved parts pricing accuracy will be reflected in increased administrative cost--included in the G&A overhead rate--to maintain more detailed cost accounting records which include the cost centers as an additional layer in the accounting structure.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

During analysis of the contractor's cost accounting system and spare parts pricing methods, development of representative cost center structures, and review of recent cost accounting and spares pricing literature, the researcher reached a number of conclusions concerning corporate cost accounting, spare parts pricing and the interrelationships between these two activities.

- 1 - Three accounting issues contributed to the spare parts pricing problems which were the subject of Congressional hearings and media horror stories beginning in early 1983. These issues were: the use of equal allocation techniques for some indirect costs, the use of plant-wide overhead rates to apply indirect costs to spare parts orders, and the application of categories of indirect costs to spare parts which received little or no benefit from the incurrence of these costs.
- 2 - The first accounting issue--use of equal allocation techniques--is no longer a problem. DOD policy now prohibits the use of equal allocation techniques for allocating indirect costs among line items of DOD contracts. Consistent enforcement of the policy by all DOD components will prevent the recurrence of this problem.
- 3 - Changes to the cost accounting system do not impact spare parts prices directly. Such changes effect the accumulation of costs into cost accounts which are the underlying support for negotiated spare parts prices and forward pricing rate agreements. Changes to the cost accounting system impact the ability of defense auditors to examine details of cost accounts and to determine the accuracy of proposed overhead rates in matching true cost incurrence.
- 4 - A restructuring of the cost accounting system by category of output with multiple cost centers, including a spare parts cost center, is possible for the contractor studied at considerable expense compared to benefits received. Introduction of such cost centers would require extensive modification of the cost accounting system including record and file structure and the computer software which supports the system.

- 5 - The spare parts cost center offers no improvements to the cost accounting system which will resolve the remaining accounting problems related to spare parts pricing. The structure introduces additional opportunities for inaccuracies in cost accumulation because of distribution of indirect costs to cost centers which do not match either the functional organization or the logical work flow and cost breakdown for the contractor.
- 6 - A cost center structure which is functionally oriented, possibly set up by major manufacturing method, may be a solution to the remaining accounting problems related to spares pricing. Such a structure would limit the averaging of dissimilar categories of indirect costs by establishing sets of indirect cost pools within each functional cost center. Indirect cost categories which did not apply to a cost center would not be included in that center.
- 7 - Changes to defense contractors' accounting systems are needed to cope with the computerized manufacturing methods which have become more prevalent in modern defense manufacturing plants. Labor hours and labor dollars are becoming obsolete as bases for allocating indirect costs since direct labor cost is becoming a less significant portion of total manufacturing cost. Recent studies by an Air Force Education With Industry team and a major defense contractor support this conclusion. These studies indicate that a cost accounting system broken down into cost centers by major manufacturing method is a feasible solution.

B. RECOMMENDATIONS

- 1 - The Naval Supply Systems Command should not advocate the establishment of a spare parts cost center within the cost accounting structure of defense contractors as a means of improving spare parts prices. An output-oriented cost center structure which does not match functional manufacturing processes and work flow provides no improvement over current cost accounting structure for the contractor studied and does not resolve any of the identified accounting issues impacting spare parts prices.
- 2 - The Department of Defense should conduct research concerning the general applicability of functionally-oriented cost centers to the cost accounting structures of defense contractors. For the contractor studied, such centers would provide a means of improving the accuracy of costs which are applied to spare parts job orders. These accumulated costs are the basis for negotiating future forward pricing rates for spare parts.

- 3 - The Department of Defense should conduct research concerning the optimal means of introducing the cost center structure among defense contractors, DOD-wide, if found to be generally applicable. With no Cost Accounting Standards Board in existence to promulgate a new standard in this area, DOD appears to have two principal alternatives, issue a regulation or propose legislation to Congress.
- 4 - The Naval Supply Systems Command, with concurrence from the Chief of Naval Operations, should expand the spare parts breakout initiative to include those categories of parts which have been excluded previously by various Navy systems commands. Any additional services, such as inspection and certification, which the Navy customer requires from a major system integrating contractor, should be procured utilizing a contractual arrangement separate from that which is used to procure the parts. The costs of the additional services may be considered more appropriately as system costs, rather than as parts costs, since the inclusion of the costs in parts prices increases the prices to some amount above intrinsic value.

C. ADDRESSING THE RESEARCH QUESTION AND SUBSIDIARY QUESTIONS

1. The Research Question

Would the establishment of a spare parts cost center within the corporate accounting structure improve the process of pricing spare parts so that the ultimate prices charged would be consistent with the contractor's effort to produce them? The establishment of a spare parts cost center, although a feasible accounting structure, will not improve the spare parts pricing process for the contractor studied. The accuracy of cost accumulation using a spare parts cost center would be no better than that achieved under the present system and could be worse because of the difficulty in determining the amount of costs to distribute to each cost center or, specifically, to the spares cost center. However, an alternative cost center structure, using functionally-oriented cost centers, may improve the accuracy of cost accumulation within the contractor's job order cost accounting system by

separating into several sets of cost pools dissimilar costs presently included in the contractor's single set of indirect cost pools. The direct relationship between resources utilized and output produced within each functionally-oriented cost center decreases the opportunities for introduction of cost accumulation inaccuracies.

2. The Subsidiary Questions

Would a spare parts cost center fit into the existing corporate accounting structure of the contractor? Introduction of a spare parts cost center requires an additional layer of intermediate cost objectives within the contractor's existing accounting structure. The contractor does not utilize cost centers in the current structure. Cost centers could be established, if desired, in the accounting structure.

What are the major obstacles to establishing a spare parts cost center? The spare parts cost center, as an output-oriented structure, is incompatible with the contractor's functionally-oriented manufacturing operations. A system of distributing indirect costs of each manufacturing function to the spares cost center must be developed. This cost allocation system is more complex and prone to inaccuracy than the allocation system presently used, and still required in the new system, to allocate costs to job orders. A second obstacle is the business environment in which major defense contractors operate. Any cost accounting system used must accumulate costs in such a way that products can be priced competitively with other contractors if the contractor is to remain in that segment of the market. Changes to the cost

accounting system, which alter substantially the costs allocated to each cost objective, will upset the contractor's competitive position for the products in which his costs have been increased and for those in which his costs have been decreased.

How would costs associated with manufacturing spare parts under a separate cost center differ from costs determined under the current accounting structure? The costs would be substantially the same under a spares cost center as under the current structure. Rates for allocating indirect costs to job orders would continue to be averages of aggregated costs for dissimilar functions.

Would such a cost center comply with Cost Accounting Standards? A cost center structure can be established which complies with Cost Accounting Standards. The researcher identified one defense contractor--a machine tool manufacturer--which presently uses a cost center structure [Ref. 5]. The Air Force Education With Industry team also concluded that establishment of a cost center structure, to cope with increasing factory automation, did not require any changes to Cost Accounting Standards to be acceptable [Ref. 14:p. 13].

What incentives might be provided to DOD contractors to motivate them to adopt this accounting structure, if feasible and advantageous? The spares cost center is feasible but not advantageous. It should not be adopted by defense contractors whose operation is organized similarly to the contractor studied. The alternative structure is both feasible and advantageous, from DOD's perspective. However, in the present business environment, a DOD contractor can adopt this structure only if its competitors

adopt it at the same time or if DOD provides direct compensation to the contractor which offsets any competitive disadvantage caused by its adopting the structure. Direct compensation would defeat the purpose of adopting the cost center structure by reintroducing the cost inaccuracies in the form of compensation for business loss. The only reasonable methods identified by the researcher of motivating contractors to adopt the structure are through DOD mandate--a new cost regulation--or through Congressional action--a new law. Either method would put all contractors on equal footing and not put any contractors at a competitive disadvantage. However, a gradual phase-in period may be necessary to limit opportunities for competitive advantage. The Air Force Education With Industry team placed considerable emphasis upon the need for a gradual change, rather than an abrupt change, to accounting practices [Ref. 14: pp. 12-13].

What effect would the establishment of a separate cost center for spare parts have on the contractor's ability to recover overhead costs? Establishing a cost center structure of any type would not impact upon the contractor's ability to recover overhead costs. However, some overhead costs may shift from being allocated to commercial contracts to being allocated to government contracts and vice versa. Overhead costs may shift also among various government contracts for products which rely upon different manufacturing methods.

Would the establishment of a separate cost center for spare parts lead to any cost efficiencies, such as reductions in total overhead costs? For contractors with accounting structures

similar to that used by the contractor studied, the spares cost center will increase total overhead costs because of the increased administrative cost associated with a more complex accounting system. Increased administrative cost is characteristic also of the alternative structure. Under either structure, the shifting of indirect costs between commercial and government contracts is likely, although the net result for the government may be either a cost increase or a cost decrease.

What would be the implications concerning present corporate structure and/or management practices of establishing a separate cost center for spare parts cost accumulation? The spare parts cost center would fragment costs of operating functional manufacturing subunits into parts which are not readily traceable to clearly defined activities which resulted in cost incurrence. The spares cost center would be unmanageable from a responsibility center perspective since costs charged to the center are not controllable by the cost center manager. The alternative structure would more closely match functional organization structure. Indirect costs could be traced to specific activities within the cost center which resulted in cost incurrence. The cost center manager would be in a position to control costs under the alternative structure with both specific assets and a definite body of employees under his management.

D. RECOMMENDATIONS FOR FUTURE STUDY

This research effort was focused on a single defense contractor, that contractor's cost accounting system, and pricing of a small

part of the contractor's total defense contracting business. Although the researcher was able to identify a number of areas which appeared to have general application, no definite conclusions concerning the general applicability of functionally-oriented cost centers to all major defense contractors could be reached. Future research should focus on the similarities and differences in cost accounting structures among major defense contractors and the impact these would have upon general applicability of functionally-oriented cost centers. This paper concludes that a spare parts cost center is not a useful accounting structure for improving spare parts prices for the defense contractor studied or for other contractors with an accounting structure similar to that used by the contractor studied. Future efforts may be directed toward identifying defense contractors which include output-oriented cost centers, such as the spare parts cost center, in their accounting structures and determining the effectiveness of the cost centers as structures for accumulating accurate costs for the output produced.

APPENDIX A

DEFINITIONS

1. Allocable Cost: A cost assignable or chargeable to one or more cost objectives in accordance with the relative benefits received or other equitable relationships defined or agreed to between contractual parties. [Ref. 7: p. 1A-B1]
2. Allocate: To assign an item of cost, or a group of items of cost, to one or more cost objectives. This term includes both direct assignment of cost and the reassignment of a share from an indirect cost pool. [Ref. 15: p. 111]
3. Allowable Cost: A cost which meets the tests of reasonableness, allocability, is in consonance with standards promulgated by the Cost Accounting Standards Board (if applicable), or otherwise conforms to generally accepted accounting principles, specific limitations or exclusions set forth in the Federal Acquisition Regulation or agreed-to terms between contractual parties. [Ref. 7: p. 1A-B2]
4. Breakout: The formal process of identifying parts that are currently bought sole source from a prime contractor that could be bought either directly from the supplier who makes them, or competitively from two or more suppliers. [Ref. 20: p. 3]
5. Cost Accounting System: The extension of the systematic recording of financial transactions reflected in the general accounting system, and controlled by or reconciled thereto, for the purpose of disclosing the material, labor, and burden costs of manufacturing and selling a product. [Ref. 21:p. 191]
6. Cost Input: The cost, except G & A expenses, which for contract costing purposes is allocable to the production of goods and services during a cost accounting period. [Ref. 15: p. 111]
7. Cost Objective: A function, organizational subdivision, contract or other work unit for which cost data are desired and for which provision is made to accumulate and measure the cost of processes, products, jobs, and capitalized projects. [Ref. 15:p. 111]
8. Direct Cost: Any cost which is identified specifically with a particular final cost objective. Direct costs are not limited to items which are incorporated in the end

product as material or labor. Costs identified specifically with other final cost objectives of the contractor are direct costs of those cost objectives. [Ref. 15:p. 111]

9. Final Cost Objective: A cost objective which has allocated to it both direct and indirect costs, and, in the contractor's accumulation system, is one of the final accumulation points. [Ref. 15:p. 111A]
10. Formula Pricing: A pricing method which distributes costs systematically over all items using factors such as labor rates, overhead rates, scrap rates, and profit which are negotiated with the contractor, and then applied to a base such as an agreed upon number of labor hours or the cost of materials. [Ref. 6:p. 28]
11. Forward Pricing Agreement: A written understanding negotiated between a contractor and the Government to make certain rates (such as labor, indirect, material usage and spare parts provisioning) available for use during a specified period of time in pricing contracts or contract modifications. [Ref. 7: p. 1A-B10]
12. General and Administrative (G&A) Expense: Any management, financial, and other expense which is incurred by or allocated to a business unit and which is for the general management and administration of the business unit as a whole. G&A expense does not include those management expenses whose beneficial or causal relationship to cost objectives can be more directly measured by a base other than a cost input base representing the total activity of a business unit during a cost accounting period. [Ref. 15:p. 111A]
13. Indirect Cost: Any cost not directly identified with a single final cost objective, but identified with two or more objectives or with at least one intermediate cost objective. Also referred to as overhead or burden. [Ref. 15:p. 112.]
14. Indirect Cost Pool: A grouping of incurred costs identified with two or more objectives but not identified specifically with any final cost objective. [Ref. 15:p. 112]
15. Intrinsic Value: The estimated or appraised worth or price based upon the real nature and inherent characteristics of a thing, and not dependent on external circumstances.
16. Job Order Cost System: One in which a contractor accounts for output and costs incurred by specifically identifiable physical units. A job order may cover the production of one unit or represent a composite of a number of identical units. [Ref. 7: p. 1A-B11]

17. Pricing: The process of establishing the amount or amounts to be paid in return for goods or services. [Ref. 15: p. 113]
18. Proposal: Any offer or other submission used as a basis for pricing a contract, contract modification or termination settlement or for securing payments thereunder. [Ref. 15: p. 113]
19. Spare Parts: Spares and repair parts, repairable and consumable, purchased for use in the maintenance, overhaul, and repair of equipment such as ships, tanks, guns, aircraft, missiles, ground communication and electronic systems, ground support and associated test equipment. ...it includes items, spares, repair parts, parts, subassemblies, components, and subsystems, but excludes end items such as aircraft, ships, tanks, guns, and missiles. [Ref. 2: p. 5]

APPENDIX B

SERVICE CENTERS

Direct Service Centers

1. Repairs & Maintenance of Special Tooling and Special Test Equipment

Major Cost Elements: Direct labor, Material, other direct costs and applicable overhead incurred

Base: Direct labor hours charged to projects by each organization assigned to the Production Overhead Pool Burden Center

2. Common Quality Service

Major Cost Elements: Direct labor and applicable overhead incurred in connection with mechanical receiving inspection and supporting tests & analyses on common inventory items as well as common manufacturing process inspection and process control engineering and testing

Base: Direct labor hours charged to projects by each organization assigned to the Production Overhead Pool Burden Center

3. Common Manufacturing Planning

Major Cost Elements: Direct labor & applicable overhead relating to performance of the following tasks:

- (a) Liaison planning
- (b) Planning documentation audit
- (c) Manufacturing assembly parts listings

Base: Direct labor hours charged to projects by each organization assigned to the Production Overhead Pool Burden Center

4. Common Minor Material

Major Cost Elements: Miscellaneous small parts, fabricating materials and minor supplier charges

Base: Direct labor hours charged to projects by manufacturing organizations

5. Common Manufacturing Processing

Major Cost Elements: Direct Labor & applicable overhead relating to the performance of batched processes or operations

Base: Manufacturing Standard hours for completed projects in each manufacturing processing cost center

Indirect Service Centers

1. Computer Services

Major Cost Elements: Direct labor, applied overhead, machine costs, software, supplies, and communication costs

Base: Computer usage units calculated by algorithm

2. User Dedicated Equipment

Major Cost Elements: Direct labor, applied overhead, machine costs, software, supplies, and communication costs

Base: Equipment by type, assigned to custodial organization.

3. Labor for Indirect Computer Application Support

Major Cost Elements: Labor and applied overhead

Base: Number of hours performed by direct information processing employees

Overhead Service Centers (Redistribution Pools)

1. Divisional Management

Major Cost Elements: Indirect labor, fringe benefits, and other indirect costs of divisional general management offices

Base: Headcount for each division as assigned to the various overhead pools

2. Plant services, Equipment Maintenance

Major Cost Elements: Indirect labor, fringe benefits, and other costs associated with the maintenance, repair and modification of company and Government-owned equipment other than special tooling and special test equipment

Base: Equipment Cost (original book cost)

3. Plant Services, Building Maintenance

Major Cost Elements: Indirect labor, fringe benefits, depreciation and rental costs, plant rearrangement, repair and maintenance, utilities, taxes and insurance

Base: Square feet of space occupied

4. Plant Services, Telephone & Telegraph

Major Cost Elements: Indirect labor, fringe benefits, materials, telephones, telegraph equipment

Base: Number of lines installed

5. Plant Services, Furniture & Fixtures

Major Cost Elements: Indirect labor, fringe benefits, materials, office furniture & fixtures

Base: Headcount

6. Plant Services, Traffic & Transportation

Major Cost Elements: Indirect labor, fringe benefits, insurance, transportation, and other indirect costs incurred

Base: Square feet of space occupied

7. Industrial Relations

Major Cost Elements: Indirect labor, fringe benefits, education and training, employee relocation, recruiting expenses, and other costs of the company industrial relations organization plus an allocation of corporate industrial relations costs

Base: Headcount

8. Office Operations

Major Cost Elements: Indirect labor, fringe benefits, records management and mail services.

Base: Headcount

9. Industrial Security

Major Cost Elements: Indirect labor, fringe benefits, and other indirect costs incurred by the industrial security, fire protection and safety organizations

Base: Headcount

10. Material Handling, Inventory Functions

Major Cost Elements: Indirect labor, fringe benefits, and other indirect costs of stores receiving, status and control and inventory adjustments

Base: Receiving memos closed as identified to requesting organization

11. Sales and Use Tax

Major Cost Elements: State and municipal sales and use tax

Base: Cost incurred in taxable overhead accounts by organization

APPENDIX C

PRINCIPAL CLASSES OF MATERIALS AND SERVICE COSTS CHARGED AS
DIRECT MATERIALS

1. Subcontracts
2. Purchased parts
3. Raw stock
4. Outside production and services
5. Common Minor Materials and parts
6. Vendor rework and processing costs
7. Gases
 - a. Special gases
 - b. Standard gases, when they become part of the end item and are measureable
8. Recording paper - when distributed by roll and identifiable to a project requirement
9. Interdivisional transfers at other than cost

APPENDIX D

INDIRECT COST POOLS

1. Manufacturing (Production)

Major Cost Elements: Indirect labor, fringe benefits of both direct and indirect employees, equipment costs and depreciation, occupancy costs, taxes, supplies, insurance and corporate allocations of operations office

Base: Direct labor dollars of manufacturing, product assurance, systems test and other support organizations

2. Engineering (Development)

Major Cost Elements: Indirect labor, fringe benefits of both direct and indirect employees, indirect travel, indirect data processing, occupancy costs, taxes, supplies, insurance, equipment costs and corporate allocation of science and engineering offices

Base: Direct labor dollars of engineering, development testing, logistics, research, product support, development and other support organizations

3. Off-site (Remote Site)

Major Cost Elements: Fringe benefits, computer costs, payroll taxes and indirect labor

Base: Direct labor dollars of respective remote organizations assigned to each pool

4. Procurement Burden

Major Cost Elements: Indirect labor, fringe benefits, occupancy costs, travel and other costs associated with purchasing and subcontract administration

Base: Costs of all direct materials, subcontracts, and outside services

5. G&A

Major Cost Elements: Indirect labor, fringe benefits, data processing, occupancy costs, taxes, supplies, insurance, equipment, independent research and development, bid and proposal costs, and corporate management allocation

Base: Direct labor dollars charged to final cost objectives

6. Information Processing (Scientific and business computer services)

Major Cost Elements: Management, supervision, indirect labor, fringe benefits, training, travel, occupancy costs

Base: Direct labor dollars of employees in information processing organizations

7. Cost of Money (CAS 414)

Major Cost Elements: Computed in accordance with CAS 414

Base: Same base as is used to allocate other indirect expenses included in the cost pool to which the cost of money is related

LIST OF REFERENCES

1. Logistics Management Institute, Spare Parts Pricing, Logistics Management Institute, Washington, DC, 15 November 1963.
2. U. S. Executive Office of the President, Office of Federal Procurement Policy, Review of the Spare Parts Procurement Practices of the Department of Defense, Government Printing Office, Washington, DC, 1984.
3. Weinberger, Casper W., U.S. Secretary of Defense, UNCLASSIFIED Memorandum, Subject: Spare Parts Procurement, 25 July 1983.
4. Weinberger, Casper W., U.S. Secretary of Defense, UNCLASSIFIED Memorandum, Subject: Spare Parts Acquisition, 29 August 1983.
5. Director of Contracts, Second Major Defense Contractor, Interview, 6 September 1985.
6. Brown, Calvin, "The Nuts and Bolts of Procuring Spare Parts," Program Manager, July-August 1984.
7. U.S. Department of Defense, Assistant Secretary of Defense (Installations and Logistics), Armed Services Procurement Regulation Manual for Contract Pricing, Government Printing Office, Washington, DC, 15 September 1975.
8. Borkland, C. W., "Navy's BOSS: Doing a Number on Spare Parts Overcharges," Government Executive, March 1984.
9. Industrial Accountant, Major Defense Contractor, Interview, 25 July 1985.
10. U. S. Congress, House of Representatives, Committee on Armed Services, Investigations Subcommittee, H.R. 5064, To Amend Title 10, United States Code, To Provide for More Cost Effective and Efficient Purchases of Spare Parts by the Department of Defense, and for Other Purposes, March 23, 1984.
11. Contracting Officer, Major Defense Contractor, Interview, 3 October 1985.
12. Anthony, R. N., Dearden, J., and Bedford, N. M., Management Control Systems, Richard D. Irwin, 1984.

13. Matz, A. and Usry, M. F., Cost Accounting Planning and Control, South-Western Publishing, 1984.
14. Demel, S., Major, USAF et al., "Automation Vs. Accounting - The Need for Change," Air Force Institute of Technology Education With Industry class project, June 1985.
15. Cost Accounting Standards Board, Standards, Rules, and Regulations, Government Printing Office, Washington, DC, 1980.
16. Liao, Shu S., Naval Postgraduate School, Monterey, CA, Interview, 31 October 1985.
17. U.S., Comptroller General, General Accounting Office, Report on the Feasibility of Applying Uniform Cost Accounting Standards to Negotiated Defense Contracts, Government Printing Office, Washington, DC, January 1970.
18. U.S., Department of Defense, Air Force Systems Command, Contracting Methodology, Compendium of abstracts to industry responses to a questionnaire for use at the AFSC CEO Conference, Andrews Air Force Base, MD, 6 June 1984.
19. Bureau of National Affairs, "Procurement-related Provisions Adopted by House/Senate Conferees in the Fiscal 1986 Authorization", Federal Contracts Report, Bureau of National Affairs, Washington, DC, 5 August 1985.
20. Hayward, Daniel S., CDR, "Project BOSS: The Navy Answer to Spare Parts Pricing Problems," Newsletter, Professional Journal of the Navy Supply Corps, January-February 1984.
21. Trueger, Paul M., Accounting Guide for Defense Contracts, Commerce Clearing House, 1963.

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