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# Methodology for Industry Impact Analysis

## Volume I

## Methodology and Summary Results



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~~ECONOMICS AND COSTING DEPARTMENT~~
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# Methodology for Industry Impact Analysis .

## Volume I .

## Methodology and Summary Results ,

by

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## FOREWORD

This memorandum reports on the initial research of RAC's Economic Impact Project performed for the Department of Defense in 1964. The Project, under the direction of Dr. Bernard Beckler, is continuing both the refinement of methods and the development of impact estimates for later programs.

Volume I describes a methodology for projecting employment and economic activity by industry that would be generated by the Department of Defense program. An evaluation of the methods and data sources, suggestions for improvement, and summary results for the 1964 Five-Year Program are also included. This volume is unclassified.

A classified Vol II presents detailed documentation of source materials and calculations for estimates derived for the procurement appropriation category.

An earlier paper, "A Case Study in Industry Impact Patterns: the F-4 Aircraft," RAC-T-451, was published in January 1965, and several papers on industrial classification problems will be published shortly.

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## CONTENTS

# Methodology for Industry Impact Analysis

## Volume I

## Methodology and Summary Results

## ABBREVIATIONS

| | |
|---|---|
| BOB | Bureau of the Budget, Executive Office of the President |
| DOD | Department of Defense |
| FSC | Federal Supply Classification |
| FYFSFP | Five-Year Force Structure and Financial Program |
| FY | fiscal year |
| IRS | Internal Revenue Service |
| MAP | Military Assistance Program |
| MATS | Military Air Transport Service |
| MP | military personnel |
| MSTS | Military Sea Transportation Service |
| NSF | National Science Foundation |
| OBE | Office of Business Economics, Dept of Commerce |
| O&M | Operations and Maintenance |
| OSD | Office of the Secretary of Defense |
| RDTE | research, development, test, and evaluation |
| SIC | Standard Industrial Classification |
| TDP | Technical Development Plan |
| TOA | total obligational authority |

## ABSTRACT

RAC's participation in the Economic Impact Project, sponsored by the Office of the Secretary of Defense, consists of a series of studies designed to determine the impact of the defense program on the economy. The ultimate objective of the project is to improve the capability of the Department of Defense (DOD) in appraising the economic effects of changes in military programs and force structure.

This report presents an account of the research effort during the first phase of study, which was completed in December 1961. Concerned primarily with the development of a methodology for measuring industry impact, rough estimates for FY63–69 were prepared, identifying a wide range of industries that participate in the defense effort. The research was organized in terms of major budget categories. In the area of procurement to which primary attention was devoted, a model was developed for specialized military equipment, including techniques for studying a series of prototypes in depth, utilizing component information and contract sources. In this connection information was sought that would allow the quantification of in-house effort by contractors in order to approximate value-added distributions. Generally, the tracing efforts were successful to second- and third-tier suppliers of prime contractors responsible for the delivery of major end-items such as aircraft, missiles, ships, and tanks. The value-added data also served as a basis for estimating employment from Census industry-wide employment/value-added ratios.

With respect to the nonprocurement appropriation categories, the research effort was less intensive. Generally the procedure involved an identification of the industry responsible for completion of the final product or service. Thereafter for several categories [research, development, test, and evaluation (RDTE) and Military Assistance Program (MAP)] prototype distributions of industry participation were borrowed from the procurement analysis for applicable hardware items, although in other appropriations—e.g., Operation and Maintenance (O&M)—Office of Business Economics (OBE) interindustry coefficients permitted assessment of lower-tier impact.

In Vol I, our research methodology and results are summarized in unclassified form. Volume II, devoted to detailed documentation of intermediate calculations and source materials for the procurement estimates, is classified Secret.

## INTRODUCTION

### Purpose

In recent years considerable concern has been expressed in business and government circles about the economic repercussions of adjustments, particularly downward adjustments, in defense spending. Of special interest has been the effect of such spending changes on specific industries. The object of this memorandum is to present a methodology that can identify these defense-oriented industries and measure their economic participation in terms of value added and employment. Volume I presents (a) a description of the estimating technique, including model formulation; (b) summary results of industry impact; and (c) evaluation of estimating methods and data sources with suggestions for future avenues of study that may offer improvement. Volume II contains the detailed documentation of data source and related research information for the procurement section of the analysis.

### Background

In the past the sources of information used to appraise future industry impact were typically drawn from existing DOD reports prepared for other purposes. For example, the Programming System, which was introduced in 1961, contains considerable information on the costs of activating and operating US military forces. In addition to an appraisal of current needs—detailed by types of equipment, supplies, services, and facilities—the programming information permits a significant forward look at these resource requirements by presenting data 5 years into the future (FYFSFP).[1] For purpose of industry analysis, however, these data, as well as such other sources as prime contract awards and budget reports, are seriously incomplete. At best they can identify only the last link in the production chain, usually a prime contractor who performs the final set of fabrication and assembly operations. As a result, the existing information base tends to obscure the activities of subcontractors and other suppliers whose efforts are essential in our modern interdependent industrial system.

To overcome this handicap and uncover many of these hidden industrial effects the Secretary of Defense early in 1964 initiated the Economic Impact Project.[2] Shortly thereafter RAC was asked to devote research attention to this subject.

The first phase of research, completed in December 1964, attempted to develop new concepts, data sources, and methodology that would serve this purpose. In addition, rough estimates of industry impact were prepared, identifying a wide range of industries whose production and employment stem directly from defense spending. (These estimates, comprising a set of 20 detailed

tables covering value added and employment by industry, were transmitted to the Office of the Assistant Secretary of Defense.[3]) As a first attempt the research effort was necessarily exploratory, and the resulting estimates are accordingly highly tentative. They should be regarded as illustrative of the kind of quick estimates that can be obtained, given not only the assumptions involved but also the constraints of time and research manpower utilized.

Hypotheses and Guidelines

In defining the research problem the monitors of the study at the Pentagon (OASD—Comptroller) suggested ground rules that affected the scope of the research. First, the DOD FYFSFP (dated January 1964)[1] was to be used as a basic framework; thus the initial measurement of defense impact would be confined solely to DOD activities. Other agencies, such as the National Aeronautics and Space Administration (NASA) and the Atomic Energy Commission (AEC), would be outside RAC's area of interest.

The commitment to the FYFSFP serves several purposes. It ensures that all economic activities of DOD (e.g., payrolls, maintenance, equipment purchases) will be considered so as to exhaust the entire budget of roughly $50 billion. In addition program information was available for source material. The appropriation breakdown, for example, permits the use of the major budget categories (e.g., procurement, O&M) as provisional control totals, whereas the program details assist in identifying and quantifying specific weapon systems for coverage and analysis. These provisional control totals refer to the budget estimates reported in terms of total obligational authority (TOA). As part of the research, these dollar values were later adjusted to reflect economic activity in the year of occurrence rather than the year in which the Government's obligational authority was granted.

Another criterion pertains to the measure of economic impact. Value added was deemed the proper concept for impact measurements because of the special interest in the contributions of suppliers below the prime contractor level (e.g., so-called "second-order" effects). The value-added approach permitted separate assessment of defense effort performed by lower-tier suppliers of embodied inputs in many different industries. (Industry definitions used in this study are those of the Standard Industrial Classification (SIC) system developed by the US Bureau of the Budget.) These effects could not be examined by use of other final product measures (such as sales or shipments), and hence these measures were considered inadequate for our purpose.

In general the study utilizes the Census concept of value added, which may be defined roughly as the value of shipments less a number of specified purchases such as subcontracts and other purchases of manufactured materials and supplies, fuels, and electric energy. This definition was modified for convenience of estimation in our contract analyses to include the total contract price less purchases of materials embodied in the weapon system itself.

Early in the study, when RAC's investigation of contract records disclosed a technique for obtaining value-added estimates, the Office of the Secretary of Defense (OSD) requested, in addition, that estimates for employment (consistent with those for value added) be derived. Both of these measures

were developed for each industry on a national basis only; regional,* occupational, and other considerations were not part of our research objectives.

A third important aspect of the study was the emphasis on specialized military hardware, that large and sensitive portion of DOD procurement whose full industry impacts cannot be determined from published DOD or Census sources. In order to analyze the procurement of major hardware items in depth, RAC suggested research by "prototyping" for a limited number of these. The probing for value-added data would depend on research ability to penetrate contract cost records of lower-tier suppliers. It was planned, assuming data availability, to continue such penetration until roughly two-thirds to three-fourths of value added could be located; the remaining value added that could not be identified by industry would be left as an unallocated aggregate. With respect to the nonprocurement categories (e.g., RDTE and O&M) OSD suggested that a less intensive study would suffice; thus no contract record search for value-added data was contemplated. The effort in these areas was confined in general to the use of rough estimating methods to obtain value-added estimates based on the final product or service involved. Accordingly, secondary sources of data and other broad-brush approaches were employed within the time period available.

One final caveat pertains to the scope and meaning of economic impact. In this study, impact is limited to industries (and individuals) supplying the Defense Department with goods and services (final products as well as embodied inputs). OSD asked that broader considerations such as the effect of military spending on private investment or the impact of respending of defense-income payments on the economy at large be excluded from this initial study.

## METHODOLOGY

As noted previously, major attention was given to the analysis of procurement activities. As a result its methodology is, as one might expect, not only more elaborate but also significantly different from that in other major segments of DOD expenditure. Only in the procurement categories were contract records directly analyzed to obtain second-order effects. In other categories a variety of shortcut procedures were utilized, e.g., SIC codes were based largely on product designations of line items, and value-added data were almost entirely derived from Census ratios. The descriptions of these estimating approaches will be covered separately with a rather lengthy section for Procurement and more abbreviated pieces for the nonprocurement categories. The discussion is presented in the following order: (a) Procurement; (b) RDTE; (c) O&M and Military Personnel; (d) Military Construction, Family Housing, and Civil Defense; and (e) MAP.

### Procurement

In connection with specialized military equipment, a series of techniques and operational procedures was developed. A model of these procedures and

*Attention to regional aspects of defense impact is being given under Project IV-B, an in-house effort of the DOD Cost and Economic Information System (CEIS).

their sequence is presented in Fig. 1, which provides an overall view of the translation of hardware requirements into industrial impact. The major operational steps included in the model are (a) end-item classification, (b) component derivation and weighting, (c) industry value-added analysis, (d) time-phasing, and (e) employment computation. The outputs of the model are estimates of value added and employment by industry for each of the equipment groups and also for total procurement. The model's operational steps, including implementation, are described separately later.

End-Item Classification. The first step involved assignment into generic categories of some 800 different items of equipment in the FYFSFP Materiel Annex—a shopping list of every procurement item with TOA in excess of $2 million during any of the program years. About three-fourths of the Annex items (in terms of number) are highly specialized military products defined in this study as goods for which there are no close civilian counterparts (e.g., Minuteman missiles, M60 tanks). The remaining annex items comprise conventional-type products, such as specified kinds of trucks and construction machinery.

Since the objective was to prepare a quick appraisal of industrial impact, individual attention to some 800 items was not practical; instead the 800 items were classified for sampling purposes into 13 groups. Criteria for degree of classification detail were dollar importance of the classes and expected homogeneity of industry impact. Attempts were made to avoid working with classes of little economic importance but also to avoid putting into a single class important items whose economic impacts were expected to be very different. In some cases—missiles and torpedoes—the groups were all-inclusive since no significant distinctions in terms of industry impact seemed to warrant their segregation into subcategories. In other cases—aircraft, ships, and ammunition—subcategories were organized on the basis of general mission or type of weapon system. For example, it seemed appropriate to assign Materiel Annex items of aircraft to one of three distinct types, e.g., either fighters, helicopters, or transport and utility. The distinction in the ship category was surface type versus submarine; in ammunition the Annex items were classified in terms of large or small caliber. A listing of each group and the Annex items assigned to them is given in the next chapter.

Of the 13 groups, 12 were for specialized hardware items and the final one was a catchall of civilian-type items and other items that could not be placed in one of the specialized groups. In general the Materiel Annex items could be assigned readily to one group or another. In some cases an item was allocated among several groups; e.g., aircraft spare parts were distributed among all three types of aircraft. In all cases, TOA was aggregated for each group and for every fiscal year from 1963 to 1969.

Component Derivation and Weighting. Next the focus of attention was stepped down one level from the weapon system itself to its major subsystems or components. For each major equipment category, a classification into major components was made. In later steps, industry impacts would be calculated for these components rather than for the equipment items themselves. The reason for this was twofold.

First, the use of major components increased sampling accuracy. Using aircraft as an example, the budget data—which are available for each aircraft

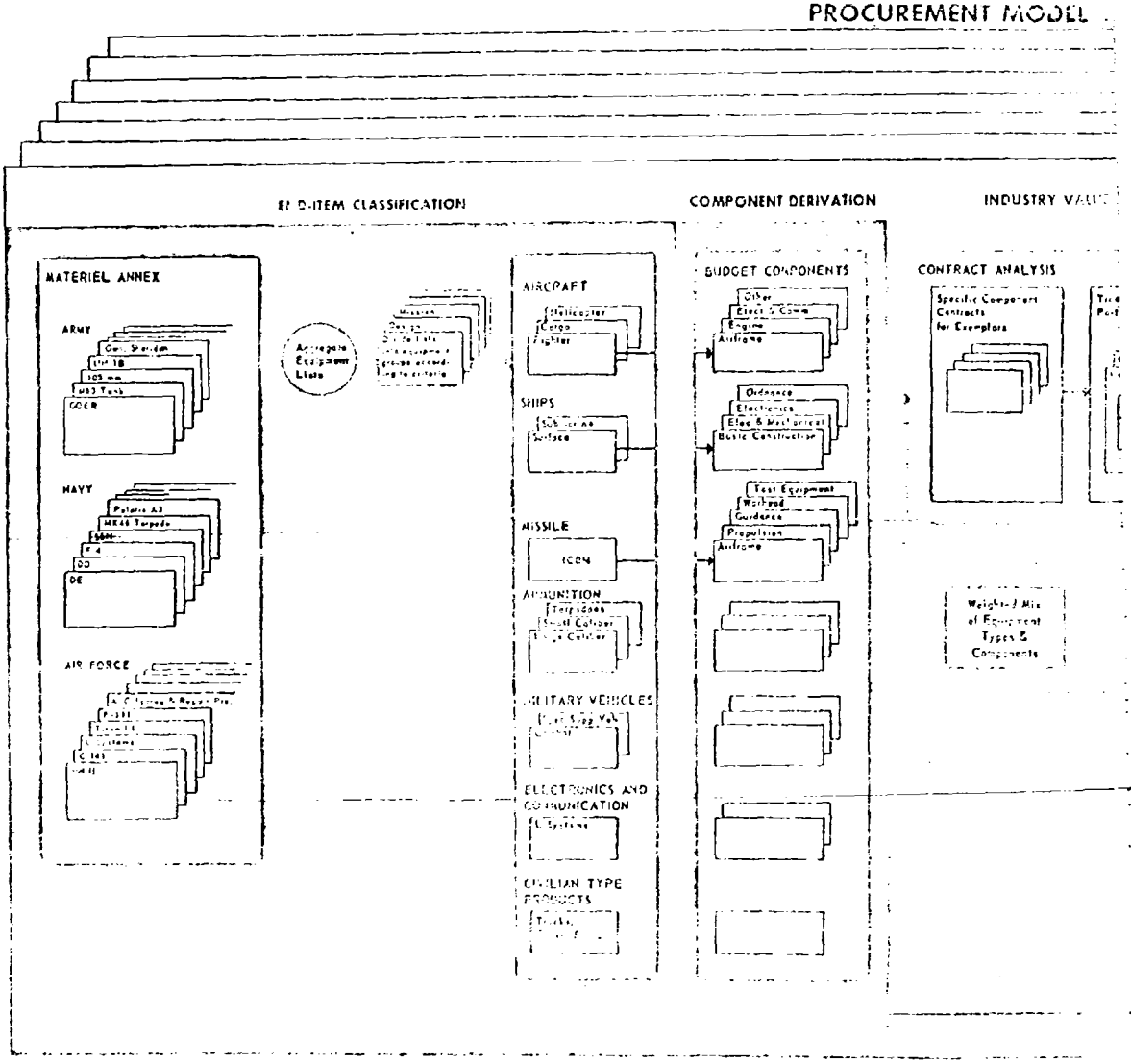


Fig. 1—Procurement Model

## PROCUREMENT MODEL

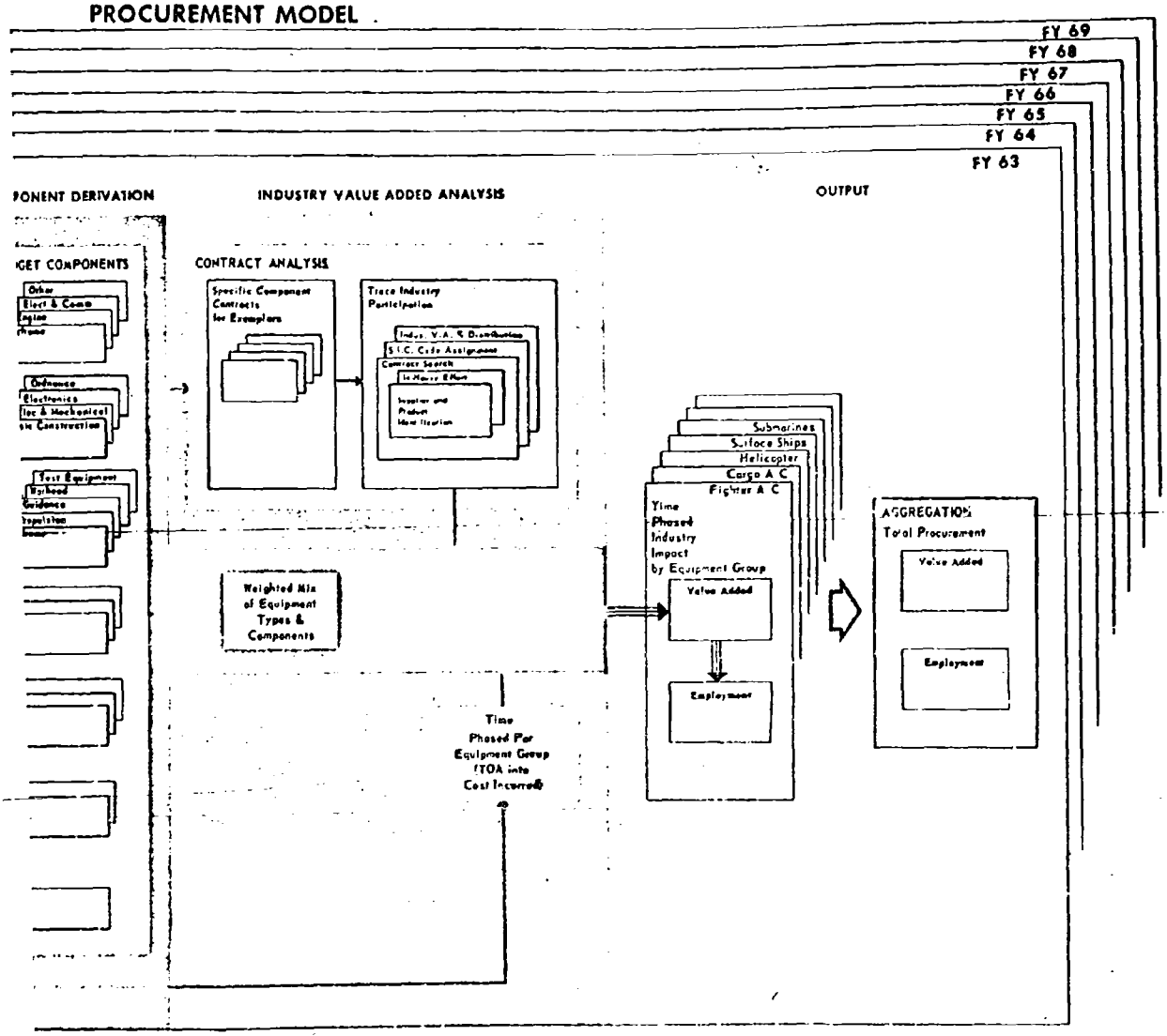


Fig. 1—Procurement Model

type and model—were distributed in four categories: airframe, engine, electronics, and other components. For each of the years covered by the analysis the dollar values by aircraft model were aggregated in order to provide a set of "weights." These annual weights were in turn used to combine the industry value-added distributions for each of the exemplar components. This technique permits reflection of annual changes in product mix within equipment groups, in terms of aircraft and other weapon systems with differing major subsystem proportions. Moreover, the magnitude of each component aggregation conditions the selection of contracts for study in the contract analysis. For large component categories, several contracts may be analyzed in order to obtain representative distributions of value added.

Second, the Government's contractual arrangement with the private firm typically takes place at the component level. For example, acquisition of fighter aircraft usually involves separate direct purchases by the Government of the airframe, the engine, and literally hundreds of other equipment items. Generally these items are fabricated by a large number of independent firms. This arrangement between the Government and its prime contractors should not be confused with the very dependent relations prevailing between each of these primes and its own suppliers of fabricated and raw materials.

Industry Value-Added Analysis. The third step in the process, the contract analysis, is the key element and a major innovative feature of the study. The purpose of the contract effort is to find suitable value-added information at the company or plant level. Prior to the search for value-added data, several preliminary decisions related to Steps 1 and 2 were required. Within each of the groups of like items, a prototype item was selected as the exemplar for all others of its type (e.g., Iroquois helicopter, F-4 fighter aircraft—see Table 1). Selections were based both on the relative size of the item and on the availability of contract data for the prototype item. When contract data were lacking, another prototype had to be chosen. In one case, for example, a preliminary decision to include a separate bomb group had to be overturned because

TABLE 1

Procurement Groups and Exemplars

| Procurement group | Exemplar for group |
|---|---|
| Helicopters | UH1B/D Iroquois |
| Fighter aircraft | F/RF-4B/C Phantom |
| Transport and utility aircraft | C-141A Starlifter |
| Missiles | Polaris A-3 |
| Surface ships | Destroyer escort |
| Submarines | SSN |
| Combat vehicles | M60A1 tank |
| Specialized support vehicles | GOER vehicles (8-ton) |
| Torpedoes, mines, and bombs | Mk 46 torpedo |
| Large-caliber ammunition | 105-mm M456 cartridge |
| Small-caliber ammunition | 7.62-mm cartridge |
| Electronics and communications | 412L components and others |
| Civilian-type procurement | Interindustry sectors |

of insufficient contract information on the Snakeye and Walleye systems. In the final analysis, bombs and mine items were combined with torpedoes into a major group with the Mark 46 torpedo as the prototype for all three types of weapons.

As noted previously the selection of contract data was guided by the budget breakdowns examined in step 2. When no component data were available for a weapon system, a single contract covering these components had to suffice. In other cases it was necessary to examine separate contracts for these components. In the F-4 aircraft analysis[4] searches were made in six separate contracts, one each for the airframe and the engine, and two each in electronics and other components.

In the contract analysis the prototype and/or its components were traced to the procurement records in each of the services. Attention was focused on "make or buy" information covering prime contractors and, where possible, second-tier and third-tier suppliers. Contract information was examined to distinguish between in-house effort (including overhead and profit) and the purchases of embodied materials from other suppliers, usually subcontractors, vendors of parts, and raw-material suppliers. The latter information was also searched for similar breakdowns of effort. These data were usually found in contractor proposals, reporting-form submissions, and negotiation analyses. In a few cases the plants were contacted directly for information.

Identification of the product supplied and the plant's name and place of performance provided information needed for industry coding. The primary sources of industry classification information were Dun and Bradstreet Reference Book,[5] Fortune Plant and Product Directory,[6] Poor's Register of Directors,[7] and the Thomas Register of American Manufacturers.[8] In general, coding procedures tended to emphasize in accordance with SIC convention establishment rather than product coding. In other cases the information made available by contractors or in contract records could be coded only on a product basis.[9,10]

On completion of the contract search the value-added data—pertaining to a particular component of the weapon system—were compiled. Samples of purchase items within specified categories of subcontracts, purchased parts, and raw materials were blown up to control totals shown in the contract records for these categories. The goal of the contract analysis was a distribution of value added by industry for the entire component. Frequently, however, contract records permitted plant and/or product identification of shipments or sales but not value added. For these, industry-wide ratios (of value added to shipments) were derived from the Census 1962 Annual Survey of Manufactures,[11] and these ratios were applied to contract purchase values in order to obtain an estimated value added. Both value-added distributions were then combined by industry. Where no identification of supplying plant, product, or industry was possible, the value-added amount was shown as unallocated and kept apart from the industry data. After industry-value-added distributions for all of the component categories had been completed, they were ready for combination into a single distribution for the entire exemplar weapon system. The weights for combining these component distributions were developed from backup information earlier in step 2. Table 2 presents the percentage of value added for each exemplar weapon system obtained directly from contract records, i.e., without sampling or use of Census value added/shipments ratios.

The tracing of purchases through primary and secondary production tiers bears a resemblance to the development of interindustry input vectors. As such, it is a contribution to a Leontief input-output model that is a general statement of the interdependencies of all industries in the economy. The most recent standard Leontief model of the US (developed by the OBE for the year 1958) is highly aggregative; its industry sectors are on a 2- to 3-digit SIC basis

TABLE 2

Percentage of Exemplar Value Added Obtained Directly from Contract Data

(Without sampling, or use of Census value added ratios)

| Exemplar | % of total value added obtained directly from contract records |
|---|---|
| Iroquois UH1B/D | 49 |
| F-4 | 68 |
| C-141A | 66 |
| Polaris | 76 |
| DE | 42 |
| SSN | 52 |
| M60A1 tank | 55 |
| COER | —[a] |
| Mk 46 torpedo | 70 |
| 105-mm cartridge | 57 |
| 7.62-mm cartridge | 59 |

[a]Value added from contract records adjusted by use of Dept of Commerce interindustry data.

so that specialized military equipment industries are largely obscured. Consequently RAC's detailed investigation of military-hardware-generating industries supplements the informational base and contributes to a fuller understanding of this portion of the economy. Since the OBE interindustry model is more applicable in the nonspecialized defense demand, the model's value-added coefficients could be utilized to estimate the industry impact of civilian-type items.

Time-Phasing Process. Step 4 in the procedure involves the time-phasing process. Since FYFSFP data are in TOA form, they reflect fundings that often considerably precede the time when goods and services are produced. A rough estimating technique was developed to lag the TOA dollar amounts to simulate payments to individuals and firms for efforts performed in the production process. Sources of data included lead-time (administrative and production) estimates for specified items of equipment shown in the weapons dictionary[12–14] portion of the Materiel Annex. In addition, several DOD reporting systems, the DD-690 and the DD-1177, contained clues considered useful for lagging purposes. The first source provides information on the distribution of Government expenditures by year of TOA so that one can determine the number of years

required to expend a given year's TOA. The second source (DD-1177) discloses contract records of costs incurred by prime contractors (for a limited number of Navy items). This source also provided information on the duration of cost experience as well as a measure of the volume by year. The DD-1177 experience for aircraft, for example, indicates a work period of 3 years with a relatively minor amount in the last year when final delivery and Navy acceptance of the aircraft occurred. As a first approximation, the contract dollar amount was distributed for these 3 years on the basis of this experience. This distribution was altered slightly toward a heavier proportion in the first year to reflect the activities of lower-tier suppliers who provide off-the-shelf items, which probably occur very early in the production cycle.

The time-phasing procedures that were finally developed varied by type of specialized equipment. The shortest production period—2 years—was applied for specialized support vehicles, although periods of 4 and 5 years were utilized for the two ship categories. The annual lagging patterns developed for each of the equipment groups were applied to the TOA estimate so that new time-phased estimates of incurred costs were obtained. These estimates were then distributed by industry according to the value-added proportions developed above in step 3.

Employment Computation. The final step (5) in the measurement process involves the development of employment estimates. In general the procedure involved the computation of industry-wide ratios (of employment to value added) primarily from the 1962 Census Survey of Manufactures.[11] For nonmanufacturing industries other sources including Statistics of Income[15] (IRS) and National Income[16] (OBE) were employed to approach an employment estimate. These ratios were then applied to the value-added data for all years to derive industry estimates of employment.

## RDTE

The RDTE analysis involved examination of program element data from the FYFSFP and financial breakdowns of program elements contained in Technical Development Plans (TDP) and other service sources. In addition a major source of information was National Science Foundation (NSF) data classifying research funds by type of performer, which permitted allocation of research funds to profit-making firms, educational institutions, military research installations, etc. In order to estimate the value added for these various activities, rough assumptions were made concerning the proportions of government in-house research and purchases of equipment. Where fabrication of test or development models was involved, the industry value-added distributions for applicable procurement exemplars (e.g., aircraft, missiles) were utilized. A more detailed discussion of these procedures follows.

Two sources of data were utilized to obtain detailed breakdowns of RDTE in FY64. The FYFSFP presents TOA distributed by branch of service and RDTE category. The other body of information comes from the NSF, which publishes research and development data for DOD and for the individual services. NSF data are distributed by type of organization performing the research and development (R&D) (hereafter referred to as "performer groups"). Cross-tabulation of these two bodies of data provided a matrix within which the detailed allocation of RDTE funds to SIC industries was accomplished (see Table 3).

TABLE 3

DOD Obligations for RDTE, FY64, by Categories and Performer Groups

(Millions of dollars)

| Row number | DOD RDTE category | Intra-governmental | NSF and RDTE performer groups, extragovernmental | | | | | Totals, by RDTE category[a] |
|---|---|---|---|---|---|---|---|---|
| | | | Profit organizations | Educational institutions | Other nonprofit organizations | Foreign | Total extramural | |
| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1 | Research | 97.3 | 32.1 | 178.2 | 17.1 | 13.6 | 241.0 | 338.3 |
| 2 | Exploratory development | 388.4 | 515.2 | 135.8 | 58.1 | 0.5 | 509.6 | 898.0 |
| 3 | Advanced, engineering, operational systems development | 367.2 | 4269.1 | 93.9 | 55.5 | 13.3 | 4431.8 | 4799.0 |
| 4 | Management and support | 717.8 | 238.5 | 23.2 | 66.5 | — | 328.2 | 1046.0 |
| 5 | Total RDTE[47] | 1570.7 | 4854.9 | 431.1 | 197.2 | 27.4 | 5510.6 | 7081.3 |

[a]Totals by RDTE category are from FYFSFP.

The NSF data are not broken down by performer group for any of the components of RDTE except basic research. DOD's category "Research" is more extensive in coverage than basic research. However, the magnitudes of the two categories are sufficiently close to permit the application of the NSF basic research percentage distribution to performer groups for breaking down the DOD research category. The resulting estimates for research by performer group are shown in row 1 of the cross-tabulation.

Among the performer groups, three were analyzed simply. The foreign group total was estimated and then excluded from further consideration. All RDTE reported under "Educational Institutions" was coded to SIC 8221, "Colleges, universities, and professional schools," and that under "Other Nonprofit Organizations" to SIC 8921, "Nonprofit educational and scientific research agencies." A ratio of value added to sales of 90 percent was applied to the estimated contract values to determine the impact on those two industries. That ratio and the employment–value-added ratios used to estimate employment were derived from OBE and IRS data. The remaining performer groups, the Intragovernmental and the Profit Organizations groups, required further breakdown before SIC industry coding was possible. The process of breaking them down required first the estimation of entries of rows 2, 3, and 4 of Table 3. Methods of estimating the required entries are indicated briefly below. Underlined headings relate to the cross-tabulation.

Column 1, Intragovernmental. The annual RDTE budget as published by the Bureau of the Budget presents obligations data by object classification (i.e., by types of services and articles purchased). For the RDTE appropriation the object classes may be divided into two groups:

(a) Object classes representing support to DOD-performed RDTE, including personnel compensation and benefits; travel and transportation; rent, utilities, and communications; and printing and reproduction.

(b) The "Other services" object class, which includes RDTE contracts performed outside of DOD as well as some services supporting DOD-performed RDTE. Thus, the DOD-performed portion of "Other services" was derived for FY64 as shown in the accompanying tabulation.

| Object class | Cost, millions of dollars |
|---|---|
| Intragovernmental RDTE | 1570.7 |
| Total RDTE obligations—group a object classes | 1053.6 |
| Balance (other services supporting DOD-performed RDTE) | 517.1 |

A finer distribution for DOD-performed RDTE was derived by means of an Air Force object classification that subdivides the Bureau of the Budget object classes into considerable detail.

Row 3, Advanced, Engineering, and Operational Systems Development. The part of advanced, engineering, and operational systems development that was performed by Profit organizations constituted nearly 90 percent of this category and 60 percent of all Defense RDTE in FY64. Coding of that portion of SIC industries was facilitated by the use of descriptive information from DD Forms 613 and from TDPs. The bulk of this category comes within four major

groups, namely, Space, Missiles, Aircraft, and Electronics. For these groups the TDPs of certain large systems were used for distributing the costs to codable components. For example, the Space group was divided into the booster component and certain smaller components. The missiles and aircraft groups are divided into cost groups such as design and aerospace ground equipment. Missiles were also broken down into ground electronics, computation, and the missile itself.

Use was made of applicable procurement prototype information for translating the hardware costs into value added by SIC industry. In the absence of a definite percentage breakdown, the portion of this category assigned to Profit organizations was arbitrarily divided into two equal parts, one representing design and testing costs and the other hardware fabrication costs. The first part was assumed to be 100 percent value added by the contracting industry, although value-added ratios and employment ratios computed for the fabrication were derived from contractor data and from the Census Bureau's 1962 Annual Survey of Manufactures.[11]

Time-phasing adjustments were applied only to that part of Advanced, Engineering, and Operational Systems Development that was performed by Profit organizations. The time-phasing estimates were based largely on information derived from the DD Forms 690.

Row 2, Exploratory Development. This category was assigned to SIC codes on the basis of descriptive program-element material in the FYFSFP and DD Forms 613. The Army portion under the education and other nonprofit groups was assigned entirely to Exploratory Development on the advice of the Office, Chief of Research and Development (OCRD) personnel.

The Navy's Exploratory Development on ships and weapons was assigned to the Intragovernmental groups, and aircraft was assigned one-third to Intragovernmental and two-thirds to the Profit group. Electronics was assigned to the Profit group.

The percentages of the services' Exploratory Development assigned to the Profit group are shown in the accompanying tabulation. In general the assigned SIC codes related to major products that could be associated with specific program elements. The dollar figures were assumed to be 100 percent value added because of the nonhardware nature of the activity.

| Branch of service | Industries | Percentage of each service total assigned to Profit group |
|---|---|---|
| Army | 18 | 35 |
| Navy | 3 | 30 |
| Air Force | 4 | 41 |

Row 4, Management and Support. Coding of this category was accomplished by the direct classification of line items from the FYFSFP and an analysis of Army installations. The latter study revealed that Army Management and Support activity was almost completely in-house, so that the extragovernmental funds were attributed entirely to Navy, Air Force, and other DOD activities.

Projection. Estimates for FY65–FY69 were based on information in TDPs for future costs by program element. Such information was available for a number of systems in the Advanced, Engineering, and Operational Systems Development programs. Where such TDP information was not available, relative distributions to SIC industries were maintained within each service and RDTE category total.

## O&M and Military Personnel

In the categories O&M and Military Personnel the analysis of industry impact depends largely on industry information developed from prime contract awards and industrial-funded activities of the military services. In general, an attempt was made to identify the portion attributable to O&M and Military Personnel of these general data sources. Second-order effects for a dozen major items of expenditure (e.g., petroleum and equipment repairs) were assessed by means of interindustry coefficients developed by OBE. Value-added estimates were derived from industry-wide statistics of Census, IRS, and OBE. FY63 was analyzed in detail because both budget object class and prime contract awards data were available for that year. The distributions based on these data were maintained for all years under consideration.

Control Totals. Budget control totals used for both O&M and Military Personnel appropriations were the direct obligations for FY63.[18] These totals, distributed by the object classification of the Bureau of the Budget,[19] are the most convenient first subdivision of the O&M and Military Personnel budget because they are broad groupings of goods and services into which can be fitted reasonably distinct industry categories consistent with the SIC used by the Bureau of the Budget, the Department of Commerce, and other agencies.[20,21] Table 4 shows the object class structure of the two sets of accounts.

TABLE 4

Percentage Distribution of Direct Obligations by Object Class, FY63

| Object number | Class | Military personnel | O&M |
|---|---|---|---|
| 10 | Personnel compensation and benefits | 89.0 | 38.0 |
| 20 | Transportation | 5.9 | 7.4 |
| 23 | Rent, utilities, and communications | — | 5.8 |
| 24, 25 | Printing, reproduction, and other services | 0.3 | 21.3 |
| 26 | Supplies and materials | 4.7 | 22.2 |
| 31 | Equipment | — | 1.9 |
| 32 | Lands and structures | — | — |
| 41–44 | All other | 0.1 | 0.4 |
| Total direct obligations | | 100.0 | 100.0 |

Prime Contract Awards Data. The prime contract awards data compiled within OSD constitute a major source of information for the identification of goods and services purchased for the several appropriation accounts. This information, for FY63, has been coded to product or service classes according

to the Federal Supply Classification (FSC) system,[22] from DD Form 350, "Individual Procurement Action Report."

Assignment of specific classes of goods and services to the O&M and the Military Personnel appropriation accounts was based on budget descriptions of programs and DOD sources indicating the nature of activities charged to them. All contract awards assigned to O&M and Military Personnel were also grouped into object classes for the purpose of matching against the direct obligations. Comparisons of prime contract awards by object class with the direct obligations from the 1965 Budget document were made to indicate the direct obligations for each object class that cannot be assigned to prime contract awards. The obligations that cannot be assigned to prime contract awards include such items as personnel compensation and benefits; contract awards of less than $10,000; direct payments to military and civilian personnel to cover per diem and incidental expenses incurred while in travel status; purchases made outside DOD without formal contracts (e.g., some utilities, payments to private hospitals or physicians for dependent care, or payments to nonservice schools for training of military personnel); and contract awards to industrial funded DOD activities such as naval shipyards, arsenals, Military Sea Transportation Service (MSTS), Military Air Transport Service (MATS), Army transportation terminals, and naval base facilities. Personnel compensation and benefits account for nearly two-thirds of the total direct obligations not covered by contract awards data for O&M and for about 95 percent in the Military Personnel account. The balance is largely purchases from industrial fund activities (more than 50 percent) and direct payments to individual DOD personnel, other than compensation and benefits.

Coding to SIC Industries. The contract awards data given in the Institute for Defense Analyses document previously cited[22] are distributed by 4-digit FSC codes. Detailed item lists[23] showing all items included within each 4-digit FSC product code were used as a guide in the determination of the SIC industry (or industries) to which the contract items were recoded. All of the O&M and Military Personnel contract awards, referred to previously, were recoded with the assistance of the FSC code item lists. The recoding of contract awards was essentially on a product basis; however, the SIC codes used are industry codes with which the products correspond.

The compensation and benefits (object class 10) for both military personnel and DOD civilian personnel were coded to SIC industry 9190, "Federal Government—Regular Government Functions." The average number of civilian DOD employees was obtained from the 1965 US budget, and the average number of military personnel was estimated from year-end data supplied by OSD.

Coding of the industrial funded suppliers was on an establishment rather than a product basis. The basic source of information on the industrial funded establishments in FY63 was an OSD compilation[24] including two types of tables that were useful in the coding process; (a) statements of revenue and costs, which showed total billings for the year, distributed by broad classes of goods or services and by kind of establishment, and (b) summaries of revenue sources, showing, for each kind of establishment, billings to the most important consumer appropriations. Each type of establishment was coded to a 4-digit SIC industry on the basis of its primary product(s) or service(s), as indicated in the statements of revenues and costs. The coding resulting from this procedure is shown in Table 5.

TABLE 5

SIC Coding of Government Establishments

| Industrial fund | Kind of establishment | SIC industry | |
|---|---|---|---|
| | | Code | Title |
| Army | Arsenals, laboratories, and proving grounds | 9119 | Federal Government—Ordnance and accessories |
| Army | Transportation terminals | 9147 | Federal Government—Transportation services |
| Army | Depot maintenance activities | 9175 | Federal Government—Automobile, repair, automobile services, and garages |
| Army | Depot maintenance activities | 9176 | Federal Government—Miscellaneous repair services |
| Army | Pictorial center | 9178 | Federal Government—Motion pictures |
| Navy | Aircraft maintenance | 91372 | Federal Government—Aircraft and parts |
| Navy | Naval shipyards | 91373 | Federal Government—Ship and boat building and repairing |
| Navy | Naval ordnance plants | 9119 | Federal Government—Ordnance and accessories |
| Navy | Navy publications and printing services | 9127 | Federal Government—Printing, publishing, and allied industries |
| Navy | Naval research activities | 9189 | Federal Government—Miscellaneous services |
| Navy | Naval base service activities | 9135 | Federal Government—Machinery, except electrical |
| Navy | MSTS | 9144 | Federal Government—Water transportation |
| Air Force | Printing and duplicating services | 9127 | Federal Government—Printing, publishing, and allied industries |
| Air Force | Laundry and dry cleaning services | 9172 | Federal Government—Personal services |
| Air Force | MATS | 9145 | Federal Government—Transportation by air |

Estimation of Value Added and Employment. First-order value added was derived by applying Census industry-wide ratios (of value added to shipments) to contract awards by industry. Similarly, employment by industry was estimated generally from Census ratios of employment to value added.

For manufacturing, industries data were available in the 1962 Annual Survey of Manufactures. Recent data on the mining industries had not yet become available when these estimates were made. (Some preliminary data from the 1963 Censuses of Manufacturing and Mining have since been published.) Consequently, data on these industries were taken from the 1958 Census of Mineral Industries.[25]

Estimates for industries other than manufacturing and mining (e.g., agriculture, trade, services, transportation, and utilities) were made primarily from two sources: (a) Survey of Current Business, July 1964 (national income number),[26] OBE; and (b) "Statistics of Income, 1961–1962—US Business Tax Returns," IRS, 1964.[15]

National income data from source a were combined with IRS data from source b for comparable industry groups in order to derive estimates of value added, supplemented by information obtained from source b on depreciation, rent paid, bad debts, and repairs.

The industrial funded DOD enterprises were treated substantially like their privately owned counterparts. Consequently, value added and employment ratios for the DOD enterprises were assumed to be the same as for the civilian enterprises producing the same goods or services.

Second-order impact was derived using the interindustry coefficients for 1958 developed by OBE. For this purpose 4-digit SIC codes were aggregated to match the OBE classification.

The industry impact was traced by these methods to 266 SIC industries for O&M and to 137 industries for Military Personnel. The estimates were consolidated into 50 groups of SIC industries.

Projection to 1969. Investigation of the O&M and Military Personnel accounts for several recent years revealed (a) considerable stability in the percentage distributions of the annual direct obligations among the object classes, (b) a small carry-over of unobligated balances (1 to 2 percent) relative to total obligations in each year, and (c) a relatively stable carry-over in unpaid obligations at the end of each year. It was assumed, on the basis of these indicators, that the economic impact of the O&M and Military Personnel accounts occurs in the year of obligation of the funds. Therefore no timing adjustments were made.

TOA was assumed to be equal to economic impact in each year of the period 1963–1969, and the value added and employment distributions among supplying industries were assumed constant. TOA for FY63–FY69 was taken from the FYFSFP.[27–29]

Military Construction, Family Housing, and Civil Defense

These accounts were grouped to save time as well as to put similar functions together.

TOA for each account in FY63–FY65 was taken from the 1965 budget.[18] Projected TOA for FY66–FY69 are based on FYFSFP documents.

DOD civilian personnel data, as well as data on compensation and benefits for FY63, FY64, and FY65, were obtained from the 1965 budget and coded to SIC 9190. Projections for 1966–1969 were based on TOA projections and the relative sizes of TOA and personnel in 1963–1965. It was assumed that TOA and industrial impact were concurrent.

Family Housing obligations for operating and leasing expenses, debt payment, and mortgage-insurance payments were coded, respectively, to SIC industries 6500, 6100, and 6400. The obligations data covering 1963–1965 for these programs were taken from the 1965 budget, and the 1966–1969 projections were related to TOA projections and the relative sizes of TOA and personnel in 1963–1965. It was assumed that TOA and industrial impact were concurrent.

The construction programs in these appropriations were allocated and coded to SIC industries by means of a set of input coefficients derived from OBE data showing the structure and magnitude of purchases for military construction in 1958. (Worksheets were made available by staff members of the

OBE, National Economics Division.) The technique used to code to SIC industries was similar to that described above for the second-order impact of O&M and Military Personnel. However, the erratic nature of construction volume, overtime, and the length of the construction period required the use of a time-phasing system for this portion of the appropriations.

A time-phasing technique was developed that reflects (a) information supplied by DOD personnel on the time relation of construction activity to the obligation of funds and (b) the technical sequence of construction processes. DOD sources indicated a 3-year impact period for the bulk of military construction, beginning with the year of fund obligation. A reasonable distribution of economic activity related to military construction appears, on average, to be as shown in the accompanying tabulation.

| Year | % of impact |
|---|---|
| Year of fund obligation (y) | 30 |
| y + 1 | 60 |
| y + 2 | 10 |
| Total | 100 |

As stated above, the set of coefficients that were developed for military construction identify supplying industries. The supplying industries were assigned to the impact years y, y + 1, and y + 2 as follows: (a) to year y, all industries supplying inputs to military construction in the form of crude materials, equipment, and services for use in activities preparatory to basic construction activity; (b) to year y + 1, industries performing services roughly coincident with the basic construction activity or producing materials and equipment preparatory to the finishing construction processes; and (c) to year y + 2, industries whose materials or services would likely be produced coincident with the performance of the finishing construction work.

Table 6 shows the assignment of supplying industries, with their SIC codes and input coefficients.

The implied balance in the percentages of year y to be assigned to the construction industries is shown in the accompanying tabulation.

| Area | Year | | |
|---|---|---|---|
| | y | y + 1 | y + 2 |
| Obligations for construction | 30.000 | 60.000 | 10.000 |
| Inputs from outside construction industry | 25.069 | 20.633 | 2.934 |
| Value added by construction industry | 4.931 | 39.367 | 7.066 |

The total construction value added was arbitrarily assigned to three industries in the percentages shown in the accompanying tabulation.

| SIC industry | % |
|---|---|
| 1511 (General building contractors) | 60 |
| 1600 (Construction other than building construction, general contractors) | 30 |
| 1700 (Construction—special trade contractors) | 10 |

TABLE 6

Time-Phased Inputs to Military Construction, Initiated in Year *y*, by Supplying Industry and Relative Input Volume

| SIC code | Supplying industry | Input coefficient (fraction of gross volume of construction) |
|---|---|---|
| | **Inputs in Year *y*** | |
| 1450 | Clay, ceramic, and refractory minerals | .01126 |
| 2420 | Sawmills and planing mills | .01043 |
| 2661 | Building paper and building board mills | .00314 |
| 2810 | Industrial inorganic and organic chemicals | .01588 |
| 3250 | Structural clay products | .03164 |
| 3270 | Concrete, gypsum, and plaster products | .03164 |
| 3300 | Primary metal industries | .01474 |
| 3420 | Cutlery, hand tools, and general hardware | .01010 |
| 3440 | Fabricated structural metal products | .08959 |
| 3461 | Metal stampings | .00451 |
| 3531 | Construction machinery and equipment | .00456 |
| 3540 | Metalworking machinery and equipment | .00002 |
| 3560 | General industrial machinery and equipment | .00168 |
| 3599 | Machinery and parts, except electrical, n.e.c.[a] | .00004 |
| 3620 | Electrical industrial apparatus | .01156 |
| 3710 | Motor vehicles and motor vehicle equipment | .06002 |
| 3720 | Aircraft and parts | .00309 |
| 3730 | Ship and boatbuilding and repairing | .00003 |
| 6000 | Banking | .00616 |
| | Total | .25069 |
| | **Inputs in Year *y* + 1** | |
| 2290 | Miscellaneous textile goods | .00011 |
| 2390 | Miscellaneous fabricated textile products | .00030 |
| 3550 | Partitions, shelving, lockers, and office and store fixtures | .01021 |
| 2700 | Printing, publishing, and allied industries | .00011 |
| 3000 | Rubber and miscellaneous plastics products | .00541 |
| 3211 | Flat glass | .00277 |
| 3510 | Engines and turbines | .00093 |
| 3535 | Conveyors and conveying equipment | .00095 |
| 3582 | Commercial laundry, dry cleaning, and pressing machines | .00124 |
| 3640 | Electric lighting and wiring equipment | .01376 |
| 3690 | Miscellaneous electrical machinery, equipment, and supplies | .00131 |
| 3829 | Instruments for measuring, controlling, and indicating physical characteristics | .00319 |
| 3982 | Linoleum, asphalted-felt-base, and other hard-surface floor covering, n.e.c.[a] | .00111 |
| 4000 | Railroad transportation | .02569 |
| 4811 | Telephone communications (wire or radio) | .00160 |
| 4900 | Electric, gas, and sanitary services | .00721 |
| 5900 | Wholesale trade | .07635 |
| 7390 | Miscellaneous business services | .01507 |
| 7500 | Automobile repair, automobile services, and garages | .00365 |
| 8000 | Medical and other health services | .00036 |
| | Total | .26693 |
| | **Inputs in Year *y* + 2** | |
| 1700 | Construction—special trade contractors | .00010 |
| 2850 | Paints, varnishes, lacquers, enamels, and allied products | .00894 |
| 2900 | Petroleum refining and related industries | .02925 |
| 3199 | Leather goods, n.e.c.[a] | .00001 |
| | Total | .02934 |

[a]Not elsewhere classified.

The data computed for the three construction industries were in value-added terms. Also, the compensation and benefits of the civilian DOD personnel (SIC 9190) were recoded as value added. However, inputs to construction from supplying industries represent gross production. Value added was estimated from these figures by the methods described above for O&M and Military Personnel. Similarly, the employment for all industries (except SIC 9190) was estimated by the methods described for O&M and Military Construction.

Military Assistance Program (MAP)

The MAP estimates represent an extremely crude first approach to measurement of economic impact for this program. A number of obvious problems have been ignored for the present because of time limitations.

The methodology used in this phase consists of the following steps:

(1) Obligations for FY63 were totaled from the MAP report [DD Compt (M) 355][30] for the following classes of goods and services, accounting in the aggregate for about two-thirds of TOA:* (a) aircraft; (b) ships; (c) combat vehicles; (d) support vehicles; (e) ammunition; (f) guided missiles; (g) electronic and communication equipment; (h) construction equipment; (i) technical assistance; (j) transportation; and (k) packing, crating, handling, and loading.

(2) The allocation of total value for 6-line items, namely, aircraft, combat vehicles, support vehicles, ammunition, guided missiles, and electronics to a few industries accounts for the preponderance of their values added in the procurement section of this report.

(3) For the other line items—ships; construction equipment; transportation; technical assistance; and packing, crating, handling, and loading—value added and employment were obtained by the method already outlined for O&M and Military Personnel.

(4) No time-phasing was attempted for this account because no basis for such an adjustment was available.

## FINDINGS

As noted earlier, the study's objective was primarily methodological, and the numerical results that were obtained served as a testing ground for further refinement of our estimating techniques. The quantitative estimates are therefore largely exploratory and should be regarded as a first approximation rather than a precise measurement of impact for each of the industries covered. They are presented as illustrative of the types of results that these techniques can yield. In order to keep Vol I unclassified, the illustrations are confined to summary examples of our estimates for the year 1963; in addition, specific industry figures are combined by size groups or shown in percentage terms to avoid disclosure. Classified data appear in Vol II and also in the tables that were formally submitted to OSD.[3]

*Procurement of new aircraft, ships, and missiles is charged to the Military Assistance Defense appropriation. Materiel supplied under the MAP, which is surplus relative to the needs of US forces, is not charged to this appropriation, except for the cost of rehabilitation and transportation.

## Defense Employment

For the purpose of summarizing the findings the 1963 employment for all defense-generated activities, shown in the accompanying tabulation, was estimated at 6.7 million persons. Of this total, private industries accounted for 3.2 million or 47 percent. It should be noted that the public sector includes both military and civilian personnel.

| Activity | Thousands of persons |
|---|---|
| DOD | 3573 |
| Private industries | 3154 |
| Total defense activities | 6727 |

Within the private sector, more than 400 4-digit SIC industries were identified. Table 7 indicates that the largest of these—aircraft (SIC 3721) and electronic transmission and detection equipment (SIC 3662)—included respectively more than 200,000 employees. Guided missiles (1925), and aircraft engines and parts (3722) were in the next size category. The 19 top industries accounted for 50 percent of private employment.

TABLE 7

Defense Employment in 1963: The Largest Private Industries

| SIC code | Industry title | Employment, thous of persons |
|---|---|---|
| 3721 | Aircraft | > 200 |
| 3662 | Electronic transmission and detection equipment | > 200 |
| 1925 | Guided missiles | 100–200 |
| 3722 | Aircraft engines and parts | 100–200 |
| 3731 | Shipbuilding and repairing | 50–100 |
| 3679 | Electronic components and accessories, n.e.c. | ↓ |
| 3729 | Aircraft parts and auxiliary equipment, n.e.c. | |
| 8221 | Colleges and professional schools | |
| 3621 | Electric motors and generators | 50–100 |
| 7391 | Research, development, and testing labs | 20–50 |
| 3811 | Engineering, laboratory, and scientific equipment | ↓ |
| 3571 | Computing and accounting machines | |
| 1511 | General building contractors | |
| 1929 | Ammunition, n.e.c. | |
| 8921 | Nonprofit educational and scientific research | |
| 1311 | Crude petroleum and natural gas | |
| 3674 | Semiconductor (solid state) devices | |
| 3511 | Steam engines, turbines, generator set units | ↓ |
| 3599 | Nonelectrical machinery, n.e.c. | 20–50 |

In terms of the major budget categories (whose funds have a direct effect on private employment) these industries participate in numerous economic activities including research, production, and maintenance. It is clear from the data shown in Table 8 that each industry produces goods and services that are identified with a variety of budget functions and probably also with a sizable number of weapons systems and other items of equipment.

TABLE 8

1963 Defense-Employment Size Classes, Selected Industries, by Major Budget Source[a]

| Major budget source | SIC code | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1511 | 1925 | 3621 | 3662 | 3679 | 3721 | 3722 | 3729 | 3731 | 3811 |
| Procurement | D | B | B | A | A | A | A | A | A | B |
| RDTE | D | A | D | A | — | B | C | C | D | D |
| O&M | D | D | — | — | — | D | D | — | D | D |
| Military assistance | — | D | D | D | D | D | D | D | — | D |

[a]Employment in thousands of people: A, 50 or more; B, 25 to 49; C, 10 to 24; D, 1 to 10.

TABLE 9

Percentage Distribution of 1963 Value Added, by Industry, for Selected Procurement Groups

| Industry | Fighter aircraft | | Missiles | | Surface ships | |
|---|---|---|---|---|---|---|
| | SIC[a] | % | SIC[a] | % | SIC[a] | % |
| 10 largest, by SIC | 3721 | 29 | 3662 | 27 | 3731 | 30 |
| | 3662 | 10 | 1925 | 17 | 3511 | 14 |
| | 3679 | 9 | 3722 | 15 | 3662 | 8 |
| | 3722 | 7 | 3621 | 10 | 3443 | 4 |
| | 3729 | 6 | 3729 | 4 | 3621 | 3 |
| | 3811 | 5 | 3721 | 2 | 3519 | 3 |
| | 3011 | 4 | 2892 | 2 | 3323 | 3 |
| | 3599 | 2 | 7391 | 2 | 3312 | 2 |
| | 3511 | 1 | 3679 | 1 | 1999 | 2 |
| | 3621 | 1 | 3674 | 1 | 3571 | 2 |
| Subtotal | | 74 | | 79 | | 71 |
| Other identified industries | | 13 | | 10 | | 8 |
| Unallocated | | 13 | | 9 | | 21 |
| Total | | 100 | | 100 | | 100 |

[a]See Table 7 for industry titled associated with these codes. Codes not shown in Table 7 are: 1999, ordnance and accessories n. e. c.; 2892, explosives; 3011, tires and inner tubes; 3312, blast furnaces, steel works, and rolling mills; 3323, steel foundries.

## Procurement

In the analysis of procurement it is possible to view this participation more explicitly by examining several selected equipment groups. Table 9 indicates the proportion of employment in leading industries (on a 4-digit SIC basis) generated by DOD purchases of each type of equipment.

The data in the table are illustrative of the industry patterns associated with procurement of different types of equipment. In general, for all equipment groups, the top 10 industries account for a large proportion of total employment, from about 70 to 85 percent. The proportion for individual industries, of course, should be regarded only as roughly indicative of their importance in


AIRFRAME
ENGINE
ELECTR
2821 Plastics materials, etc.
3011 Tires and tubes
3079 Miscellaneous plastics products
3211 Flat glass
3296 Mineral wool
3312 Blast furnaces . . . rolling mills
3316 Cold rolled sheet, strip, and bars
3323 Steel foundries
3334 Primary production of aluminum
3339 Primary smelting and refining of nonferous metals
3361 Aluminum casting
3362 Brass, bronze, copper base alloy castings
3369 Nonferrous castings, n.e.c.
3391 Iron and steel forgings
3392 Nonferrous forgings
3399 Primary metal industries, n.e.c.
3423 Hand tools (except edge tools . . . files and saws)
3429 Hardware, n.e.c.
3443 Boiler shop products
3452 Bolts, nuts, screws, rivets, and washers
3461 Metal stampings
3479 Coating, engraving, and allied services, n.e.c.
3481 Miscellaneous fabricated wire products
3494 Valves and pipe fittings, etc.
3499 Fabricated metal products, n.e.c.
3511 Steam engines, turbines, and turbine generators, etc.
3533 Oil field machinery and equipment
3541 Machine tools, metal cutting types
3542 Machine tools, metal forming types
3544 Special dies and tools, etc.
3562 Ball and roller bearings
3564 Blowers, exhaust, and ventilating fans
3569 General industrial machinery and equipment, n.e.c.
3599 Miscellaneous machinery, except electrical
3611 Electrical measuring instruments, etc.
3612 Power distribution and specialty transformers
3621 Motors and generators
3622 Industrial controls
3629 Electrical industrial apparatus, n.e.c.
3635 Household vacuum cleaners
3641 Electric lamps


Fig. 2—Industry Distribution of Value Added for the F-4 Aircraft by SIC and Industry Title

each equipment group. The industry percentage cannot be considered precise because of the presence of the unallocated portion (ranging from 10 to 24 percent, and also the frequency of 2- and 3-digit SIC categories among the roughly 400 codes that were covered. Furthermore the identification of industries depended in large measure on the degree of probing of second- and third-tier suppliers. Despite these handicaps and caveats it is not surprising that there is concurrence of applicable leading industries within the aircraft, the ship, and ammunition groups. For example, within each of the three aircraft categories, SIC industries 3721, 3722, and 3729 (see Table 7 for industry titles) were, as expected, considerably important. Likewise, there is similarity of industries in the two ship categories where 3731, 3662, and 3511 (see Table 7) rank high.

As indicated in Table 9, the 10 largest industries were found to account for a large proportion of value added and total employment (from 70 to 85 percent) for each of the equipment groups. Below this level there was considerable diffusion of impact, with a large number of SIC industries involved, each accounting for relatively small proportions of total value added and employment for the equipment group. Figure 2 illustrates this diffusion for the F-4 aircraft exemplar, showing value-added contributions identified to 60 SIC industries.

TABLE 10

Percentage Distribution of Defense Employment in 1963, by Procurement Category

| Procurement categories | Distribution, % |
|---|---|
| Fighter aircraft | 28 |
| Transport and utility | 9 |
| Helicopters | 3 |
| Missiles | 22 |
| Surface ships | 6 |
| Submarines | 7 |
| Electronics and communications | 10 |
| Torpedoes and ammunition[a] | 6 |
| Combat and support vehicles[b] | 3 |
| Civilian-type items | 6 |
| Total procurement | 100 |

[a]Includes 3 categories for which separate estimates were made.
[b]Includes 2 categories for which separate estimates were made.

Another set of statistics bears on the relative importance of each of these equipment groups in the total procurement category. As noted earlier, these play an important part in the weighting of industry contributions. Table 10 presents these data for 1963; the proportions are of course not representative of all years covered in our analysis.

## LIMITATIONS AND SUGGESTIONS

The requirement for quick and crude estimates of defense impact imposes, as one might expect, certain limitations on the research process and hence on the findings. The purpose of this section is to identify these limitations so that they may be taken into consideration when the findings are analyzed and the overall task is evaluated. In addition, it affords an opportunity to select priorities among the research areas requiring improvement during the subsequent research phases.*

The procurement prototypes absorbed our major research attention. The assignment of 800 Materiel Annex items to one or another of 13 equipment groups involved an assumption that the prototype system or component that was selected in each specialized equipment group is representative of all items in its group for purpose of industrial impact. A problem quickly arose of assigning certain items to particular groups. Quick judgments have to be made for questions such as: Should torpedoes, bombs, and mines be in one group? Should other explosives be included in this group? What military items, if any, should be assigned to the civilian-type group? One possible solution to the problem of nonhomogeneity within a given group is to develop additional specialized equipment categories.

Another problem in this area concerns the assumption of proportionality for support items (e.g., spares, ground-handling equipment, and ground-support equipment) to end items (e.g., aircraft, missiles). Not only were the dollar values of the end items used for distributing the value of support items among various types of aircraft and ships but also spares had to be distributed to the weapon system's major components (e.g., airframe, engines, electronics) using end-item proportions. Given sufficient time, an intensive study of these support goods and services would be desirable to test the proportionality assumption as well as to investigate the possibility of alternative approaches. This type of analysis was scheduled for a later phase of research during the summer of 1965.

Another problem concerns the budget backup data (described in step 2) that provide breakdowns by component elements for weighting purposes. If a new system entered the inventory in 1965, data were shown for that year. However, for new systems acquired after 1965, no budget backup data are available so that the component mix for future years is in doubt. This is especially important for components subject to rapid change (e.g., electronics). For several items (e.g., torpedoes) budget backup data could not be found for any year. Furthermore, when they were available, certain inconsistencies were noticeable. Each of the services reported component breakdowns in a different manner in several areas. Within a given service there seemed to be no uniformity of detailed breakdown reporting; e.g., unlike other missiles the Pershing data included no value for airframe.

*In addition to the research limitations discussed below, there were a number of administrative constraints affecting the project. For example, in establishing liaison with one of the services and validating our "need to know," we had to stipulate in advance the weapons systems to be studied. We were thus, in effect, "locked-in" on a set of equipment items for which contract and budget backup data could be obtained. An attempt to avoid such a narrowly construed scope of interest in favor of a broader charter of study appears advisable.

A number of flaws in the contract analysis may be classified under the general rubric of sampling. In the selection of contracts for analysis of industry value-added distributions, there was usually no problem of identifying the proper contract for the major element (e.g., airframe, engine). For other components (e.g., electronics) the choice of sample items from the universe of all government-furnished equipment (GFE) electronics was often based on little evidence concerning their representativeness for impact purposes, in the absence of complete listings of all relevant items. Occasionally listings were available from several sources, e.g., Government Furnished Aircraft Equipment Requirement Schedule (Form DD-610), and the Budget, Planning, and Programming Guide (BPPG); however, time did not permit extensive searches for such forms. Many of these were apparently not available in Washington.

A similar situation prevailed in selecting supplying plants within a particular contract. Only the larger of many suppliers (of say raw materials or parts) were studied. This also could have led to biased results.

A limitation with respect to data sources relates to the fact that contractor-supplied information was occasionally in error. Wrong firm names and addresses were offered and a considerable amount of effort was made to identify several of these correctly from public sources.

The search for data, pursuant to the general ground rule of reaching two-thirds to three-fourths of value added, resulted in different degrees of probing among contracts. In one case the required level of value added was reached by going no deeper than the second tier. In other cases, third- and fourth-tier levels were examined.

Another issue pertains to the differences in definition of value added. In the contract analysis, nonembodied inputs are included as overhead items and, therefore, in value added. These estimates are combined with noncontract estimates of value added obtained from Census ratios, which defined value added to exclude these nonembodied inputs. It is planned in the next "go-round" to adjust the value-added estimates to approximate the Census definition. Furthermore the Census ratios are based on industry-wide proportions, and these may be out of line with the proportions for military goods even in the same industry. It is hoped that the results of the 1963 Census survey of defense-oriented industries (MA-175) will provide help in this matter.

When contracts included multiple items it became difficult to segregate the industry impact of one of them (e.g., fire-control director) from others of the same contract (e.g., radios).

With respect to coding, several features have already been mentioned. Perhaps they may be reiterated here. Because of the disparate forms of available data, a mix of product and establishment (plant) coding had to be used. This is prevalent not only in Procurement, but also in RDTE and O&M. For example, in O&M the line-item designations of prime contract awards were coded on a product basis, whereas industrial funded activities of DOD (e.g., arsenals, shipyards) could be coded only on an establishment basis.

Another coding problem relates to the Census rule against disclosure of establishment SIC codes. In order to simulate the Census code, sources such as Dun and Bradstreet, Fortune, and Poor's were utilized. These sources were occasionally inconsistent among themselves in the way they coded particular

establishments. One way of ascertaining the possible distortion involved here would be to request Census to run a test comparison of a large sample of our codes.

Another problem affecting coding relates to the level of aggregation of our sources. When OBE interindustry sectors were used (as in the case of civilian-type procurement items, O&M and Military Personnel), data beyond second-digit details were often not available. In addition, incomplete identification of products in contract records prevented 4-digit classification in some cases. Accordingly, there is a mixture of 2-digit, 3-digit, and 4-digit codes in our final summary tables. Although the employment and value-added figures for these are not duplicative, some adjustment ought to be made to put them on a 4-digit basis, perhaps by further study of unpublished input-output worksheets.

In O&M and Military Personnel, where prime contract award data were employed, it became necessary to convert these data from FSC codes to the SIC basis. The conversion is approximate since no accurate conversion techniques apparently exist. The development of such techniques through sampling and other procedures is required. It is expected that a future research assignment will improve this conversion capability.

The study's time-phasing procedure was carried out in a highly aggregated manner based partly on data from DD-690[30] and DD-1177[31] and selected budgetary and Weapons Dictionary[12] information dealing with administrative and production lead-times. Accordingly the general factors used to time-phase the TOA numbers are highly tentative. In addition, in the absence of readily available TOA data for ' · years prior to 1963 the prime contract award series, by type of major equipment, was used to extrapolate the TOA back to earlier years in order to reflect time-phased impacts for long lead-time groups of items. It is recognized that conceptually the contract award series is somewhat different from TOA.

Another major defect of the time-phasing process is that in procurement groups the same time of impact has been assumed for all industries in a given prototype analysis. It is clear that the time of impact for a raw material industry would be different from that of an industry concerned largely with fabrication and assembly. In addition, some distinction should be made for differential time-phasing by major components; it is planned to incorporate this improvement in the next research phase.

In general, these comments suggested the need for study in depth of several weapon systems and perhaps in several different budgetary accounts in order to develop a more reasonable time-phasing procedure. In the follow-on phase of research, this procedure was carried out for the procurement prototypes that contained component breakdowns.

In general, the final results do not divide goods and services produced outside the US. In some accounts (e.g., RDTE) an attempt was made in worksheets to keep these data separate. Although the problem is relatively small, there may be some need for identifying the net domestic impact.

Our study of DOD civilian personnel, completed shortly after the impact estimates described in this paper, contains separate estimates for industrial-funded activities (e.g., arsenals, shipyards). These estimates of value added and employment, classified according to their primary industrial-type activity and also to budgetary source of funds (e.g., O&M, Procurement), provide additional detail in the Government section.

Another problem relates to the handling of SIC industry 6512, "Operators of nonresidential buildings." Information received after the final tables were completed suggests that our data source—namely, the contract awards series—was in error since the activities coded here include such services as contract engineers for service on the distant early warning (DEW) line. Proper coding would probably substitute several other industries, mainly 7391, "Research, development, and testing laboratories," and 8911, "Engineering and architectural services." A start has been made toward revising the codes as indicated. Additional information can be searched in the next phase.

The OBE interindustry data for 1958 provided a major source of information on second-order impact, especially in the nonprocurement areas. For military construction, especially missile sites and other items that are acutely sensitive to changes in technology, these coefficients are probably outdated. Further study of unpublished military construction data in the services was performed and appears to provide better source material.

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