Evaluating the Availability, Role and Performance of Subcontractors in the Aerospace Industry

Executive Summary

to

Air Force Business Research Management Center
Wright-Patterson Air Force Base
Ohio 45433

by

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Executive Summary

This study examines the feasibility of developing a subcontractor database for use in industrial base identification and planning, and of the prime contractor decision to make or buy components from firms in the subcontract/vendor private portion of the defense industrial base. The project has three tasks: to identify aerospace subcontractors, to investigate databases on privately held firms and to examine prime contractor decisions to make or buy components from subcontractors or vendors.

In completing the first task two alternative approaches are possible. The first is a direct approach and involves the identification of specific firms who either continuously or occasionally sell raw materials, parts and components, and subassemblies to prime contractors. The second is indirect and involves a specification of an industrial base pyramid. At the apex of the pyramid are the system assemblers with raw material suppliers at the base. Components in the pyramid represent particular industry groupings. In identifying aerospace subcontractors the second approach is used because this approach is more useful from a planning perspective and because there is no systematic record regarding the use of

specific subcontractors by those firms holding prime contracts with the Air Force. Acquisition planning and production base analysis require that the specific supply activities which naturally form the pyramid be identified with as many firms included as possible.

The investigation of databases on privately held firms is necessary because such firms represent a significant portion of the American economy. The types of information required to complete industrial base identification include product, production and financial information. At the present time there is no single data base which provides all three kinds of information at the micro or firm level. Product information in terms of four digit Standard Industrial Classification (SIC) Code is available for 8.1 million firms included in the Small Business Administration, Office of Advocacy (SBAOA), Master Establishment List (MEL). The information in this database for small business firms is compatible with the information available in the Economic Information Service (EIS) database showing plants or establishments of SEC registered corporations in the United States. Thus use of the MEL data information on small business establishments and the EIS data information on establishments of listed corporations provides access to virtually the entire industrial base of the United

States, at the establishment level and vendor level, and provides a means of increasing contractor/subcontractor/vendor bidding lists.

The completion of the third task involved a telephone and personal interview effort with a spectrum of companies doing business with the Air Force. On the basis of these interviews it was concluded that there is no single factor which dominates the make-or-buy decision. Rather, the make-or-buy decision is made in an environment of a number of varied and dynamic constraints. These include facility, skill capability, production capacity and utilization, time frames, regulatory and financial considerations. Moreover, the make-or-buy decision is managed, in each firm contacted, by a committee that is guided by a set of standard operating procedures. These procedures do not, however, establish (published) priorities for the factors to be evaluated. The survey provided no support for the hypothesis that the make-or-buy decision is determined solely by cost considerations.

Beyond these three specific defined tasks, production base analysis is discussed as it relates to the consideration of databases, establishments and enterprises and make-or-buy decisions. Two points should be emphasized. First, there are strong parallels in the conceptual framework of production

base analysis and acquisition planning. For both production base analysis and acquisition planning it is most useful to take a broad, economy wide perspective to industrial base considerations. Second, the demands for data are similar as well: production base analysis and acquisition planning both require product and production information. Both can be made more effective if supplemented with financial information. At the present time the same kinds of data limitations that constrain acquisition planning also constrain production base analysis. To this end, efforts to obtain more and better product, production and financial information for both public and private firms will provide dividends in a variety of areas.

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Final Report

to

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by

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TABLE OF CONTENTS

APPENDICES

Chapter 1

Introduction

Both the Department of Defense (DOD) and the Air Force have become increasingly concerned with the structure and viability of the defense industrial base, those business firms that are or may be capable of providing required military goods and services. This concern arises because information regarding industry structure and viability is needed for production base analysis or strategic planning and for more effective acquisition. The concern extends not only to the so-called first tier firms who are the prime contractors on major weapons systems but also to second and third tier firms who are subcontractors and to vendors who provide follow up supplies, services and raw materials. In examining the defense industrial base there is no difficulty in identifying prime contractors or in obtaining financial and production information on them for they tend to be large public corporations registered with the Securities and Exchange Commission (SEC). The problem in assessing the defense industrial base arises in the second, third, and fourth tiers. These latter firms tend to be smaller and many are privately held corporations, partnerships, and sole

proprietorships. Consequently, public production and financial information may not be available for them, preventing the type of industrial base planning and acquisition envisioned by DOD and the Air Force.

As for the specific concerns of this study, the overall purpose is clearly identified in the Scope Statement of the contract:

> This study examines the feasibility of developing a subcontractor data base for use in industrial base identification and planning, and of the primary contractor decision to make or buy components from firms in the subcontractor/vendor/contractor private portion of the defense industrial base.

The Scope Statement continues by identifying the three major tasks which are to be accomplished: (i) identifying aerospace subcontractors, (ii) investigating databases on privately held firms, and (iii) examining the prime contractors' decision to make or buy components from subcontractors and vendors. With respect to the organization of this final report, Chapter 2 is concerned with the first task (also identified as Task 4.1 in the Statement of Work). Chapters 3 and 4 report on the second task (also identified as Task 4.2 in the Statement of Work) while Chapter 5 discusses the third task (also identified as Task 4.3 in the Statement of Work). Chapter 6 is an effort to relate the work undertaken in completing these tasks to production base analysis. The final

chapter offers a summary and conclusions. The remainder of this introductory chapter attempts to provide further background on the kinds of information needed for industrial base planning and acquisition, the availability of such information, and an overview of the importance of this study.

The Need for Information

Planning can be defined as the selection and relation of facts regarding the formulation of proposed activities in order to achieve a given goal. One goal of DOD and the Air Force is the effective use of acquisition dollars, securing the timely delivery of quality items at the lowest possible cost. Achievement of this goal requires, in part, financial information on suppliers. The DOD is unlikely to secure what it desires from a firm on the verge of financial collapse.

Another goal or concern of the DOD and the Air Force is the availability of surge capacity in the industrial base: can American industry respond quickly and effectively to a sudden and unexpected demand for military materials? In this instance planning requires information regarding production as well as financial conditions.

With these two goals in mind, the types of information necessary for the completion of effective planning activities and effective acquisition can be specified. The first type

of information is product information, information indicating which firms are currently producing particular products as well as which firms, although currently not producing the products, are capable of producing them. The goal is to obtain bids from the largest possible number of firms. Bidding competition can serve as a mechanism for assuring low cost and high quality. Product information is necessary, therefore, for it is a requirement in preparing an appropriate bidding list. But product information is also necessary for strategic planning; indeed, it is the first step in determining what the capacity of American industry is as it relates to the manufacture of particular products.

Two major alternative forms of product information are available. One alternative relies on Standard Industrial Classification (SIC) coding; that is, an SIC code will indicate the major industrial classification of a firm -- for example, whether it is a producer of electrical machinery or apparel. The problem with this type of product determination is that it may be too aggregative even at the four digit level. For example, the Air Force might be interested in securing bids on electrically heated windshields from all firms currently producing or capable of producing these items. A search of firms using the SIC

classification will not provide information at this detailed a level.

The alternative to SIC product identification can be called self-identification where the firm itself describes in its own words the various products that it makes. An example of such an approach is the Small Business Administration's Procurement Automated Source System (PASS). In a questionnaire (SBA Form 1167) which is completed by the company, the firm is asked to "list products and services offered and special capabilities". The firm is also asked to do this within a limit of 32 words. A search through the PASS system is accomplished on the basis of key words. Thus a firm which produced electrically heated windshields but only used the word "windshield" in the product identification would not be included in a bidding list that used the key words "electrically heated windshield". In short the self description approach may lack appropriate precision.

There is a middle ground between the extremes of SIC coding and self description. An example of this is the product listings developed by trade directories such as the World Aviation Directory. The basic approach involves questionnaires and relies on self description. Repeated issues of the Directory will be suggestive of appropriate

classifications and standardization is likely to occur over time. In this instance a bidding list can be obtained directly from the publication itself and at the appropriate level of product detail. The problem here is that a firm may not find it useful to have itself listed in a trade directory.

The second type of information, useful for acquisition and strategic planning is production information. Here the concern is with the firms' capacity to produce the product, the size and age of its plant, the number of its employees, even its recent production history. With this kind of information, estimates of the firms' ability to produce particular items at particular rates can be made. Production information can be used to establish production structures with capacity and capacity utilization indicated for firms at each tier level. Production delays at one tier level may be due to full capacity utilization at that tier level or at a lower tier level. These kinds of relationships are generated using production information and form the basis for production base analysis.

The third and final category of information is financial. It would include, as a minimum, income statement and balance sheet information. The financial information is useful for

strategic planning because it provides an additional dimension to size and effectiveness considerations as indicated by the firm's economic viability. This viability in a free enterprise market economy is determined and reflected by its financial health. From the perspective of a bidding list, it might be useful to distinguish financially healthy firms. And, the actual terms of an acquisition contract may be affected by information which a contract officer has regarding the firm's current financial situation.

Clearly, strategic planning and acquisition require the three different types of information. The quality of analysis and decision making is dependent partly on the quantity and quality of information regarding the firms, and partly on the relations between firms: which companies supply which firms with which products? These inter-firm relations are not a normal part of any conventional data set.

To summarize the discussion to this point, strategic or industrial base planning, production base analysis, and acquisition procedures, if they are to be accomplished effectively, require: product, production, and financial information. In addition it would be useful if information regarding inter-firm relations were available.

Obtaining Necessary Information

There are a number of procedures that have been used in order to obtain product information. Reference can be made to SIC coding, various self-description systems, and trade directories. At this point, it is only necessary to indicate that most data sets will have some sort of product information. Using these data sets, it is possible to identify firms which produce specific products. If the objective is to increase a bidding list, a number of data sources could be employed that extend across the range of business organization forms (corporations, partnerships, and sole proprietorships), the range of business ownership (public and privately held corporations), and the range of business sizes (large and small firms). It is to a firm's advantage to make known the products it produces, for the more widely available this information the greater the number of potential customers. It is not difficult to obtain product information, but the completeness, accuracy and reliability of such information is subject to question.

If product information is relatively easy to obtain, production information is obtained only with difficulty. One reason for this difficulty is the lack of any systematic, legally imposed reporting requirements. Although firms may be required to report numbers of employees, there are no

similar requirements regarding plant size, plant age, normal production capacity, maximum production capacity, etc. And unlike the incentives to the firm to make product information widely available, a firm has an incentive to make production information public only if such information is favorable. For example, a firm may be reluctant to reveal a very small or a very old plant or that it is currently operating well below normal production capacity.

As for financial information, there appears to be a dichotomy. First, there are publicly held corporations who are required to register with the SEC and to file income statement and balance sheet information. For these firms then there is a wealth of available financial information. Indeed, a number of financial information companies such as Standard and Poor's and Disclosure Inc. are licensed by the SEC and have prepared computer readable data sets which contain this financial information. There is an additional advantage with these data in that there is a consistency between firms because the financial statements are prepared according to normal accounting standards. This is not to say that no financial information is available for businesses that are not registered with the SEC. There is a reason which encourages such firms to make financial

information available. The incentive in this instance is to obtain a credit rating from credit rating firms such as Dun & Bradstreet. But not all non-SEC registered firms will find it necessary to obtain such credit ratings.

At this point it is appropriate to narrow the focus of the discussion to the defense industry. Any firm that contracts directly with the DOD is identified in DD Form 350 as a prime contractor. A prime contractor in this context may be the supplier of a major weapon system, or may have been a subcontractor/vendor on the major weapon system (supplying parts, components and/or subassemblies to the prime contractor) who now is supplying DOD directly with follow on parts for repair and maintenance of the system. Consider General Dynamics, the prime contractor of a major weapons system. General Dynamics may rely on a large number of other firms for assistance in completing its project. From the standpoint of strategic planning (and follow on acquisition) it would be essential for DOD to know all of the firms, all of the subcontractors/vendors, utilized by General Dynamics. But DOD does not require and is not provided with

such information; rather prime contractors are only required to identify major/critical components at the time the contract is signed. Thus, General Dynamics on receiving a prime contract for an airframe system might identify the Pratt and Whitney engine division of United Technologies Corporation as a major/critical subcontractor but would not identify firms that might supply transducers, gyros, cables, fasteners or fuel line tubing to itself or to Pratt and Whitney.

Col. B.E. Voorhis, USAF, Director of Subcontractor Management Section at the Air Force Contract Management Division, AFCMD/OD(SM), was interviewed and stated that major/critical subcontractors are designated as a function of the critical nature of the components (products, components and/or subassemblies) made for a weapons system. Thus, the critical nature of a component may be evaluated on the basis of: 1) its contribution to the performance of the system, 2) its impact on the delivery schedule of the system, or 3) or its impact on the cost scheduling of the system. The decision on the major/critical nature of the component is made by the Air Force Systems Program Office (SPO) in coordination with the prime contractor. The components judged to be critical

constitute the list of the subcontractors who are then monitored for contract compliance by the SPO and the prime contractor. This, then, forms the basis for the list of major/critical subcontracts, listed by contractor. The list is dynamic, based on the changing nature of the components from one weapons system to another, and for a given weapons system over time.

It would appear then that there is no problem in identifying DOD prime contractors which can be done from DD Form 350. To the extent that these prime contractors are SEC registered corporations who have a credit rating from one of the credit rating agencies, financial information would be readily available. Product data would also not be difficult to obtain. However, production information and the dependency of the firm on subcontractors/vendors would be very difficult to obtain, especially the latter. In other words some assessment of first tier firms in the defense industrial base is possible. The assessment of second, third, and fourth tier firms is much more difficult. But even if all subcontractors/vendors were known, production data would still be difficult to obtain.

An Overview

In an era of rapidly increasing defense expenditures and general economic distress, questions regarding the viability

of the defense industrial base are to be expected. The situation regarding prime contractors is of the utmost importance but it is a situation which can be evaluated in one form or another because product, production and financial information is available.

The dependency of prime contractors on subcontractors/vendors is equally important. An evaluation of these lower tiers of the industrial base is very difficult because of the lack of subcontractor/vendor identification and the high probability that even if subcontractors/vendors were identified, it would be very difficult to compile extensive product, production, and financial information on them.

The purpose of this study is to examine the issue of subcontractors/vendors and subcontracting. The first concern is the identification of subcontractors/vendors. The second concern is the availability of information on subcontractors. The following analysis separates these two questions. The identification of subcontractors/vendors is approached indirectly through a consideration of the defense industrial base. As for data availability, the approach is to survey a variety of data sources, examining each to determine which single source or combination of sources would provide product, production, and financial information on the largest

and most diverse possible set of business firms. The third concern involves the factors that determine the extent to which prime contractors rely on defense subcontractors/vendors, factors which influence the "make or buy" decision. In this instance the approach was to directly ask the prime contractors the reasons why they rely on subcontractors/vendors to the extent that they do.

A number of defense analysts have argued that the most important problems in the defense industrial base reside in the second, third and fourth tiers, with subcontractors/vendors. This study will not assess the validity of this argument. Rather the objective is to establish whether the argument can be resolved empirically; that is, whether firms acting as subcontractors/vendors can be identified, whether the necessary data are available, and what the factors are that determine subcontractor/vendor dependency.

Chapter 2

The United States Defense Industrial Base: Structure, Definitions and Data

This chapter is divided into four parts. The first part attempts to describe the industrial base supporting the production of major weapons systems. This is initially accomplished by reference to a general structure and then by reference to a firm specific structure for production of Air Force weapons systems. The second part of the chapter examines various sets of definitions which deal with information regarding business units and the specific elements within the business units. The third part examines data sources on SEC registered business units while the fourth and final section reviews data sources on these business units which are not registered with the SEC.

Industrial Structure

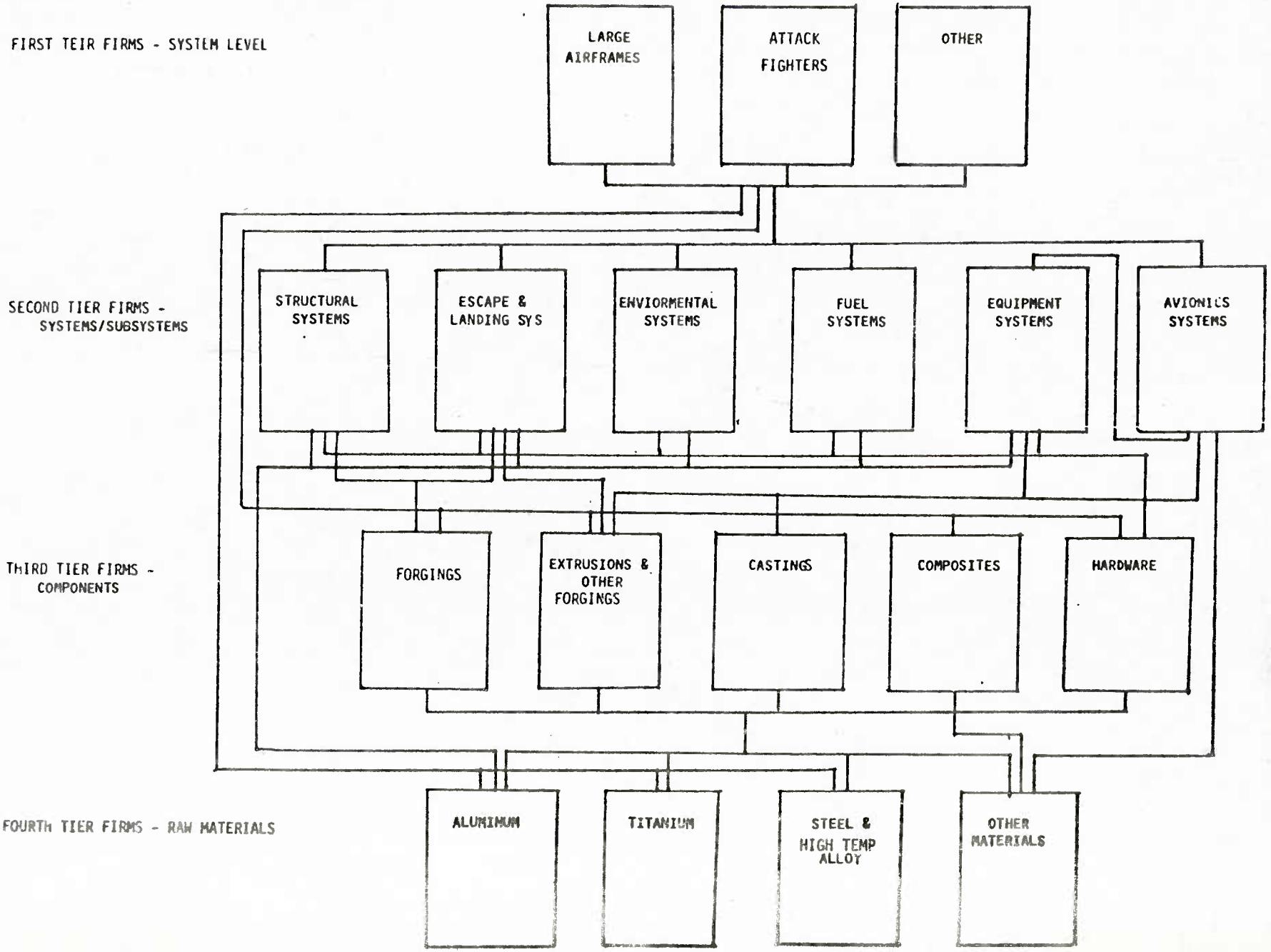
Given that one charge of this contract is to indicate a method of increasing the contractor/subcontractor/vendor bidding list, it is useful to consider the overall industrial structure necessary for the completion of major weapons systems. Figure 2.1 depicts such a structure. Firms supplying raw materials represent the base of the industrial pyramid while system assemblers represent the top.

Figure 2.1

Industrial Structure for Major Weapons Systems

Figure 2.1

Industrial Structure for Major Weapons System

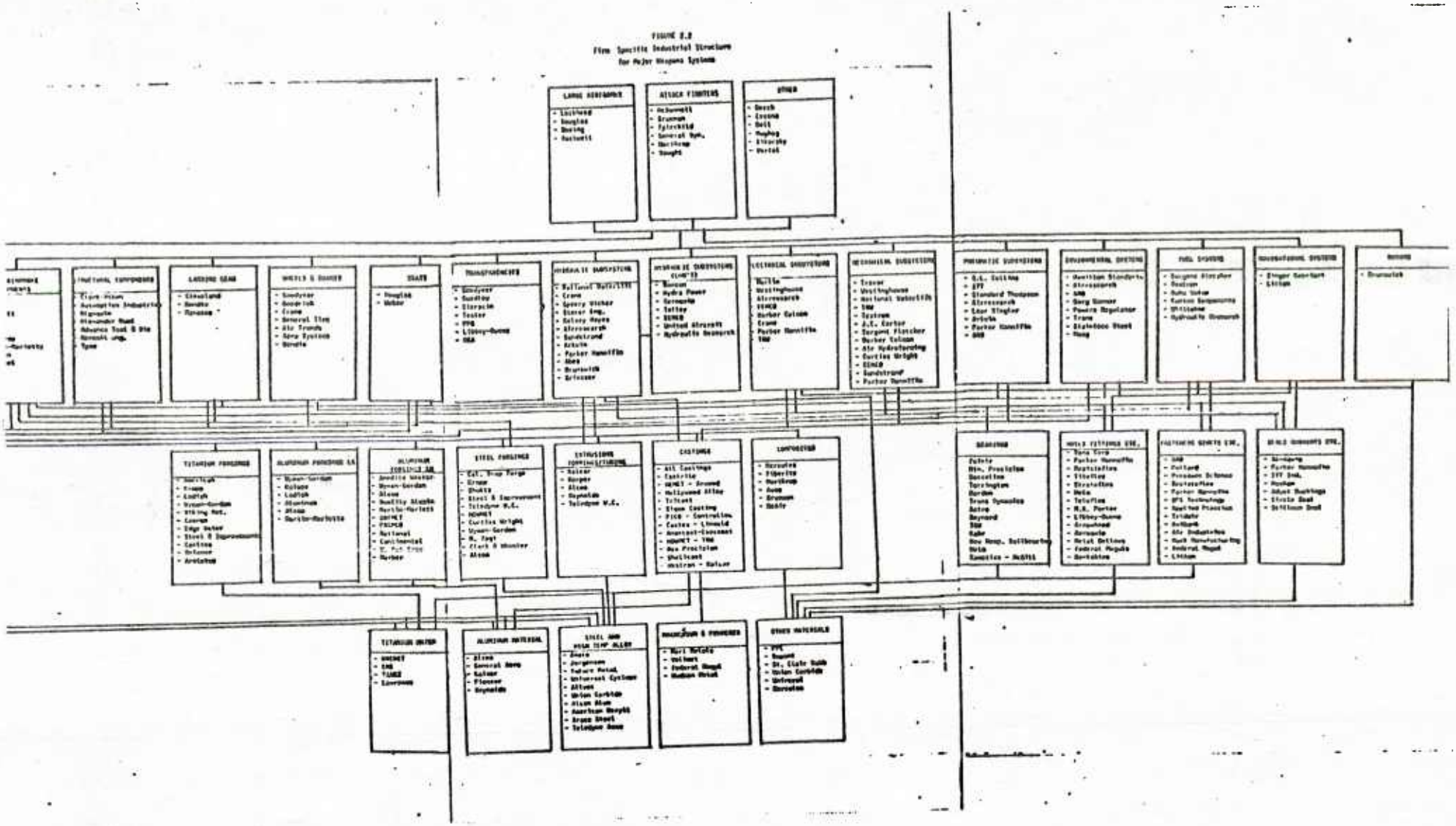


The first step in acquisition planning is to identify the particular weapons systems, the subsystems, the components and parts, and the raw materials that will be needed to complete the system.[1] The second step is to identify the firms that currently produce or have the capacity to produce the completed system, subsystems, components and parts, and raw materials. In effect the second step is to fill in as completely as possible each of the boxes as shown in Figure 2.2. Thus, Figure 2.2 attempts to make Figure 2.1 more meaningful. This step obviously requires product data. The third step requires production data for all the firms identified in the second step and is the link to production base analysis. Acquisition planning would move beyond the third step and involve an analysis of the financial information on the identified firms. This would constitute the fourth step.

To underscore the potential magnitude of these efforts consider the B-1 Bomber, certainly a major aerospace weapons system. The B-1 Bomber has a single and easily identified prime contractor or first tier supplier: Rockwell International Inc.

[1] Dan Z. Sokol, AERONAUTICAL SYSTEMS DIVISION: Preliminary Aircraft Sector Analysis, Sept. 10, 1982, Prepared by Manufacturing Directorate, Aeronautical Systems Division. This study was most useful.

Figure 2.2
Firm Specific Industrial Structure for Major Weapons Systems



But the complete subcontractor/vendor structure, the second, third, and fourth tiers, is complex and not easily identified. As stated earlier, DOD policy only requires that the major/critical components be identified in any given prime contract. The complexity of the industrial structure and the gap in information created by the fact that only major/critical products are identifiable, is reflected by the estimates regarding the number of subcontracts (not the number of subcontractors) involved in the B-1 Bomber. Best estimates place the number in the vicinity of 30,000.

If this description of the industrial base is accurate and if the assumption regarding the magnitude of subcontractor/vendor involvement is correct, then any attempt to deal with the contractor/subcontractor/vendor bidding list must involve the entire industrial base of the United States. Work presently being done on production base analysis by the three Armed Services and the Institute for Defense Analysis indicates that interrelationships and interdependencies are far reaching and in fact extend throughout the economy. Thus in order to deal appropriately with the subject at hand, increasing the contractor/subcontractor/vendor bidding list, it is necessary to focus upon the entire industrial base. Any narrower focus (for instance, excluding raw material

suppliers) is likely to result in the omission of significant numbers of important firms.

Definition of Terms

There is a set of terms used in the business and computing areas that have, simultaneously, similar yet unique meanings. These terms are data, data set, data source and database. The first term simply means that there is information of some kind available about a topic, in this instance, business units. The term data set refines the term "data" and indicates that a unique set or specific grouping of data is available on some aspect of a subject. Data might refer to information available about some topic, or simply information. Data set would refine this by establishing a specific context about some aspect of the information. Data would be anything known about the group of business firms while a data set might be the bankruptcy information about those firms.

Data source indicates that data concerning businesses are available either from a unit that generates the data or from a unit that distributes the data. For instance the SEC directs that certain business units provide it with financial information regarding operations, information which

becomes part of the public domain. This information is then distributed under license by either Standard and Poor's or Disclosure Inc. These latter two firms would be the data sources for this firm specific financial information.

Database is the fourth term and normally refers to a data set or several data sets integrated together using a computer program. These computer programs are referred to as information management systems (IMS) or a data base management systems (DBMS). A database (IMS or DBMS), of which there are several different types (generally available), is a computer program that allows the researcher to organize the data according to different keys or classes and is able to produce items from the entire database according to particular keys or classes. For instance, if the data file on bankruptcies maintained by Standard and Poor's were incorporated into a database framework, it would be possible for the researcher to command the computer to print out all bankruptcy proceedings in Texas (first key) in Standard Industrial Classification (SIC) code 3559 (second key), under subchapter "n" of the bankruptcy laws (third key) where the companies involved had more than 450 employees (fourth key).

In the following discussion the reference is either to a data source or to a data set that contains information

appropriate to a particular aspect of the business community.

A second set of definitions that must also be kept in mind while dealing with the business community consists of three terms: establishment, enterprise and taxpaying unit. These definitions are used by both the Commerce Department in its references to business and by the Small Business Administration when discussing small business.

An establishment is the smallest unit in which business activity is conducted and on which statistical information is collected (Small Business Administration, The Regulatory Flexibility Act, October 1982). The establishment concept makes no reference to either ownership or taxpaying status. Furthermore, establishments may be branches of larger firms and may differ from separately owned and operated businesses that are similar in purchasing power, advertising coverage, management and control systems, technical resources, and access to capital and credit. Most small businesses are establishments.

Enterprise refers to all establishments of a "parent" company. For instance an enterprise can own subsidiaries, branches and unrelated establishments. In most instances, it is necessary to use the enterprise concept to study the characteristics of small firms since the ownership issue is

Table 2.1

Business Organization in 1980

Legal forms of Ownership

16,568,077 Business Units

75.48% Proprietorship

16.26% Corporations

8.23% Partnerships

Source: U.S. Department of Treasury, Internal Revenue Service, STATISTICS OF INCOME REPORTS, 1980

The major source of financial information concerning registered corporations arises from reporting requirements imposed by the SEC. The listed corporations are required to issue annual (10-K) and quarterly (10-Q) reports and other periodic financial statements. The annual reports normally must be audited. The data required includes the firm's income statement and balance sheet.

The SEC permits financial information corporations, such as Standard and Poor's, and Disclosure Inc., to collect and compile the information and to provide the information for public use in various forms from computer database information to microfiche. The fees that these financial information firms are allowed to charge are generally regulated by the SEC.

The financial information firms find it necessary to divide the financial data into several categories that parallel the structure of corporations. Both Disclosure Inc. and Standard and Poor's: Compustat II, for example, provide corporate financial information including complete income statement and balance sheet with additional information on subsidiaries, ownership and products. Both Standard and Poor's and Disclosure Inc. provide annual and quarterly information on the corporate entities that may be considered

as the consolidated corporation as well as the corporate segments.

A corporation may have a number of subsidiaries, that may be separate SEC registered corporations and may, therefore, represent a very complex business organization. Figure 2.3 presents the subsidiary or corporate structure of Teledyne Inc. and is indicative of this complexity. This information was provided by Disclosure Inc. Their database, as well as the Standard and Poor's, COMPUSTAT II database includes the registered subsidiaries. But the financial information may be organized in another way, broken by SIC code. For instance, the segment file provided by Standard and Poor's Compustat: Business Information File divides Teledyne into the five business segments as shown in Table 2.2. One of the major business segments of Teledyne Inc. is the financial segment that includes insurance and other operations.

Finally, a corporation may be divided into the establishments where the actual work of the corporation is carried out. An example of such establishment data for a plant of the Teledyne Corporation is shown in Figure 2.4. Appendix 1 shows the complete establishment structure of

Teledyne (there are 217 establishments each with limited information). This information is available from the Economic Information Systems (EIS) division of Control Data Corporation. However, the information available at the establishment level is very limited: financial information is limited to sales and share of the market, product information to SIC industry code and industry name, and production information to employment size class. The point is that employment, payroll and sometimes sales data are available at the establishment level. Generally financial data are available only at the enterprise level.

With reference to the definitions established previously, and in terms of Figure 2.3

Figure 2.3

Structure of Teledyne Inc.

Figure 2.3
Structure of Teledyne Inc.
(an Example of Corporate Complexity)

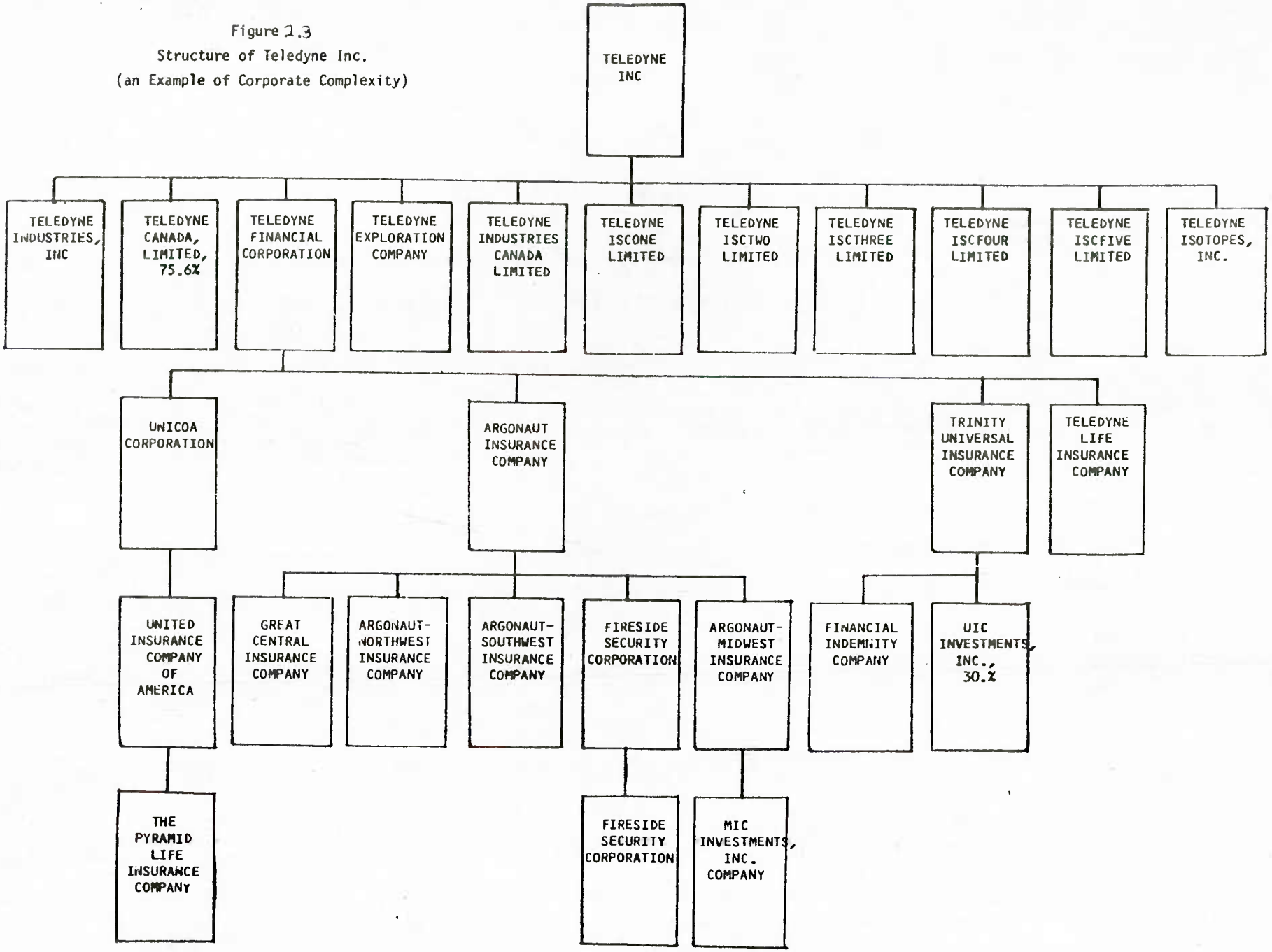


Table 2.2

The Segment Structure of Teledyne Inc.

COMPANY CUSIP #

TELEDYNE INCORPORATED 879335

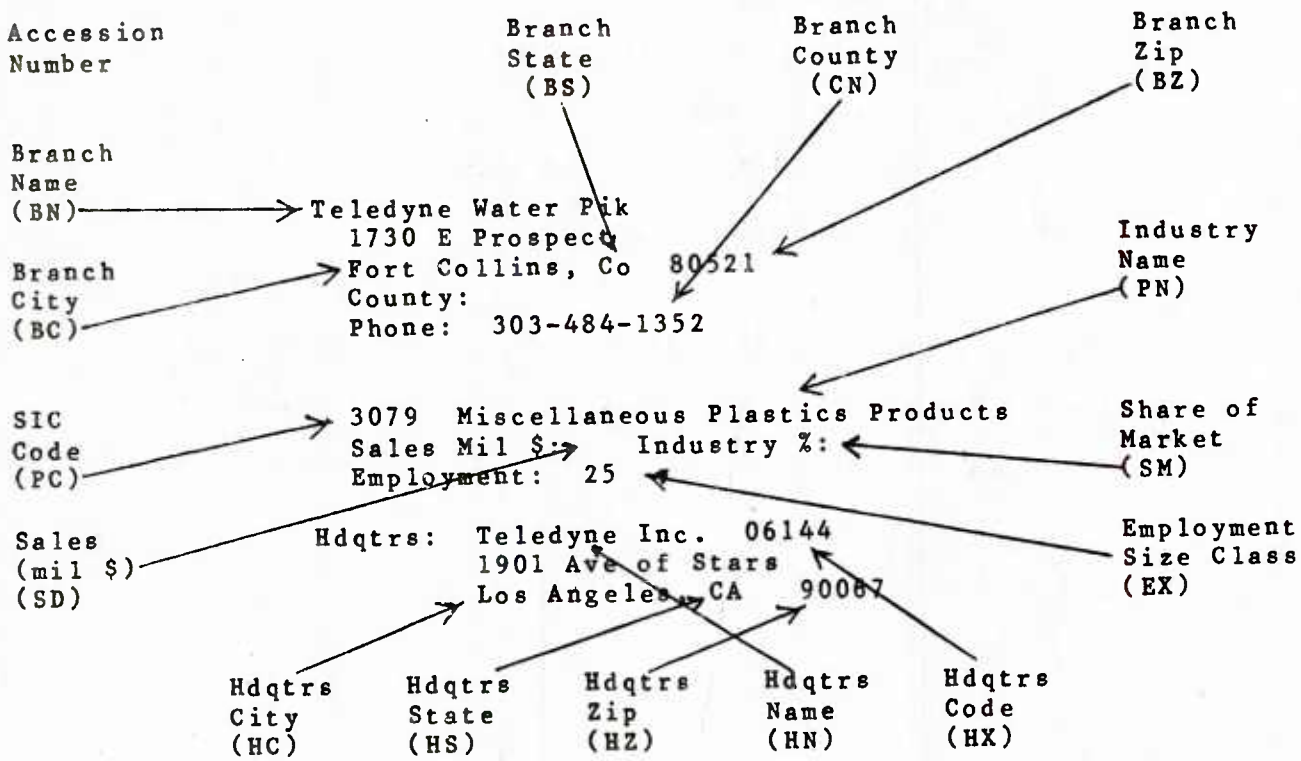
1. Industrial Products and Services
2. Aviation and Electronics
3. Specialty Metals
4. Consumer Products and Services
5. Insurance and Finance

Teledyne Incorporated is divided into the 5 segments, as noted. The plant structure of Teledyne is indicated in Appendix A, as developed by the EIS database.

Figure 2.4

Establishment Information

Example: Teledyne Inc.



Teledyne Inc. would be an enterprise and the Teledyne Waterpik Co. would be an establishment. The data source for the establishments of any of registered corporations would be EIS Inc. or Dun & Bradstreet. The EIS database contains only establishments with more than twenty employees or more. This could also be considered a data set as would the Standard and Poor's and Disclosure Industrial File that contains the balance sheet and income statement information on SEC registered corporations and corporate segments.

There is another information source for corporations that is maintained by Disclosure Inc. This is called the SOURCE file and contains product information. The file is queried by requesting companies that produce certain kinds of products. For instance, the user may ask for products by military specification number and the database will produce all of the companies authorized to produce or distribute the given product as shown on Table 2.3. In addition to Military specifications, one may query the database using Federal specifications, Procurement specifications, SAE specifications, Metric standards NAS standards or AN-MS standards. The standards are defined in The Identified Sources of Supply, National Standards Association, 1982 (Disclosure Inc.).

Table 2.3
DISCLOSURE INC. SOURCE File page 2
Example: Search on Military Specification Number2
Partial Listing
013312 Mil-c-11693/7a(1) card no: 14 Capacitors, feed through, radio

interference reduction, dc (hermetically sealed in metal cases) established and non-established reliability styles cz23,cz24, czr23 and

czr24

DOD (Department of Defense)
5910 (capacitors)
1978 Janll
Qualified products list

ASI ELECTRONICS, INC.(D)
ABACUS ELECTRONICS CO., INC. (D)
ACACIA SALES, INC. (D)
ACRO ELECTRONIC DISTRIBUTORS (D)
ADIRONDACK RADIO SUPPLY (D)
AEROFLITE ENTERPRISES, INC. (D)
AKRON ELECTRONICS SUPPLY (D)
WILLIAM B. ALLEN SUPPLY CO. (D)
ALMO INDUSTRIAL ELECTRONICS, INC. (D)
ANCAR ELECTRONICS SUPPLY, INC. (D)
ARROW ELECTRONICS, INC. (D)
BELL INDUSTRIES (D)
BONO ELECTRONICS (D)
BRILL ELECTRONICES (D) CAM/RPC (D)
CENTENNIAL ELECTRONIC, INC. (D)
CETEC-MOLTRONICS (D)
CLASSIC COMPONENTS SUPPLY, INC.(D)
CORNELL-DUBILIER ELECTRONICE - FEDERAL PACIFIC ELECTRIC CO. (M)
DEECO, INC. (D)
DENVER/WINTRONICS (D)
DIXIE ELECTRONICS, INC. (D)
DOUGLAS ELECTRONICS CO. (D)
ELECTRO ENTERPRISES, INC. (D)
ELECTRONIC DISTRIBUTORS, INC. (D)
ELECTRONIC EQUIPMENT CO., INC. (D)
ELECTRONIC SUPPLY OF ANDERSON (D)
ELECTRONIC SUPPLY OF RIVERSIDE (D)
FEDERATED PURCHASER, INC. (D)
FORT WAYNE ELECTRONICS (D)
...T WAYNE ELECTRONICS (D) (D) (D) AL PACIFIC ELECTRIC
partial listing onlyD) (D) (D) AL PACIFIC ELECTRIC
D = Distributer M = ManufacturerFIC ELECTRIC

Data Sources on Non-SEC Registered Business Units

There are several data sources that include the group of businesses that are not registered with the SEC and may be termed private: that is, proprietorships, partnerships and privately held corporations. One of these is available from the Dun & Bradstreet Corporation that collects information on business units as part of a credit rating process. Therefore, Dun & Bradstreet will not have information on all business units, only on those business units that require a credit rating. All of the information in these files is proprietary; the information is available from Dun & Bradstreet on a fee basis.

There are a series of differing files (data sets) available from the Dun & Bradstreet efforts and these will be discussed in turn. All of the various categories of files stem from the same basic effort. The reference should the reader desire an overview of this data source is DUN'S CENSUS OF AMERICAN BUSINESS, (Dun's Marketing Service, 3 Century Drive, Parsippany, New Jersey, 07054.)

The basic file, containing the largest number of establishments but with the smallest amount of information on each unit is the Dun & Bradstreet "Dun's Market Identifier" (DMI) file. The file contains information on approximately

4.7 million establishments. Information available on each establishment includes:

1. Dun's number, a Dun & Bradstreet identification number;
2. Business name and street address;
3. Principal officer of business and title;
4. Annual sales volume;
5. SIC code - four digit level primary and up to five secondary codes;
6. Parent firm and Dun's number for parent firm;
7. Manufacturing indicator;
8. Status indicator to denote if this establishment is a headquarters, subsidiary, branch or independent establishment;
9. Year in which business was started;
10. Geographic location; and,
11. Area code and phone number.

This information is generally compatible with the information available on establishments of registered corporations provided by EIS as shown in Figure 2.4. The DMI file is available for the years 1976 through 1982.

A second data source provides information that is somewhat compatible with the Dun and Bradstreet DMI file is the Market Data Retrieval Inc. (MDR) File or yellow pages

listings. The information available in the MDR file is as follows:

1. Sequence number within each state;
2. Business name and address;
3. Geographic location: city name, state and Standard Metropolitan Statistical Area (SMSA);
4. SIC four digit industry code;
5. Area code and phone number;
6. Type of business;
7. Population code for city location/size;

For sources other than the DMI file and the MDR files, the IRS maintains a Business Master File of all proprietorships which includes substantial financial information of each proprietorship. This file is not available for public use. A statistical sample is extracted from this population, where information on each sampled unit includes sales and complete profit and loss information. This sample is available as the Statistics for Income on Proprietorships. None of the IRS information on proprietorships is available as micro data.

The IRS also maintains information on partnerships. The information is taken from IRS Form 1065 or IRS Form 1040, and includes 1.2 million units as of 1977. Information

includes sales, receipts and complete profit and loss statement items, for every other year. The IRS also maintains a file on corporations comparable to that for the proprietorships in the U.S. In addition, the files include a corporate balance sheet.

In comparing the data available from Dun & Bradstreet's DMI file and the Market Data Retrieval file with that from the IRS, a distinction between macro and micro data must be drawn. Macro data refers to information that is available only for groups of firms (usually a minimum of three) and is characteristic of the data available from the IRS. The information is presented in this way to maintain the confidentiality of income tax information. Micro data on the other hand is firm specific information. But because accuracy is not required by law it may be somewhat inaccurate. The DMI file and MDR file information represent micro data.

The IRS also maintains a sample of about 250,000 tax returns of corporations. This is referred to as the Source Book for Corporations (IRSCSB) and includes complete balance sheet information. It excludes all self-employed proprietors and government operations. Data are available with a three year lag, with 1980 data now available. It is partially

comparable with the information in the Dun & Bradstreet Financial Statistics File, a subset of the DMI file. While the asset items are comparable between the two data sources, the reporting units are not necessarily comparable. The Dun & Bradstreet Financial file stresses balance sheet items, particularly liabilities that might be important in credit ratings. The IRS stresses the expenses involved in production. The Dun & Bradstreet file has no information on depreciation and taxes.

It should be noted that efforts have been made to use the Dun & Bradstreet Financial Statistics File (FINSTAT) for analysis purposes, particularly in regard to small business firms. One such effort involved the University of Texas Center for Constructive Capitalism. An initial concern involved the extent to which the firms contained in the FINSTAT file represented an appropriate cross section of American business. A second concern involved the accuracy and reliability of the data in the FINSTAT file. Sufficient problems were encountered that the Center discontinued its attempts to use FINSTAT in analytical studies of small business. SBAOA is still working with the FINSTAT data.

The Bureau of Census issues annually a report entitled COUNTY BUSINESS PATTERNS, for approximately 4.4 million

establishments, excluding railroads. The variables include employment and payrolls with a 3 digit SIC code available. The information is for unincorporated and incorporated establishments with employees. The major identifier is the Employment Identification Number (EIN). These data are based on tax reports to the IRS and Social Security Administration, Form 941. The primary comparative micro data source is the Dun & Bradstreet DMI file.

The Unemployment Insurance System (U.I.) collects statistics on employment and payrolls for businesses excluding farmers and railroad workers who are covered by the Railroad Retirement Board. It is basically a non-agricultural and non-government statistical collection. It covers the period 1940 to date. The primary comparative data sources are the Dun & Bradstreet DMI file and the COUNTY BUSINESS PATTERNS.

The U.S. Department of Commerce maintains publication entitled ENTERPRISE STATISTICS. It is issued every 5 years. As of 1977 it included 5.6 million enterprises. The information includes employment, payroll, sales, value added in manufacturing, new capital expenditures in manufacturing and inventory. It also includes corporations, proprietorships and partnerships. A number of industries are excluded,

however, transportation, communication, utilities, finance, insurance and real estate. Again this is a macro-data source and the information is released only for minimum groups of enterprises, as are the IRS data.

The Equal Opportunity Employment Commission maintains a file on enterprises or establishments with more than 100 employees. This covered 168,000 companies in 1979. The information included employment by major 1-digit SIC code. Single and multiple company units were shown separately. It excluded farms, government units, and self-employed. The companies covered were all corporations. This, according to the Small Business Administration, Office of Advocacy was the only source of occupational data on small business available to the SBA. No alphabetic identification of individual company units was possible. As used in this sense, apparently the terms enterprise, company and corporation are synonymous.

Still another potential source of information is a one percent sample of social security numbers, representing one million workers maintained by the Social Security Administration. The data included age, race, sex, industry and quarterly wage approximations. It covers the period 1957 to date. A self-employment file from the IRS

schedule SE is also maintained.

The final data source would be the GNP Share by Small Businesses which is developed and maintained by the Joel Popkin Company. This work is a breakout of GNP accounts by business size. It is based on payroll and sales data ENTERPRISE STATISTICS by the Bureau of Census and STATISTICS OF INCOME developed by the IRS. It is for the period 1963 - 1976 and matches the information from the Bureau of Economic Analysis, National Income Accounting definitions. Major components are worker compensation, net interest, profits, capital consumption allowance and indirect business taxes. Estimates are for company units with 500 or fewer employees.

To conclude this chapter it is useful to provide a brief summary of the various data sources discussed. This summary is presented in Table 2.4 with the various sources being divided into <u>micro</u> and <u>macro</u> data categories.

Table 2.4

Table 2.4

SOURCE	ESTABLISHMENTS	VARIABLES	INDUSTRY	DATA AVAILABLE YEARS	TYPE
I. Micro Data: Dun & Bradstreet Dun's Market Information (DMI) file	4.7	firm**, sales employment	4-digit SIC	I976-on***	Establishments
Market Data Retrieval	9.0	firm	4-digit SIC	I976-on	Establishments
Economic Information Service	---	firms, sales, emply.	4-digit SIC	Current	Listed Corporation Establishments
Standard & Poors Compustat II	---	firm, balance sheet income statement	4-digit SIC	1960-Current	Listed Corporation & Subsidiaries
Standard & Poors Business File	---	firm, balance sheet income statement	4-digit SIC	1977-Current	Segments of Listed Corporations
Disclosure Inc.	---	firm, balance sheet income statement	4-digit SIC	Current	Listed Corporations & Subsidiaries
Disclosure Inc. Source	---	Product	Product Specification	Current	Corporation or Establishment Supplying Product
SBA	80,000	Product	Keyword	Current	Establishment
II. Macro Data: Bureau of Census County Business Patterns	4.4	Employment, Payroll	3-digit SIC	1954-Present	Establishment
Unemployment Ins, Bureau of Labor Stat.	---	Employment, Payroll	Industry	I969-1979	Reporting Unit
US Dept of Commerce, Enterprise Stat.	5.6	Employment, Payroll Some Other	4-digit SIC	1958-1977	Enterprise
Equal Employment Opportunity Commission 100 or near Exepl	.16 (168,000)	Employment	4-digit SIC	1974-1980	Establishments
Social Security Adm - 1% Sample	1.0	Firm	4-digit SIC	I960-1975	Reporting Units, Enterprise or Est.
Social Security Adm. Self-Employed 1% Sample	---	Wages	4-digit SIC	1960-1975	Reporting Unit
IRS: Statistics of Income: Proprietorship	11.3	Sales, Rec, Profit	4-digit SIC	1948-I977	Legal Ownership, & Propeitorship
IRS: Statistics of Income: Corporation	2.2	Sales, Rec, Profit	4-digit SIC	1948-I977	Legal Ownership, Unit Corporation
IRS: Statistics of Income: Partnership	1.2	Sales, Rec, Profit	4-digit SIC	1948-1977	Legal Ownership & Partnership
IRS: Sample of Corporations	(250,00)	Sales, Balance Sheet	4-digit SIC	1948-1977	Corporations
Joel Popkin: Small Business, Share of GNP	---	GNP	Excludes Agriculture	1963-1976	Component

* State of Small Business, 1982: pps 259-260
** Firm data: data identifying the firm, address, offices, phone number, branch, headquarters, establishment and product line
*** Dun and Bradstreet were significantly expanding their establishment coverage by I976. There are serious problems in comparing the pre-1976 with the post-1976 period.

Chapter 3

The Small Business Community: Industry Databases

Introduction

The congressional mandate expressed in Public Laws 96-302 and 96-354, instructs the Office of Advocacy of the Small Business Administration (SBAOA) to develop a database to be used for historical description and for policy analysis. Public Law 96-354 amended Title 5 of the United States Code, to improve federal regulation, by creating procedures to analyze the availability of more flexible regulatory approaches for small businesses. It should be noted that in fact both of these public laws had the goal of promoting economic growth in the small business component of the American industrial base.

It is clear that the databases developed by the SBAOA are the only databases presently available that would be uniquely suitable for increasing contractor/vendor/subcontractor bidding lists if such lists are to include the broadest possible cross section of American business firms. As a consequence, this chapter will focus on the two databases maintained by the SBAOA. The SBAOA database work involves the

purchase of Dun & Bradstreet data and Market Data Retrieval Inc. data as the basis for its work. There is considerable modification of the purchased data to create a valid and workable database. Release and use of these data are limited because of the SBAOA contractual agreement with Dun & Bradstreet.

Nature of the Small Business Community

When dealing with the small business community it must be recognized that the community is defined in various ways. For instance, one way of defining the small business community is to argue that it constitutes all of American business and industry that is not included in the corporate units or subsidiaries or establishments of SEC registered corporations. From the perspective of this study such a definition seems inappropriate as it confuses an ownership characteristic with what is essentially a size characteristic.

But even using a size dimension, alternative definitions are still possible. Section 1-701 of the Defense Acquisition Regulations contains 12 pages of quantitative definitions of small business. Overall there seem to be four characteristics: first, owner managed; second, limited dollar volume of sales or assets or limited volume of employment; third, financial control by the owner of the establishment; and fourth,

localized operations. The kinds of limits normally found for the second characteristic noted are: under 500 employees in manufacturing and research and development and under 100 employees in all other operations per establishment, average annual receipts (over the past three fiscal years) of $12,000,000 for general construction or average annual receipts of under $2,000,000 in service related activities.

The definition which is used in this study is that provided, for research purposes, in the STATE OF SMALL BUSINESS: A Report of the President, 1983 (page 28): "Small Business is defined as a business having fewer than 500 employees."

The State of Small Business(p.34) defines three types of establishments that are enterprises:

1. small - establishments with fewer than 100 employees owned by firms with fewer than 100 employees.
2. apparent small - establishments with fewer than 100 employees owned by firms with more than 100 employees.
3. large - establishments with more than 100 employees owned by firms with more than 100 employees.

Importance of Small Business Units

Before moving to a direct discussion of the two databases maintained by the SBAOA, it is useful to indicate the general environment of the world of small businesses. One aspect is shown in Table 3.1 that indicates the number of establishments and employees. Data are presented for all industry and two individual industries, manufacturing and services.

This table indicates that approximately 80 percent of all establishments can be classified as small and about one-third of total employment is within such establishments. Small establishments in manufacturing are relatively less important: approximately 60 percent of manufacturing establishments are classified as small and account for 16 percent of manufacturing employment. For services small establishments constitute about 90 percent of the establishments and provide 30 percent of the employment.

Table 3.2 shifts the focus from establishments to enterprises and indicates the number of enterprises that fall into each of four "number of employee classes" as of 1980.

Table 3.1

Small Business Environment

Employees and Establishments

1980

(in thousands)

	SMALL	APPARENT SMALL	LARGE	TOTAL UNITS
All Industries				
Establishments	4,036.0	566.0	137.0	5,009.0
Employment	30,262.0	14,329.0	48,487.0	93,078.0
Manufacturing				
Establishments	367.9	139.4	62.1	569.4
Employment	4,999.5	3,458.2	23,250.6	31,208.3
Services				
Establishments	928.4	93.0	31.5	1,052.9
Employment	6452.9	3,205.2	11,691.3	21,394.4

source: State of Small Business, 1983, p. 201.

Table 3.2

Number of Enterprises by Employment Class:

Total, Manufacturing and Service.

1980

(1000 Employees)

Industry	1-19	20-99	100-499	500 - over	ALL
U.S.Total	3,523.	366.9	65.4	14.7	3,971.0
Manufacturing	257.5	72.8	17.9	4.2	351.9
Service	780.1	75.2	20.4	5.5	881.5

source: State of Small Business, 1983, page 202

Again data are presented for the total economy and two industries: manufacturing and service.

Additional insight regarding the small business environment can be obtained by comparing small business dominated industries with the large business dominated industries. Again using the definition of small business as firms with 500 employees or less, then for all industries small

business had 54.8 percent of total sales and 54.2 percent of total employment for the period October 1981-October 1982. Further, mining and manufacturing are the two industries that are most clearly dominated by large firms. The mining industry had 90.5 percent of sales and 78.8 percent of employment accounted for by firms with more than 500 employees (State of Small Business, 1983, page 18). Manufacturing also had 77.9 percent of all sales and 73.4 percent of all employment in establishments with more than 500 employees. The small business dominated industries were construction, retail trade, wholesale trade and service.

In summarizing this overview several points are worth noting. First, because an establishment is the smallest unit in which "business activity is conducted and on which statistical information is collected", it is probably more appropriate for DOD to concentrate on establishments in its efforts to increase its contractors/subcontractors/vendors bidding lists. Such a concentration should also apply with respect to acquisition planning. Focus on the establishment seems appropriate because it pinpoints as specifically as possible the unit at which production activity takes place.

A second point suggested by this overview is that efforts to expand bidding lists and to improve strategic and acquisition planning must extend to small business.

This is the case because small business represents a significant portion of the business community and employs large numbers of people. Even for the manufacturing industry, which is dominated by large business, small businesses generate over 20 percent of sales and 25 percent of employment.

A third and final point is that business organization patterns in the United States are complex and changing. There is a need for further analysis of this structure and for careful monitoring of change. Such conditions must be satisfied to maintain the appropriateness of bidding lists and the effectiveness of acquisition planning. With this in mind, the question of small business databases can be addressed.

Small Business Administration, Office of Advocacy Database

The Small Business Administration is involved in an integrated effort to develop and to organize data on the role of small business in our economy. Public Law 96-302 states that a small business data base is necessary for historical purposes and for public policy purposes. An "indicative" database is necessary for creating mailing lists and an "external" database is necessary for developing statistical modeling and policy analysis. The indicative database is

referred to as the Master Establishment List, or MEL, while the external database is called the U.S. Enterprise and Establishment Microdata File, or USEEM. There is a also a subset of the USEEM file that is used for financial profiles. It seems quite clear that for purposes of increasing the size of the bidding lists, the MEL database is the appropriate focus. It is also clear that the same source could be made available to prime contractors should they desire to increase the bidding list of subcontractors. USEEM, on the other hand, would be used to undertake any modeling that might be deemed desirable and necessary on the small business community, that is, to integrate small business into acquisition planning analysis.

A. Master Establishment List (MEL)

The development of the MEL was undertaken in order that the SBAOA might carry out its responsibilities in conducting research and analysis to facilitate growth of small business (Report, submitted to Small Business Administration by SOCIAL AND SCIENTIFIC SYSTEMS INCORPORATED, November, 1982.) Information in the MEL database includes, as a minimum, company name, company address, industry classification (by SIC code) and geographic location. The basic function of the MEL database is to permit communication with the small business

community. The basis for the MEL database is the Dun & Bradstreet DMI file and the Market Data Retrieval Inc. file. While there were other data sources that might have been considered as the basis for the MEL file that were more comprehensive in that they included more establishments; none of these other data sources included the amount of information that was available on the DMI file for each establishment. The DMI file contained 4.6 million records when it was first used to develop the MEL file. The industry coverage in the MEL file is shown in Table 3.3.

Table 3.3

Master Establishment List

MEL File: Coverage by Industry

Establishments

1981

(thousands)

Agriculture	168.7
Mining	52.4
Construction	827.7
Manufacture	523.4
Transportation, Communication and Utilities	266.7
Wholesale Trade	703.2
Retail Trade	2,196.5
Finance, Insurance and Real Estate	778.5
Services	2,595.7
Public Administration	0.0
Other	9.5
TOTAL ESTABLISHMENTS	8,122.3

SOURCE: Preliminary Report on the Development of the Master Establishment List, by Social & Scientific Systems, Inc.
Detail may not add to total due to rounding.

The MEL database appears to be a valid approximation of the small business population, although it is clear that the MEL database would exclude all small businesses that work out of their home, with no separate telephone number and no need for a credit rating. In validating the accuracy of the MEL database, several verification procedures have been used, one of which uses the University of Michigan nonhousehold sample (THE STATE OF SMALL BUSINESS, March 1983, p. 287.). Validity

procedures and updating methods applied to the MEL file are important and are discussed beginning on page III.17 of the preliminary report submitted by Social and Scientific Systems, Inc. on the MEL file.

B. United States Enterprise and Establishment Microdata (USEEM)

While the MEL File appears to be the appropriate database that DOD may use to increase its contractor/subcontractor/vendor bidding lists, the USEEM file appears to be the appropriate database for acquisition planning. While the USEEM database is considerably smaller than MEL File, it does contain more information. The name and address for establishments in the USEEM file can be matched by computer to the Dun & Bradstreet file.

This information is stripped off in the process of creating the USEEM database, which is why the name and address information can be matched back to the USEEM establishments. USEEM also contains subfiles or subsets that are: (i) structured for enterprise consideration; (ii) structured for longitudinal research (research over the period 1976 - 1982); and, (iii) a subset for research using relatively complete profit and loss information as well as balance sheet information.

The Brookings Institution, under contract from the SBAOA began working on the development of a microdata database for the American business community in January of 1980 (USEEM: U.S. Establishment and Enterprise Microdata, Version 3, Business Microdata Project, The Brookings Institution, April, 1983, prepared by Candee S. Harris). The basic objective of the project was to define the appropriate population and to establish its relationship to measures of aggregate business activity. After the determination of the project parameters, a data source had to be selected, and the data obtained, subject to verification or validation measures and made usable. It was also desirable, if possible, to have longtitudinal data in order to track changes in the aggregate population. Information is now available for 1976, 1978 and 1980 with 4.7 and 4.9 million records, respectively. In

addition to the longitudinal files maintained by The Brookings Institution, Prof. David L. Birch has an enterprise file for the period 1969 - 1976. Birch's information came from the Dun & Bradstreet DMI files but Birch's work is not directly comparable to the Brcokings work. (see: The State of Small Business, 1983, pages 40 - 88, which compares The Brookings Institution approach to the MIT approach. Birch uses an earlier file with a conceptually different approach to the small business community.)

Table 3.4

Establishments (Records) in the USEEM File

By Industry, By Division

in thousands

INDUSTRY DIVISION	1976	1978	1980
TOTALS	4,171.7	4,698.5	4,957.0
Agriculture	87.4	108.3	118.7
Mining	34.7	39.8	45.6
Construction	518.0	575.4	608.7
Manufacturing	431.1	455.9	510.9
TCPU*	182.0	194.5	207.7
Wholesale Trade	462.2	505.7	529.4
Retail Trade	1,407.0	1,445.0	1,462.5
FIRE**	275.6	400.8	403.6
Services	772.9	972.8	1,069.5

* Transportation, Communications, and Public Utilities

** Finance,Insurance, and Real Estate

SOURCE:USEEM: U.S. Establishment and Enterprise Microdata, Brookings Institution, Version 3, April 1983, prepared by Candee S. Harris.

Summary

There is no single database which provides the desired product, production, and financial information on small business firms. However, there are two qualifications to this statement. The first qualification arises from the existence of the MEL file; this file allows for product line identification (SIC code) at the firm specific level for what appears to be a substantial number of small business. Thus this file can be used to increase contractor/subcontractor/vendor bidding lists. The second qualification arises from the existence of the USEEM file. This file provides select production and employment information for a smaller number of small business firms but not at the firm specific or micro level. Thus, some strategic and acquisition planning can be accomplished but not in the breadth or depth that might be desirable. Appendix C identifies documents that describe and explain the development and use of the SBAOA databases.

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Chapter 4

Increasing the Contractor/Vendor Bidding Lists

Traditionally DOD has not involved itself directly in the subcontractor selection required by any prime contract. Rather, the process of selection of subcontractors as well as the "make-or-buy" decision is basically left to the prime contractor. Furthermore, except for indication of designated major/critical components by subcontractor, the prime contractor is not even required to report to the DOD the names of the subcontractors. For whatever reason, the number of subcontractors available in the defense industrial base appears to have been diminishing. It is not our intention here to document this point. Further, it is not our intent to document the problems faced by subcontractors which have prompted their exit from the defense industrial base. Our intent in this chapter is to demonstrate a method by which DOD (the Air Force) can increase the defense industrial base by increasing the list of companies that could bid on DOD vendor contracts as well as be available to bid on contracts from prime contractors. In proceeding to this objective, the discussion initially focuses on the various kinds of data elements that are available in a database. The next section examines the various ways in which the information contained

in a data base can be used. The third section outlines the general concerns involved in a data base approach to increasing bidding lists. The final section provides a specific example of the application of a database approach to increase bidding lists.

Data Elements in a Database

The data elements included in any database fall into one of two basic categories: numerical information and descriptive information. Production and financial information fall into the first category while product information (even though it may be represented by numbers such as SIC codes) falls into the latter category.

In making comparisons between firms or for a single firm over time, a problem may arise in consistency of both categories of information. Unless standardized definitions are employed, information is likely to be inconsistent. Take financial information as an example. Accounting conventions impose specific definitions and, thus, financial reports (audited) are likely to yield consistent data. As an even more specific example, consider the concept "net sales". Sales consist of the amount of billings to customers for regular products or services delivered during an appropriate period. As used in one particular database,

and according to given accounting standards, the gross billings are reduced by cash discounts, trade discounts and merchandise returned. Net sales will, therefore, include any revenue source that is expected to continue for the life of the company as it is currently defined and omit consideration of future acquisitions and/or divestitures. It will include other operating revenue, installment sales and franchise sales when and if available. Net sales would exclude non-operating income including all one time income, interest income, equity in earnings of unconsolidated subsidiaries, other income, rental income, gain on sale of securities or fixed assets, discontinued operations and royalty income. Only if standardized conventions are observed can reliable facts and/or conclusions be drawn from data sets.

The point is that effective use of a data requires the user to know something about the nature of the data: the general kind of information (product, production, and/or financial), the coverage (registered corporations, publicly listed or privately held, unlisted corporations, proprietorships, partnerships), as well as consistency, accuracy, and reliability. The preceding two chapters, if they have accomplished their purposes, provide perspectives on these issues. Indeed the use of a database methodology

to increase contractor/subcontractor/vendor bidding lists must begin with a determination of whether or not appropriate databases exist.

Using Information from a Database

The construction and use of a database involves planning. The key concepts in database construction are: formulation of desired results, visualization of the results and the way of accomplishing them, formulation of procedures to obtain information, and the actual collection of facts. The database constitutes the collected facts. Before considering the various ways in which a database can be used, it is important to consider planning from a somewhat different and broader perspective. K.J. Radford (Reston,1980) has an interesting definition of strategic planning. He contends that strategic planning is not an attempt to eliminate risk, but a means of recognizing it and of acting to take advantage of rewards, as well as to avoid the dangers that the risk might offer. Radford and others have noted that this kind of strategic planning may well be as much political as an economic or technical phenomenon.

A narrower focus on planning, as that term is used here, involves the capability of DOD to identify the particular establishments or enterprise units that can provide particular types of products and services either to DOD (follow-on contracts) or to the prime contractor on a particular time schedule and at a particular cost. There are at least two ways that these kinds of determinations can and are being made: (i) using informal data sources and existing "knowledge" of the defense industrial base business units, and, (ii) using formalized and systematic, existing, establishment specific databases. DOD officials will have developed considerable informal knowledge of some of the companies of the defense industrial base. They will not and indeed cannot have developed much knowledge of the more than 569,000 small business manufacturing establishments that constitute the manufacturing U.S. industrial base (See:chapter 3, Table 3.2). This represents the lower tiers of companies of the industrial base and, potentially, of the defense industrial base. Database planning seeks to investigate the impact of a specific and formalized database structure as added to the present acquisition system.

Turning now specifically to the uses of databases,

there are two generalized kinds of queries that one must consider: top-down queries and bottom-up queries. Top-down queries are those that are generated from high level decision makers. These types of queries almost always deal with specific aspects of particular systems and generally are made with regard to the system and not with regard to the kinds of information available. An illustration may be useful. Assume that a stated military purpose is to develop an airframe system that can fly in excess of MACH 3, and higher than 150,000 feet. It is possible to indicate that no known airframe system has these characteristics. Queries that would likely be generated by acquisition officials (this is the perspective taken in this example) would concern the characteristics of the system itself. Thus these queries would deal with the future. A database, necessarily, deals with the past and this is so whether the database is formal or informal. It is unlikely that information in any database could deal directly with queries concerning a system that no enterprise has yet constructed. The point is that top-down queries are those stemming from officials that have to make decisions concerning future action or current actions that impact only in the future and not from available data.

Bottom-up queries are those than can be answered from

existing data or data sources. The bottom-up approach begins with the existing data and attempts to classify the kinds of queries and information available from the given database. There are, broadly speaking, three types of answers that can be generated from a formalized database: direct answers, inferential answers, and modeled answers.

DIRECT ANSWERS. A direct answer to a query is an answer where a given datum in the database will directly respond to a given query. A query on the investment of a company can be answered by giving the mean annual investment over the past "n" years, or the magnitude of investment each year over the past "n" years. A query on whether a company was profitable in a given year can be answered with the net operating profit of that company for the year. An acquisition officer might desire to compare the profitability of one company with respect to the profitability of another company. An acquisition officer might desire to know if a given company, attempting to obtain a "prime contract" has actually produced that kind of product even though the four digit SIC code indicates that the company has done so. The acquisition officer knows that the four digit SIC code only indicates a product line, not a given product.

In these instances the query is directly answerable from the data elements in the database or with a calculation

from a datum or data presently available. One reason, perhaps, for the necessity of a calculation is to adjust for the size of the company or establishment. Sheer size of business units can bias an answer if data elements are directly used. Calculation of a return on investment ratio or a capital output ratio can eliminate a size bias and can, therefore, permit comparison of two different size companies on the same relative and absolute scale.

A somewhat more complicated question may be answered directly from a database, but with the originator of the query having to supply the conclusion. Suppose that a contract will require a corporation to invest $18,000,000 over a 14 month period, and the appropriate acquisition officer desires to know whether the corporation can handle an investment of this magnitude. The answer may be direct, as the database indicates that over the past 8 years the corporation has invested $3,000,000 annually in plant and equipment. The conclusion, however, is left to the requesting officer in that this person must now determine whether a corporation that has invested $3,000,000 per year over the past 8 years can handle an investment of $18,000,000 in 14 months.

INFERENTIAL ANSWERS. An inferential answer is an answer to a query where there are no direct data elements that are relevant to the query, but where an answer can be developed from several data elements. For instance, if a DOD official desired to know whether acquisition policy was "profit neutral" for prime contractors as against civilian only corporations, the answer could be developed in the following ways:

Step 1. Create matched samples of corporations from the database by SIC code at the four digit level, by corporate unit or by segment or by establishment and by sales volume.

Step 2. To eliminate the size bias, create a new variable defined as profit per dollar of investment and/or profit per dollar of sales. Otherwise the larger corporation might have more <u>dollar</u> profit just because it is larger. The newly created variable would compare the corporations on a relative scale without bias.

Step 3. Rank the corporations based on the constructed variables using a rigorous test: zero sales to the DOD for civilian only companies and 40 percent or more sales to the DOD for prime contractors.

Step 4. Since this is a comparison of matched samples for unknown populations, it is necessary to make inferences at various levels of confidence. The inference made is to the degree of profit neutrality of DOD policy, making allowance for error. This involves well established statistical procedures.

A number of assumptions are required in the analysis including the assumption that the selection of the matched samples actually reflects the respective populations and that the calculated variables actually measure the profitability of the policy.

MODELED ANSWERS. Modeled answers would be the responses to queries where there are no direct data in the database and where an inferential answer would, therefore, be inappropriate. As an example, it might be necessary to attempt to forecast the impact of inflation (materials and wages) on the cost of systems, products or services. Alternatively, one might desire to judge the impact of various types of contracts on the cost and timeliness of delivery of a particular system, product or service. Two types of modeled answer methodologies are immediately apparent: linear regression (econometric or some other mathematical and/or statistical system) and System Dynamics.

There are numerous examples of both approaches in DOD and Air Force literature.

To conclude this point, it might be asked why the interest in increasing contractor and/or subcontractor and/or vendor bidding lists. The answer reflects the basic political philosophy mentioned initially: enlarging bidding lists is consistent with greater competition and the involvement of an important sector of the economy, small businesses, in the defense effort. A second question concerns the nature of the answer to the database question of increasing bidding lists; that is, from an initial perspective the use of a product database to increase a bidding list represents a bottoms up query with a direct answer. But, as the following sections will indicate the answers may be somewhat more complex.

General Concerns Involved in a Database Approach to Increase Bidding Lists

Two prerequisites need to be satisfied if DOD (Air Force) is to significantly increase contractor/subcontractor/vendor

bidding lists. The first requirement means increasing the number of firms that would be willing and able to bid against each other to provide raw materials, parts and components, subassemblies and assemblies to either the DOD or to prime contractors. There would be more than 1 company able to make tank hull castings, more than 2 companies able to make airborne radar systems or more than 3 companies capable of making aircraft landing systems(Gansler, p. 130). It is important to note that the loss of lower tier contractors for various products required in prime contracts is undoubtedly the most critical of growing problems in the industrial base(Gansler, p. 130).

The second requirement would be the willingness of DOD contracting services to make efforts to identify the potential subcontracting firms and to take the steps to aid those willing and able to compete. In is not sufficient to say that DOD or prime contractors are doing the job. It is not sufficient to say that the cost of contracts is increasing. It would be necessary to take an active role in this matter and to answer directly the complaints of the firms that are the actual or potential contractors/vendors/subcontractors. That means that the Air

Force, for instance, must directly contact the firms and work with them in establishing guidelines for vendor work that are comparable with the kinds of guidelines that the contracting services have established for dealing with prime contractors.

A Policy Approach

As a starting point, the contracting services might consider the implications of previously mentioned Public Law 96-354, as applicable to small businesses. The overall purpose of the law is to create procedures to analyze the availability of more flexible regulatory approaches for small business entities. One of the major areas of study of the SBAOA (and one of its charges in developing and using the MEL database) is to determine the ability of small business to comply with government regulations. For instance, if the paper work required presently by DOD acquisition policies (boilerplate) is so onerous that a small business cannot afford it; then DOD may be missing out from existing and valuable technology, efficiency and delivery. It becomes then a major point that DOD may simply have to re-evaluate its acquisition policies with respect to small business if it is to gain access to all the technology and efficiency presently existing in the American economy.

Without becoming more specific, what must be done is to apply the policy statement of General Bernard L. Weiss (Director of Contracting and Manufacturing Policy of the U.S. Air Force) in "Contracting and Manufacturing Newsletter", AFRP 70-1, Volume 20, No. 1, April 1983) to the area of subcontractors:

> The last and most important area of emphasis will involve our efforts to increase our industrial responsiveness and productivity. Initial efforts in the area of manufacturing technology and technical modifications have shown our ability, as first steps, to bring on new manufacturing methods and place them on American factory floors. We need to use our peacetime contracting and manufacturing process to provide a springboard for possible mobilization and surge requirements in the event of a crisis. We intend to work hard at integrating Air Force policies in the area of facilities and equipment, technology and human resources to enhance productivity of our great nation.

But what are the implications of these general concerns for the type of data base needed for increasing contract/subcontractor/vendor bidding lists? Assuming that DOD is willing to engage in follow up activity, the minimum data base must provide the names and addresses of the establishment officers for all manufacturing businesses with their SIC code. This would permit the DOD to directly contact the desired firms to determine the following:

1. Within the four digit SIC code, the products specifically produced by that company;

2. If the products are desirable, what conditions would be required for the companies to bid on (i) contracts directly from DOD and (ii) outstanding subcontracts from prime contracts;

From the preceding chapter, it seems clear that the MEL database would solve this access problem. Since the information in the MEL is proprietary, negotiations would need to occur between the DOD and the SBAOA and perhaps, with Dun & Bradstreet and with MDR Inc. for the use of the database(s). Further, SBAOA is directly charged by Congress to investigate problems of regulatory flexibility and cost when applied to small business establishments and enterprises. Therefore, it seems likely that DOD working with the SBAOA would provide a natural alliance in attempts to determine a suitable middle ground by which small businesses could accommodate DOD contractor/subcontractor/vendor business without suffocating from "boilerplate".

Procedures for Using a Database To Increase the Contractor/Subcontractor/Vendor Bidding Lists

It is clear that in order to maintain and improve the effectiveness of DOD and Air Force acquisition, it is useful to inform as many firms as possible about prime contracts to be awarded by DOD and the Air Force. This is accomplished, in theory, by advertising in the COMMERCE BUSINESS DAILY. In addition it is useful to identify as completely as possible the vendors in the lower tiers of the production process that may supply prime contractors and subcontractors with raw materials and raw materials and/or generic parts and components. This allows firms to resolve the make-or-buy decision more effectively. But other goals besides acquisition effectiveness may be served by appropriately constructed bidding lists; these include the achievement of social objectives with regard to small business and minority owned business. But how can bidding lists be expanded and what represents a database approach to such expansion? These questions are the focus of this section.

A bidding list at the very minimum consist of various product designations and the firms that are currently producing or capable of producing the designated products. The product information may be descriptive or may be in

numerical form such as SIC codes. The firm information would include the firm's name and address. Again, this is the minimal information necessary for a bidding list; additional product information as well as production and financial information would be useful but not essential for purposes of determining firms who might be interested in bidding on a contract and/or in being a subcontractor/supplier to a DOD prime contractor.

Bidding lists can be developed and expanded in a variety of ways. One informal approach is simply to rely on the knowledge of DOD acquisition officers. These individuals, through their experience, will be familiar with various firms and the products they produce or are capable of producing. These individuals may also use their contacts to determine that other firms have the ability to produce the particular products. The difficulties associated with this type of bidding list determination and expansion are rather obvious. It may be awkward and problematic for some acquisition officers to "pick the brains" of other acquisition officers. And what happens if the knowledgeable acquisition officer leaves the field, especially if that departure is sudden and unexpected? At the very least then this type of informal bidding list determination must be converted into some sort of written form. Even then it remains limited by

the experience and memory of individual acquisition officers.

Another method for establishing and expanding bidding lists is the use of trade directories. Indeed the function of directories such as the World Aviation Directory is to provide a listing of firms who believe themselves capable of producing the various products used and needed by a particular industry. A variant of this method involves associations that are not based on trade or industry. For example there may be directories based on geographic region (an increasing likelihood as States and regions become more competitive in attempting to attract new industry). Another example is the previously mentioned PASS system operated by SBA. These methods for bidding list determination and expansion overcome the experience and memory limitations associated with the first method for bidding list determination.

The industry wide database approach to bidding list determination involves a reliance on computerized files where the purpose for the compilation of the files was not primarily an identification of various firms who produce various products. As defined, there is an immediate disadvantage to reliance on a database approach to bidding list construction: the product definitions and designations may not be as precise as they could otherwise be. The

database approach offsets this potential disadvantage with several potential advantages: (i) it is likely to be more inclusive in the sense of covering more firms; (ii) it is likely to provide more than the minimal amount of information; and (iii) it is computerized and, as a consequence, is likely to be readily usable at a variety of different sites simultaneously through time sharing. Whether these potential advantages actually obtain depends on the particular databases or database used to formulate the bidding list.

Of the various databases examined in the course of this study, the one which would maximize the size of bidding lists would be the SBAOA MEL file. As was indicated in Chapter 3, the MEL includes as a minimum a company's name, its address, its SIC industrial classification, and its geographic location and extends to 8.1 million records or establishments. While this file provides maximum coverage, the product detail is very aggregative relying simply on four digit SIC codes. This is the tradeoff: maximum coverage at the cost of detailed product information (as well as at a cost of production and financial information). But the use of the MEL, might be considered as only the first step in producing an appropriate bidding list. Having made a broad and rough determination on the basis of the MEL

other databases could be employed to provide additional information and to generate more specific product determination. For example a computerized version of the World Aviation Directory has been developed (in connection with prior research by the current contractor). This database could be used to determine whether the firms listed were also part of the MEL and, for those firms contained in both databases, to provide more specific product information. The SBA's PASS system could be used in a similar fashion to provide more specific product information, and this is currently under development.

Rather than relying on other databases to provide more detailed product information, an effort could be made to directly contact firms in the appropriate SIC codes to obtain not only more product information but production and financial information as well. Such an approach uses the MEL only as an initial starting point but would be a labor intensive and expensive process.

Still another alternative would be to begin with the MEL and determine which firms had participated in defense related activity in the past. This could be accomplished for those firms that had directly contracted with DOD by a review of DOD form 350 records from prior years. For other firms, identification could be accomplished by queries to

prime contractors. These procedures would define the firms at the various tier levels who had actually participated in defense and defense related production, a core bidding list so to speak. It should be noted that in this regard the DOD form 350 represents a database and provides useful product information.

It should be noted that Dun & Bradstreet has developed a methodology and prototype system to provide prospective purchasers with information regarding potential suppliers. The system, initiated in 1981, is designated as the Purchasing and Procurement Information System (PPIS) and is built from the DMI file. Firms in the DMI file are surveyed (by mail or by phone) and, on the basis of the survey three digits are added to the four digit SIC code (product line code) to provide more detailed product information. This seven digit number identifying specific products is also attached to the firm. A user having determined the appropriate seven digit product code can query the system to determine which firms produce that product; in effect producing a bidding list for that particular seven digit product. This system might be viewed as a potential model of a operating system that could be used by DOD. Appendix D discusses this system in some detail.

Conclusions and Recommendations

These remarks should provide sufficient information to indicate how databases can be used to construct and expand contractor/subcontractor/vendor bidding lists. To conclude this section and this chapter, it is useful to indicate the essential elements that must be combined to achieve the ends of expanded bidding lists, more effective acquisition, and a strengthened defense industrial base.

The first element is that if acquisition officers are to in fact accomplish this job, there must be a path to promotion and advancement for those that successfully accomplish the goal. The path to success in the military as elsewhere is accomplished using career objectives.

The second element regards the size of the American industrial base and the methods needed to access that base, or portions of it. Substantial funds for the procurement and use of modern computing equipment would be required just to provide information to individuals as they would need it, in either direct answer form, inferential answer form, or modeled answer form.

The third element requires the personnel to handle the problem. The problem is to use the database to identify those small and not-so-small businesses that appear to be able to handle the production of the required items and to determine specifically what the firms would require in order

to entice them to bid on defense business as either prime contractors or as subcontractors. This would include identifying subsets of, for instance, the 510,000 manufacturing small businesses. It would also involve personal contact with the small businesses on more than an occasional letter basis.

The fourth element requires that the policy recommendations coming from this group be heard by DOD. It would probably involve the development of a structure for handling subcontractor/vendors that is similar to the structure for handling prime contractors. This is not to say that control of subcontractors be placed with DOD or the required service rather than with the prime contractor, but that an analysis of necessary changes is required.

The fifth and final element required is that the DOD officials establish a feedback system both with prime contractors and with small and large businesses (other than prime contractors) to work out a suitable approach to increasing the contractor/subcontractor/vendor bidding lists.

Chapter 5

Make or Buy Components for Weapons Systems: The Nature of the Decision

On any one contract between DOD and the weapons contractors in the private sector there are literally thousands of components that might be available commercially or produced by companies other than the direct or "prime" contractor. In the phase of contract management entitled "pre-award", a procurement plan must be submitted by the prime contractor to the Air Force listing the components that the prime contractor suggests be made and those to be subcontracted. The objective of this procurement plan is to accomplish the best possible procurement system based on time and dollars for the benefit of the Air Force. This procurement plan is subject to approval by the DOD at the time of contract award. The nature of the decision separating of the to-be-made and the to-be-bought items as accomplished by the contractor is the focus of this chapter.

The Basic Hypothesis

With the increasing complexity of the weapons systems bought by DOD and the ever present worry about cost overruns, the make or buy decision has the potential

for being very important to the contractor. But DOD as an arm of the Federal government is also very interested in these decisions as they impact DOD policies in terms of long range planning. There is also the more specific and previously mentioned concern that the defense industrial base is shrinking across the spectrum of manufacturing companies in the United States. It has been estimated by knowledgeable members of the several Systems Program Offices at Wright-Patterson Air Force Base and Andrews Air Force Base that the F-16 and the B-1 aircraft have as many as several thousand companies all under contract to the prime contractors, (General Dynamics and Rockwell International, respectively) to manufacture one or more system components. The speculation is that these represent only the second tier of contractors and that several thousand others may well be involved at the third or fourth tier levels.

Based on the multiplicity of contractors at the several levels of a major weapons system contract, it is clear that decisions of whether to make or buy routine as well as critical components are important decisions. As such there must be an environment within which these decisions are made and the nature of the decision is subject to pressures of which DOD and the Air Force should be made aware.

Task 4.3 then has as its objective the development and testing of a hypothesis that responds to the above problem formulation. The hypothesis developed states simply that:

Ho: contractor make or buy decisions focus exclusively on the cost differentials among the alternative manufacturing/service possibilities.

Ha: The above is not the case.

The testing of this hypothesis is accomplished through personal and telephone interviews with a spectrum of companies doing business with the Air Force and making or buying components or raw materials being the object of the make-buy decision. The list of companies contacted appears in the appendix to this chapter along with the Air Force Plant Representative Offices which have contributed to this study.

Contractors Selected for Study Contribution

Unknown personnel telephoning to request somewhat sensitive information on a contractor's manner of making decisions is not normally given much contractor sympathy. Recognizing this fact the authors have been fortunate in that one has been for several years a member of the national Board of Directors of the International Society of Parametric Analysts, a systems cost oriented organization.

The Board members of this organization provided a first list of individuals associated with many of the prime contractors, i.e. General Dynamics, Lockheed, etc. From this group a number of contracts were then made with sub-contractor levels, i.e. TRW, Sperry, Litton, etc. The focus was to gain access to the documentation of a spectrum of companies who actually make the decision for make-buy and to analyze the pressures brought to bear on the decision itself. Companies such as Martin Marietta, whose Denver Division concentrates almost exclusively on highly classified products and does not have foreign offsets problems as a make-buy consideration and Sikorsky Aircraft Company, a Division for United Technologies, which builds aircraft all over the world and continually contracts with foreign companies as a part of their responsibilities under Government to Government activities are included in this spectrum interviewed.

A total of companies have been interviewed as a part of this effort either through personal contact or by telephone. In most instances the chairman of the make-buy committee was the one providing the information and in each case the chairman was cooperative in the extreme. Once the nature of the study had been explained the willingness to provide help

was outstanding.

The Prevailing View

The classic textbook in this area by Moorel covers the theory of the decision on the basis, primarily, of cost alternatives. Moore suggests that companies in the private sector are known for buying more than fifty percent of their components - even the ones that can be made - and the sales dollar is, therefore, split so that the prime contractor obtains less than fifty cents and subcontractors/vendors more than fifty cents. The basic consideration is that a second source is then available for comparison of costs. Thus, the make-or-buy decision is usually viewed as a split level decision in the domestic market, and several Air Force contractors made the same point for this study; i.e. dual sources make for good manufacturing cost comparisons.

This split level acquisition does not appear to be as common in the defense oriented market place since low volume production and other pressures mitigate this need for cost comparisons over long time periods.

Two pressure points developed by Moore seem to have significant influence however. First is whether or not the prime contractors facilities can support the

manufacture, i.e., if foundry equipment is not available then castings must be bought. Second is whether or not the skills, technical as well as managerial, are available for the component manufacture, i.e., machinist skills are not as available today in small companies as they once were.

Survey Results

In order to assess the textbook theory and to evaluate the hypothesis, twenty-two companies at the prime contractor level as well as second and third tier levels have contributed their comments as to the nature of the make-buy decision. In addition six AFPROS (Air Force Plant Representative Offices) have also contributed their views on the operation of procedures in the make or buy decision.

The one main philosophical aspect to this decision area is common to each of the parties contacted and can be stated as follows: the make or buy decision is a multi-faceted envelope of dynamic pressure oriented and cost based policies that have as their core the self image and business sector survival of the company making the decision. An appropriate analogy is the balloon that responds to pressures from many directions at any given moment but is also responsive to the internal air pressure as the core of its maintaining a specific volume. A company makes these

decisions with its own welfare at heart but also with a cost orientation and a number of other considerations as parts of the procedure. The classical texts 1,2 all have suggested a committee of manufacturing experts should make these decisions and all of the companies contacted have such a committee procedure in operation. Each of the companies also has standard operating procedures for these committees although the documentation varies from quite extensive to quite abbreviated. The thrust of all the documentation is focused upon the philosophy as stated above.

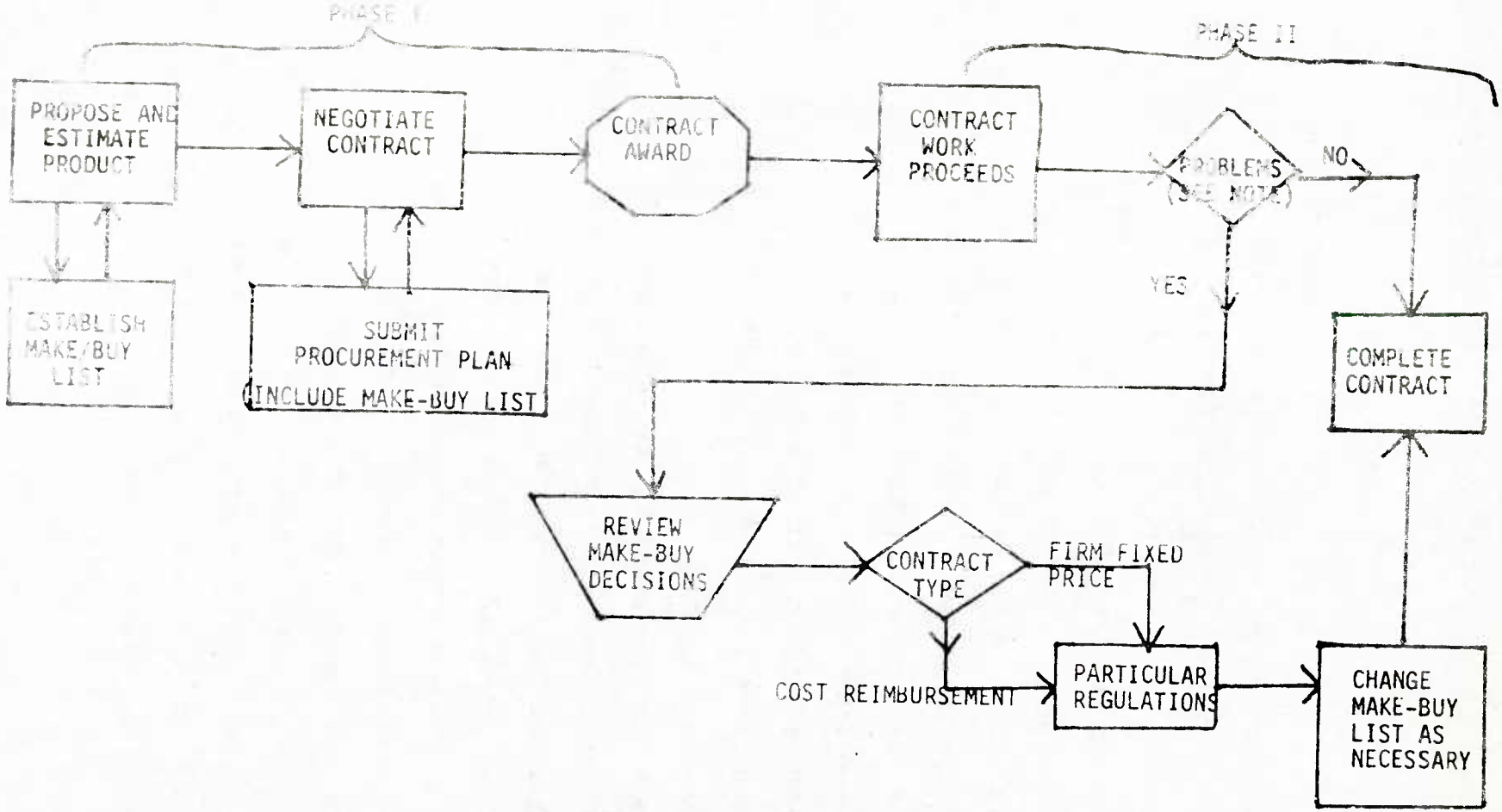

Figure 5.1

KEY DECISION POINTS FOR MAKE/BUY

Note: The make/buy decision often occurs at certain key stages of a contract. During the estimating and proposal stage a make/buy list is established as a part of the procurment plan. The make/buy mix is left unchanged throughout the contractural period unless problems of technical performance, quality, delivery capacity, or other factors necessitate a review of the make/buy mix.

The diagram illustrates the key decision points for mak/buy and the major considerations at each point.

In Figure 5.1 the activities associated particularly with the make-buy decision as they track the contract award system are portrayed. During the proposal and cost estimation periods of any contract the initial selection of those components to make and buy are made by the prime contractor. The contract is in the process of negotiation and the procurement plan including a list of the components to be purchased become part of the negotiations. The DOD accepts or further negotiates the plan and requests any changes to the make-buy list as a part of the final negotiations for the contract, and these activities complete Phase one of the make-buy activities.

When the contract has been awarded, the second phase is entered through the actual negotiations of the prime with each of the subcontractors for the components specified in the procurement plan as scheduled to be bought. Contract effort proceeds and if no problems in component performance, delivery schedule or other aspects of the subcontractor effort surface during the contract period the original make-buy list is adhered to for the contract period. As problems arise the monitoring of the contract compliance being performed by both the Air Force°s Systems Program Office (SPO) and the prime contractor notes such problems of

their jurisdictional responsibilities. When such problems are judged to have a significant impact on the weapons system performance, delivery or other element of the contract the DOD and the prime contractor may decide to find a second source for purchase of the item or move the item to a make category wherein the prime may have the resources to produce the product in-house. This decision is made carefully as the particular contract, i.e. firm fixed price or cost reimbursement or other kind of contractual from may not be easily changed. The judgment of the prime and DOD are of course dependent on many factors outside the actual make-buy decision nature as developed by this diagram.

There appear to be a number of pressure points that are common to the spectrum of companies surveyed in this study. Each is briefly discussed below as representative of the discussions held and the conclusions drawn are common to the majority of the opinions expressed.

First:

The critical nature of the component to the operation of the system or part thereof that the company is manufacturing. If the company is, for example, responsible for the guidance and control system, then the gyros are critical to the satisfactory operation of the system. Thus,

all other things being equal the decision will probably be made to make the item rather than go out for bids. The theory here is that control of the specifications, manufacturing, and problem response will be better for the engineers in the prime contractor's employ than if the item were to be bought from a low bidder who will need extreme documentation and guidance. The same argument applies to an item for which the company may have gained a reputation in the past, i.e., a company which has gained a reputation for making high quality products will not easily make the decision to buy even though the cost alternative may favor this decision. The logic of this seems to be in line with the philosophy stated above; the first consideration for the make-buy committee is company survival.

Second:

There are, of course, certain obvious make or buy decision parameters that are seldom considered more than once. For example a company may make the decision that machining beryllium will not be done in-house because of the hazards associated with such work. In addition there may be a decision not to enter the market place in making

micro-circuits or components such as nuts, screws or other items. Since the capitalization required for making micro-circuits is high and the competition for routine fasteners is high, entering a very specialized production area or a highly competitive one is a very risky decision. Such a decision is seldom made unless circumstances make it highly profitable to do so. This facet of the problem seems a highly logical one as the funds necessary to enter production can be enormous.

Third,

Facilities loading of the plants available to the company are another area. Several of the contractors maintain control of the product through manufacture of the prototype and development phase for products and then contract for the production volume. In this manner the problems to be solved in the manufacture of the item can be controlled by the prime contractor and then minimized through the knowledge of the prime contractor as the subcontractor dedicates facilities and skills to the actual production. Dedication of machine tooling facilities and skills is a costly procedure, whereas dedication of assembly and test facilities and personnel is much less costly. The rationale here is that machine

tool costs are quite high and the training of the machinists is a long term effort. Assembly and test facilities are usually quite easily obtained and the assembly personnel are not highly skilled in comparison. Thus, the prime contractor wishes to maintain the control over the final phases of the product being built and can more easily establish the assembly areas from which DOD oversees the final phases of production.

An interesting sidelight on this aspect of the problem is that the supply and demand theory appears to be inverted in this area. But the explanation is fairly simple. As the production run for an item reaches its climax and its production rate begins to decline, the demand for assembly workers at the low end of the pay scale also decreases. Workers who have been trained stay on the job as the natural selection process takes effect and their pay scale is rising as a function of seniority on the job. The unit cost for certain assembly areas at the end of a production run is, therefore, higher than the unit cost at the beginning of a run based on the accumulation of these more expensive workers and technical people. Some extremely capable personnel maybe moved to more complex, new contracts but the 'old' contract still

has to have the personnel expertise needed to complete production and these are expensive personnel.

Fourth:

As the time frame for the start of production extends out years into the future instead of merely months, the need for better estimates becomes imperative. As errors in cost estimates are encountered in the making of a product, so the errors in a cost analysis submitted by vendors become even more of a risk as the control over the figures is lost by the increasing levels of contractor to DOD relationships.

Three to five years into the future is not an unusual time frame for estimates now being made for the start of production. Therefore the make-buy analysis must be driven by confidence in the supplier, the supplier's continued existence and skill capability, and the contractors' willingness to continue working in the defense sector.

Fifth:

Each contractor in the defense sector is now aware of the concern for the support of minority owned businesses. This concern is reflected in the need to assign capable and valuable skills to contract administration,

engineering assistance and other support efforts from the prime contractor. The sources contacted in the course of the current study suggested that the percentage of contract, in dollar value, that is typically agreed to as part of the procurement plan ranges from five to ten percent. However, the skill effort assigned is a bit out of proportion to this and thus the impact on the make or buy decision is another dimension of the problem,

Sixth:

Just as the concern for minorities is a regulatory requirement for companies manufacturing for the defense sector, so too is the facet of foreign offsets. A radio that might be required in Canada for their armed forces must have a certain percentage of the manufacturing done in-country and the contractor may have to set up facilities for support of local industry to accomplish such efforts. General Dynamics, the Sikorsky Division of United Technologies, and Sperry, for example, have been involved in such foreign offset concerns for some years. The make or buy decision must include the accumulation of these offset areas as a part of the entire procurement, but also requires a great deal of corporate concern as distinct from the make or buy decision.

Seventh:

One problem in procurement which impacts on the defense sector is the problem of "embedded items" in a product sphere those "embedded items" are not normally built for the defense sector. Such items as micro circuits and chips placed in video games are also very useful in radar, airborne fire control and other avionics systems. The vendor for such items may have a commercially desirable product which fulfills a role in the defense sector as well. The commercial vendor is typically not willing to document the product to the Military Standards level and the make or buy problem becomes more complicated for the prime contractor.

Essentially the contractor personnel interviewed had no recommended change to the respective DARs (1) that address the make-buy decision. The one possible exception to this statement is the "hardware exclusion" area where a component design by a "prime" contractor may be shifted by the DOD to a "buy" category. Two of the contractors interviewed suggested that this tends to inhibit and frustrate engineering and production talent based on the proprietary attitudes inherent in a self-designed product.

Results of the Study on Make-Buy

As detailed earlier in this chapter the companies contributing to this area represent a wide spectrum of activities in the weapons system business at both the prime and sub-contractor levels. The one principle result of the interviews with the make-buy committee chairmen is that the nature of the decision is as consistent as any result can be. Each of the contractors place the make-buy decision in an environment that first of all supports the employer and responds to the needs of the DOD in the sense of the product to be built from the performance aspect. Once these two elements have set the foundation for a contract negotiations, the remaining pressures as developed above in this chapter form the manner of entries on the make-buy list as provided in the procurement plan. Critical components, facility and personnel skill loading obviously provide a somewhat vested interest in the employing of resources by the prime contractor. However, the need to respond to the minorities and small business concerns of the Federal Government often mitigate any overall sense of the loading need.

The hypothesis as developed in the first part of this chapter is the overwhelmingly rejected and the cost of a product becomes only one element in the nature of the

make-buy decision. The outstanding characteristic of this portion of the study is the consistency of the contractor response in that each lists the same set of forces that impact on the Committee as established in the interviewed company.

Summary

The nature of the make or buy problem, in essence, is one of great concern to the contractor who must make decisions in an environment of a number of varied and dynamic constraints. Facility and skill capability and capacities, time frames and reliability of estimates, criticality and reputation as well as the regulatory and financial aspects all exert pressures which influence the decision. As the text books have encouraged since the 1950s, a committee of experts is typically the means employed to reach a decision; committees for make or buy decisions are the unanimous means to accomplish this task among the companies contacted. Standard operating procedures (SOP) are published by each company and serve as the basis for the committee meetings and decisions. However, none of the contacted companies indicated a priority listing these pressure points as discussed above as

being the driving forces for the committee deliberations. The problem is too dynamic for placing such elements in an SOP. the analysis, therefore, suggests a rejection for the hypothesis established earlier. Cost is only one of several considerations and at times, may be a secondary consideration in the make or buy decision.

We might add that the make-or-buy decision is handled precisely the same way by companies that are heavily into classified work, with no foreign production offsets and by firms heavily involved in military hardware with substantial foreign offsets.

Chapter 6

Production Base Analysis

There has been and is a continuing concern among various DOD officials regarding deficiencies in the defense industrial base. This concern is expressed in congressional hearings, statements by military personnel including General Alton D. Slay, as well as in various documents published by DOD and the armed services. Specifically, the concern is directed at the ability of the defense industrial base to respond to the kinds of DOD weapons systems requirements that might arise in different environments. Three kinds of environments are mentioned: (i) a five year peacetime procurement program;

(ii) an ability to respond to a "surge" requirement in hardware production (either selective hardware systems or all hardware systems over a given period of time short of an actual United States military engagement); and,

(iii) full mobilization.

The term "production base analysis", is an attempt to determine the delay time needed to accomplish certain military hardware production goals given the existing industrial capacities of the defense industrial base and the environment

in which the decisions are being made. The analysis also looks at the capital improvements needed to rectify identified problems.

From the Air Force point of view there are a number of studies that have dealt with either the entire problem or particular aspects of the problem. These include the 1976 Defense Science Board study of Preparedness Planning, the 1980 Defense Science Board study on Industrial Responsiveness, and the December 1980 Report of the Defense Industrial Base Panel of the House Armed Services Committee. In 1975 Air Force Logistics Command undertook an analysis which integrated wartime logistics support with the available industrial capability. In addition there was the Air Force Systems Command's PAY OFF 80 which assessed national productivity issues in the context of DOD's capability to efficiently acquire weapons systems. In 1981 Air Force Systems Command undertook an assessment of the impact of current acquisition policy on the efficiency and the availability of critical manufacturing capabilities within the defense industrial base. In 1981 Air Force Logistics Command defined the "contract surge" methodology for increasing the production output of out-of-production spare parts. Finally, there is the most recent study done

jointly by Air Force Systems Command and Air Force Logistics Command entitled PRODUCTION BASE ANALYSIS FOR FY 83.

To repeat, production base analysis focuses upon the ability of the defense industrial base of the United States to produce various quantities of military hardware in a given period of time and in various environments. One apparent characteristic of such analysis is that it usually deals with problems in physical or real terms rather than in monetary terms. The conceptual framework of the analysis is defined as "how long will it take to produce n-number of hardware units", not "how much will it cost to produce n-number of hardware units". A second characteristic of production based analysis is an attempt to isolate critical production bottlenecks and constraints that preclude the attainment of desired production goals. The kinds of recommendations which result from production base analysis investigations are those concerning capital investment incentives, stockpiling of long lead materials and the like that might eliminate bottlenecks and other constraints.

The discussion in this concluding chapter identifies and examines briefly the various methodologies that have been applied in production base analysis and indicates how the activities accomplished in the completion of current

research contribute positively to the effectiveness of production base analysis. It is to be noted that these activities are not defined as tasks to be completed in the covering contract's statement of work. Rather, it was decided to include the present chapter because discussions with various individuals indicated that it would provide a useful link between the specific concerns of the current contract and other activities concerned with the viability of the defense industrial base.

Methodologies Used in Production Base Analysis

A study by Paul McCoy, prepared for the Office of the Under Secretary of Defense for Research and Engineering (IDA paper P-1632, volumes I and II) attempts to develop and present a method for identifying key sectors of the U.S. industrial base which could constrain a major force expansion. The study sets forth a method for calculating defense industrial requirements for a "surge" or major force expansion.

McCoy begins his analysis by indicating that there are three general methods currently used for mobilization planning. The first is the critical path method used in lead

time studies done for particular weapons systems.[1] The major advantage of this kind of analysis is that the detailed parts, components, supplies and subassemblies can be individually tracked with an ability to explicitly analyze the time delays involved in the production process. The disadvantage is that usually only one weapon system can be analyzed at a time, with an inability to determine what happens to schedules and lead times when the entire economy is operating in a "surge" or full mobilization environment.

The second method mentioned by McCoy uses the standard Leontief Input-Output approach. This method uses the Department of Commerce tables for the U.S. economy which include 485 groups, with the ability to combine the various groups to develop forecasts of U.S. production requirements.[2]

The third general approach mentioned by McCoy is the use of a linear programming model such as the one developed for the Federal Emergency Management Agency (FEMA). In this type of model the constraints can be explicitly included in the model in predicting capacity expansion. This model does not take into account production time delays and, because of the computation complexity of solving the linear equations, the model uses broader commodity groupings than other procedures.[3]

Having mentioned the three general methodologies, McCoy

goes on to develop and explain the Industrial Mobilization Planning Model (IMPMOD). Because it represents one of the more interesting approaches to production base analysis, it is useful to explore IMPMOD in more detail. We can begin by examining the critical path network for aircraft production illustrated in Figure 6.1, (taken from the McCoy Report). This network indicates the relation between the contractor/subcontractor/vendor tier levels discussed in Chapter 2. Critical path analysis goes one step further and indicates the specific relationships between the cells in the various tier levels. The critical path network serves to underscore a significant point developed in the prior

Figure 6.1

Critical Path Network for Aircraft Production

Source: Taken from Paul McCoy, IMPMOD Model, IDA

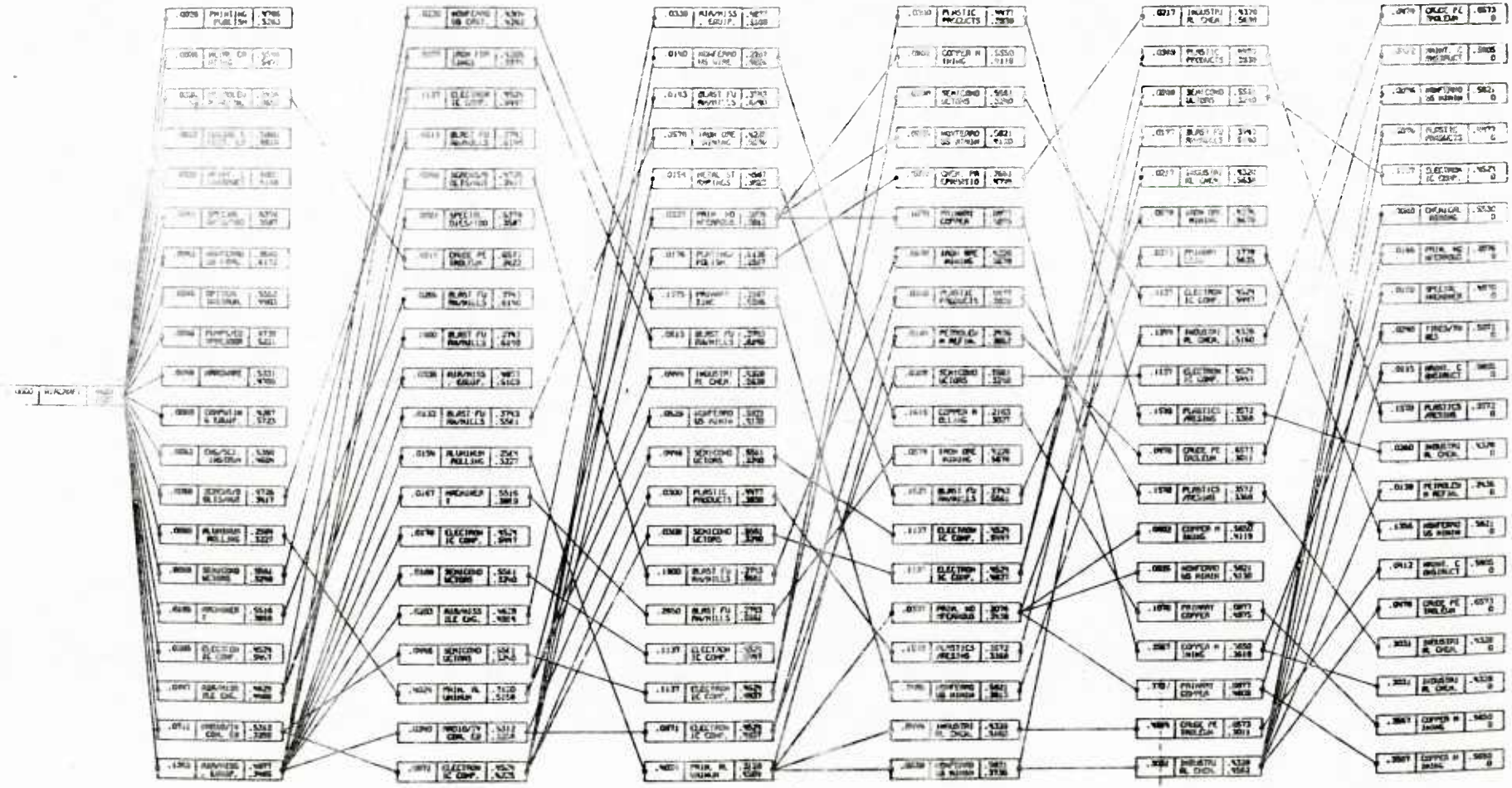

Figure 6.1. CRITICAL PATH NETWORK FOR AIRCRAFT PRODUCTION

chapters of this study: when considering military hardware production, it is not useful to limit the considerations to a subset of American firms but to take an economy wide perspective.

For example, the cell on the left side of Figure 6.1 represents the SYSTEM (first) tier or the assembly of the final military hardware unit. The cell is labeled AIRCRAFT. A line from one cell to another on the figure connects a box in one tier to a box in another tier and indicates that a commodity is directly required in the production of the commodity in the previous tier. For instance in Figure 6.1, the leftmost box indicates that Aircraft is the final output. This requires production from Aircraft/Missile Equipment (second tier, lowest box), which in turn requires radio TV commercial equipment, (second box from the bottom, third tier); aircraft missile engineering(fifth box from the bottom, third tier); electronic components (second box from the bottom, fourth tier) and so forth. The point is that in order to determine the lead times required to increase the output of military hardware, it is not sufficient to simply look at the "defense industrial base" or the first tier. Simply, the bottleneck to expanding production may well be in a third

tier area such as industrial chemicals; hardly an industry that would normally be considered as located in the defense industrial base. The bottlenecks to added production (at any tier level), may be from inadequate capacity, competition from other military production hardware requirements, or competition from civilian production.

In interpreting the structure of Figure 6.1, cells in each tier are arranged in increasing importance of production contribution to the higher tier. Thus the bottom cell in each tier contributes the most to the production of the end item in terms of dollar value. Air/Missile Equipment contributes the most in the first tier; Electronic Components contributes the most in the second tier, and so on. This is indicated by the number preceding the cell name. For Air/Missile Equipment for every dollar spent in the production of the end item, Aircraft, .1363 dollars is spent on Air/Missile Equipment; .0711 is spent on Radio/TV Communications Equipment; .047 dollars is spent on Air/Missile Engineering, and so on. The top number on the right side of the NAME of each cell is the value-added by that industry cell in the production of that commodity; the production of that industrial cell as measured by such expenditures as wages, profits, rent, taxes. The number on

the bottom right side of each cell represents the purchases of commodities by that cell NOT derived from lines to that commodity from lower tiers. But the output of a firm which is not accounted by its value added must be accounted for by its purchases from other firms. This is why the two numbers on the right of the cell name sum to one (1.0) when the cell makes no purchases from other cells in the table. If a cell makes purchases from other cells then the left hand side number from the appropriate cells must be added to the two right hand numbers of an upper tier cell to obtain a value of one.

McCoy indicates the major assumptions of his study model, cited in his report. They are:

** 1. All commodities can be treated as aggregate groups at the four digit SIC code level;

2. All future mobilization DOD purchases will be in the same pattern as planned for the FY 1986 five year defense plan;

3. All defense end items are delivered according to the same time-phased pattern during mobilization;

4. Total non-defense spending is not reduced during mobilization and is at the same pattern

as shown for 1981 and grows at the same rate;

** 5. Production process times for individual commodities are estimated based on the smallest order lead time observed for the past ten years;

6. Commodity queue times can be neglected; and

7. Production capacity growth is unchanged during mobilization.

At present the IMPMOD model can set the parameters as desired, hence the limiting assumptions become model variables. The starred assumptions remain in the present IMPMOD model.

In the development of the IMPMOD model as with all input-output models, there is the significant problem of estimating industrial capacity.[4] There is also the problem of having to deal with the input-output coefficients that may be significantly out of date. Still given these assumptions and limitations the model is able to indicate time-phased production requirements of critical parts as related to capacity and delivery of end items in the particular military hardware area.

Thomas, in his review of IMPMOD("Economic Models for Projecting Industrial Capacity for Defense Production: A Review") concludes with a number of recommendations. One of

his recommendations is that research be supported to provide better estimates of capacity for "most important defense industries". This is perfectly consistent with arguments made in earlier chapters that strategic planning (as well as more effective acquisition) requires production data; the two terms "capacity" and "production data" are, in this context, referring to the ability of the firm to produce. Thomas also recommends that the Bureau of the Census should support studies leading to determination of the physical limits of plant production, rather than practical capacity. This is consistent with the earlier discussion, particularly in the context of assessing surge capability. A final recommendation that is consistent with the analysis presented in the previous chapters is his recommendation that funding should concentrate on studies of problems associated with potential business bottlenecks. This would be the case in attempting to determine whether in fact contractor/subcontractor/vendor units are declining, going out of business or shifting to civilian production.

Features of Production Base Analysis

There are certain key features of production base

analysis. These, not necessarily in order of importance, are (i) concern over the fiscal environment and economic priorities within which any given military acquisition will occur, (ii) a concern for the availability of strategic supplies and materials needed to produce the final military product, (iii) the capacity of the critical industries or plants to provide the inputs required for the final assembly, (iv) the lead time required to produce the critical items needed in the final military hardware units, and, (v) the management skills required to plan the use of the capacity, material supplies and labor time in creating and using the components which, in turn, are used in creating the final military hardware unit. As noted, capacity studies are difficult to obtain, but are necessary in order to establish the rated and used capacity of the various industry components required. Production base analysis, with the exception of the input-output models, tends to focus excessively on the defense industrial base industries or first tier firms without taking the necessary broad view of the industrial base of the United States. For many hardware units produced for the military, the problem of multi-national acquisition complicates the problems of production base analysis.

Most production base analyses tend to use a common set of "lead time" estimates for the various components. For instance, the FEDERAL REGISTER (Part II) for June 25, 1974 provides background on the rules and regulations governing the Defense Materials System , identifies the items involved and provides the estimated lead time and the "minimum number of days in advance of the first day of the month in which the shipment is required". This provides the lead time estimates for many of the items involved. Estimates of JAMAC (AFSC/PMDM) provide the results of a 1983 estimate for lead time information for aerospace contractors: the average lead time in weeks for small and large orders for various aerospace materials(Memorandum: Material Lead Time Information, JAMAC, Wright-Patterson Air Force Base, Ohio, 45433). Additional and related lead time information is provided in the USAF PRODUCTION BASE ANALYSIS, FY 1983. In some instances the lead time information appears to be the result of current surveys. Elsewhere it appears to be published standard commercial information.

An Alternative to Traditional Modeling

Military analysis is usually structured in terms of

past history and existing DAR forms. A paper done by Lt. Col. O. M. Collins presents some interesting possibilities for breaking this traditional mold. The traditional mold is either to use the Input-Output Matrix approach and historical matrix coefficients in developing an applied input-output model, or to use the existing DAR forms in carrying out the analysis. Collins notes that a decision to establish a credible industrial planning process must come from the highest levels of the military and must be supported by a management hierarchy. Note that these are similar to the requirements for an effort to use a database to increase contractor/subcontractor/vendor bidding lists, as stated previously. However, the process must include a decision concerning whether the planning will be reactive or will be pro-active. Pro-active, in this context, means an ability to plan and shape the future industrial base resources to match anticipated needs and technology. In short the production base planning agenda will have to be reshaped to focus upon problems of production surge or problems of full mobilization. To this extent the existing or historical models including the DD Form 1519 appear limited to the historical perspective.

At this point it is useful to consider certain

concepts which might contribute to a more creative and forward looking production base analysis. First, a credible industrial planning process should establish a guide to the development of production base resources in a transition from the present situation to the future. Instead of basing production analysis on a point-solution-surge set of assumptions, the degree of surge capability (desired) should be based on a conscious management decision to be prepared to surge from peacetime production rates for a given system or set of systems, by some stipulated factor and within a given period. For a longer term vision, production base analysis must ensure the availability of industrial base establishments and industrial base resources to satisfy stipulated technology and military hardware force objectives (Collins, 26). Basically this approach would imply a change in the present day business assumption of maximum profit in the short term.

A second concern in establishing an industrial base planning process is the understanding of the linkages not only between macro-economic planning at the industrial sector level, but also micro-economic planning at the industrial segment and/or establishment level. It would seem clear that the objective of any production base planning

process would be to develop the necessary information to provide decision makers with the required data as well as the establishment of a framework within which the data may be focused toward given policy goals. The information provided might be direct data, inferential information or a modeled answer.

Basic Considerations of an Integrated Planning Approach

In any continual production base planning approach, the key consideration is to relate the industrial base establishments with the materials, supplies, parts and components required by the appropriate establishments to provide inputs and to assemble the end product hardware units. A related critical question is the identification of the establishment units and the capacity of those units not only in terms of investment capacity but also in terms of labor skills and availability. Thus the requirement is to determine not only the goals of the production base planning approach but also the specific information required to be able to set those goals. The particular model used should be selected accordingly. The following considerations form an initial framework within which to consider an integrated

planning approach for the Air Force.

The first and perhaps the most important issue is to ensure that focus is maintained on the United States industrial base, and not simply some subset reflected as the "defense industrial base". This point is amply demonstrated in Chapter 2 of this study, and by McCoy using the IMPMOD model. In terms of Figure 2.1 of chapter 2, a bottleneck can in fact occur at any point from petroleum supply through aluminum forging, composite material development as well as in the more familiar areas such as electronic chip/subassembly development.

A second point underscoring the necessity of identifying required materials and components is that the orders may be optimized through the use of materials stockpiles or multi-year prime or subcontracts. In a period of surge (or of full mobilization), the availability of critical raw materials is paramount. This availability of raw materials may be the link permitting immediate hardware production while the process of producing raw materials is brought to full capacity levels. A major effort is needed to ensure that substitute materials (or less expensive but less effective materials) are known to the planners.

Third, it is also important to identify all domestic

capacity that could be transformed in a given period of time to support a mobilization or a surge requirement. This may be particularly important in the event of multi-national production of hardware units, such as the F-16. The USAF PRODUCTION BASE ANALYSIS FOR FY 1983 considers this point. The F-16 system consists of 5,000 suppliers of all types of materials with over 700 suppliers providing repairable items. There are approximately 115 items of government furnished equipment (GFE) delivered with or installed with each production aircraft. Except for the forward fuselage, all major structural subassemblies are coproduced by participating European industry.

A fourth point is also noted by Collins; the establishment of a production base analysis planning methodology should be identified as a means to an end rather than as an end in itself. The planning system should be the vehicle for integrating policy and program acquisition decisions to accomplish the goal of efficient and effective acquisition of military hardware. As such, it is necessary to carefully describe and define the planning goals and structure. To fail to do this is to permit the model to define the goals and the structure.

As a fifth and final consideration, the assumptions on

which the production base analysis planning rest must be carefully defined. While the following list is not exhaustive, it is illustrative of the kinds of questions to which answers must be assumed: (i), will civilian or domestic production continue at the same level and rate of growth, or will military production expand relative to present domestic production? (ii), will domestic capacity need to expand to replace foreign multi-national production of military hardware components? (iii), to what extent will negotiation exception principles be followed in the planning phases? (iv), what are the expected military expenditure levels to be/or what percent of GNP is expected to be allocated to the military hardware base planning? (v), is the planning to be based on aggregated industry groups at the four digit SIC code level (IMPMOD) or is the analysis to be carried out for each system? (vi), should the analysis reconsider the lead times estimated for the production of materials and components in each unit or are the existing conventional lead time estimates considered to be sufficient? (vii), are commodity queue times to be included in the analysis?

It appears that the critical path network, as demonstrated by IMPMOD, forms a basic industrial framework

upon which production base analysis can be carried out. It also seems that much more attention must be paid to disaggregating the analysis from the four digit SIC code level to the individual plant/establishment unit involved in the production of military hardware components. Not only is it necessary to know the 5,000 establishments involved in providing inputs to the F-16, we need to know whether there are another 5,000 establishments that could provide the same materials.

Summary

This discussion of production base analysis has had two broad goals. The first was simply to review the meaning, nature, and methodologies associated with production base analysis. The second was to provide reactions to production base analysis as suggested by the analysis of the first five chapters of this report. The main conclusions are: (i) production base analysis is a critical procedure for assessing the ability of the economy to respond to defense requirements; (ii) production base analysis is likely to be most useful and effective when it takes the broadest possible perspective; and (iii) production base analysis requires

product, production and financial information but goes beyond these data requirements by demanding information regarding the interrelations between firms and industrial levels or tiers.

Chapter 6: Footnotes

1. For example, the study of the 155mm self-propelled howitzer (Industrial Base Responsiveness Study for Howitzers, Medium, Self-Propelled, 155mm M109A2, Department of The Army, Armament Materiel Readiness Command, Rock Island, Illinois, May 1978.) Further, one might consult the U.S. ARMY SYSTEM FOR AUTOMATION OF PREPAREDNESS PLANNING (ASAPP), October 1, 1981, U.S. Army Industrial Base Engineering Activity, Rock Island, Illinois 61299. ASAPP replaces a manual system for preparation of production base analysis (PBA) with an automated system which takes advantage of Industrial Preparedness Data (IPP) in machine readable form. Also: Industrial Base Responsiveness Study for the TOW Weapon System, Department of the Army, Redstone Arsenal, Alabama, June 1978, and Ammunition Production Base Leadtime

2. Dr. R. William Thomas, IDA, notes in his study Economic Models for Projecting Industrial Capacity for Defense Production: A Review, Institute for Defense Analysis, Program Analysis Division March, 1983, that there are three models currently available to the Department of Defense that use the basic Input-Output methodology: first, the Defense Economic Impact Modeling System (DEIMS) developed and maintained by Program Analysis and Evaluation, OSD; second, The Revised Growth for Industrial Potential Model (REGRIP) developed and maintained by the Federal Emergency Management Agency; and, third, the Industrial Mobilization Planning Model (IMPMOD) developed by Paul McCoy of IDA and currently being maintained and expanded by Thomas. The interested reader may wish to consult, in addition to the McCoy and Thomas studies, the work on DEIMS by Blond, The Defense Economic Impact Modeling System, The Office of the Secretary of Defense, Program

3. This approach is discussed in D. B. Belzer and R. J.

Nesse, A Model to Identify Potential Resource Constraints in a War Mobilization, Battelle Pacific Northwest Laboratories,

4. With respect to the capacity problems, capacity studies were those provided by the Bureau of Census , June 1980 (Survey of Current Business, June, 1980, p.25 and March, 1981, p. 31). The capacity definition is "Practical Capacity"; that is, assuming the level of output that can be achieved with the framework of a realistic work pattern (8 hour day), and that sufficient labor, materials and utilities are in place for the capacity utilization to occur.

Chapter 7

Summary and Conclusions

As indicated in the introductory chapter to this report, three major tasks were to be accomplished:(i) identifying aerospace subcontractors, (ii) investigating databases on privately held firms, and (iii) examining the prime contractor's decision to make or buy parts, components and/or subassemblies from subcontractors and vendors. This concluding chapter summarizes the findings with regard to each of these activities. It also summarizes the connection between the current study and production base analysis, discussed in Chapter 6.

Identifying Aerospace Subcontractors

This study could not completely identify specific firms who either continuously or occasionally sell raw materials, parts and components and subassemblies to the firms who hold direct contracts with the Air Force and with DOD. The reason was the absence of available historical data on individual subcontractors maintained by the Air Force. Rather, the

methodology for identifying aerospace subcontractors was accomplished through a consideration of the defense industrial base as that term is broadly defined. At the top of the industrial pyramid are the prime contractors, the firms who deal directly with DOD and the Air Force; they are the first tier firms. Below the prime contractors are the second tier firms who produce and supply the prime contractors with systems and subsystems. The third tier firms supply systems and subsystems to prime contractors and the DOD. The fourth tier firms supply all tiers with raw materials.

The point of this analysis is that any attempt to assess the viability of the U.S. (defense) industrial base must include an assessment of the strength of the firms in all tier levels not simply those immediately identifiable as aerospace contractors and subcontractors. A related point is that regulations require only that the prime contractor identify major/critical components and parts of the production effort (by subcontractor) a dynamic phenomenon (See: AFSCR, DAR Supplement, Section XXIII, 6 August 1982, "Subcontracting policies and procedures"). In addition, an assessment of the

viability of the U.S. defense industrial base depends not only on the strength of the firms currently involved in defense production but on the strength of all the firms who could participate in defense production. It is possible to construct, at least on a limited scale, the four tier pyramid for defense activity in a general sense (Figure 2.1 of Chapter 2) and also for specific major weapons systems (Figure 2.2 of Chapter 2). The significance of this to the Air Force is that it points to the approach that must be used if there is to be a realistic increase in contractor, subcontractor and vendor bidding lists.

Chapter 2 is concerned with the nature of the producing units in each of the tiers. These producing units may be distinguished in terms of legal status, that is corporations, partnerships, or proprietorships. They may also be distinguished in terms of establishments and enterprises. Establishments are the smallest unit in which business activity is carried out and on which statistical information is collected. The concept "enterprise" includes all establishments of a parent firm including the parent or headquarters establishment. The U.S. industrial base consists

of all establishments and/or enterprises included in the industrial pyramid.

Databases on Privately Held Firms

Chapter 2 distinguishes between SEC registered corporations and all other business units. Such firms are required to file financial statements which become part of the public domain. There is, therefore, no difficulty in securing product and financial information on these firms although production data may be somewhat more limited. Obtaining information on the establishments that constitute the subsidiaries of a public corporation is likewise relatively straightforward. Information on the SEC registered corporations as well as their registered subsidiaries is provided by both Standard and Poor's Inc. and Disclosure Inc. Information on the establishments constituting the enterprise is provided by Economic Information Service Inc. (EIS). Obtaining information on the other business units, privately owned establishments and firms, is more difficult for there are no requirements that data concerning these units be made available to the public.

Chapter 3 begins by examining the relative importance of

the small business community for it is these types of firms who are likely to be privately held (not SEC registered). This examination indicates that even for the manufacturing sector of the economy small business firms - establishments with less than 500 employees - still account for 25 percent of all employment. Thus, any effort to construct an industrial pyramid or to analyze an industrial pyramid which omits small business units will involve serious omissions. However, the Small Business Administration, Office of Advocacy (SBAOA) has established the Master Establishment List (MEL) file and this file allows for product identification at the firm specific level for some 8.1 million establishments.

In addition, the SBAOA has also created the United States Establishment and Enterprise Microdata (USEEM) file which provides select production and financial information for a smaller number of small business firms.

The MEL file together with the USEEM file can provide significant insights into the nature of the private portion of the American industrial base. These two files together with the Standard and Poor's file or Disclosure Inc. file and the

EIS file on SEC registered corporate establishments can provide the information access and analytic capability for the entire American industrial base.

Chapter 4 of this study takes up the issue of using available databases to increase bidding lists. The point is established that increasing the size of bidding lists serves a number of goals including the generation of competition which in turn facilitates more effective acquisition. It would also serve to expand the number of firms which could be relied on in the event of a rapid expansion in military production. As far as the actual use of databases to expand bidding lists is concerned, the conclusion is that the SBAOA MEL file with the EIS establishment file would be most useful because they are so extensive and include the focus on establishments. Chapter 4 also contains suggestions for supplementing the information contained in the MEL file so that the existing DOD bidding lists might become more comprehensive and more effective.

The Make or Buy Decision

The industrial base pyramid does not simply evolve, but is shaped by a variety of forces including such broad forces as the federal government antitrust laws. In the context of

the current study the industrial base pyramid is also affected by the make or buy decision of business firms. The purpose of Chapter 5 is an assessment of this decision as it occurs within the context of aerospace weapons systems. This assessment was accomplished through personal and telephone interviews with a spectrum of companies doing business with the Air Force. In a very real sense the make or buy decision determines the structure of the industrial pyramid, since a company's decision to "make" rather than "buy" clearly affects the number of business units in the next lower tier.

As for specific findings, it was concluded that there is no single factor which dominates the make or buy decision for the firms surveyed. Rather, the decision is made in an environment of a number of varied and dynamic constraints. These include facility and skill capability, plant capacity, plant utilization, time frame and reliability of estimates, part or component criticalness, firm reputation and regulatory and financial considerations. Moreover, the make or buy decision is handled in each firm contacted by a committee that has standard operating procedures for its guide. These procedures do not assign priorities to the factors to be

evaluated. The survey provides no support for the hypothesis that the make or buy decision is determined solely by cost considerations.

Production Base Analysis

Chapter 6 moves considerably beyond the narrowly defined tasks indicated in the existing contract's statement of scope or work. This chapter attempts to relate the activities undertaken in connection with the current contract to activities and concerns expressed by other researchers and policy makers with whom we have had contact in completing the specific tasks.

In a broad sense production base analysis can be interpreted as an attempt to define the industrial base pyramid either from the perspective of all DOD acquisition or from the perspective of a particular weapons system. However, production base analysis is, as its name suggests, analytical and the analysis is concerned with production. Thus, production base analysis examines the relationships which exist between firms within a tier as well as the relations which exist between tiers. In essence, production base

analysis, although it may be accomplished with different methodologies, is concerned with answering the question: Is the industrial base capable of responding to a defense buildup of a particular size within a particular period of time?

As for the commonalities between production base analysis and the more narrow concerns of this study, several are mentioned in chapter 6. The first is that a broad view should be taken regarding the defense industrial base; assessments must be accomplished by considering all four tiers of the industrial pyramid and should extend beyond the firms currently participating in defense production. The second is the view that all of the data necessary for analysis is simply not available. An effective bidding list would require product, production and financial information, but production information is not only lacking for privately held firms but for publicly held firms as well. Thus, production base analysis is limited by the availability of production data.

Appendix A

Teledyne Establishment Structure

DEPARTMENT
OF
ECONOMICS

UNIVERSITY OF NOTRE DAME

NOTRE DAME, INDIANA 46556
PHONE 219/239-6335

A-1

June 20, 1983

Bernice D. Slatin
Administrator, Database Reports
Economic Information Systems, Inc.
310 Madison Avenue,
New York, New York 10017

Dear Ms. Slatin:

Thank you for sending the "Line of Business Report" on Teledyne. I have ordered that a check be sent to you in payment of the Report. The University of Notre Dame will forward the check.

The work that I am doing is for the U.S. Air Force, Wright-Patterson Air Force Base, Ohio. We are attempting to demonstrate to the Air Force, on this contract, the advisability of obtaining and using certain databases in order to bring a higher degree of competition into their purchasing. The report we are doing is a feasibility study not an implementation. I should like to obtain permission to use portions of the Teledyne Inc. report and to include the total report as an appendix to my study.

The purpose of the inclusions would be to illustrate what it is possible to do with the database involved, not to undertake an analysis.

Sincerely

William I. Davisson

William I. Davisson
Department of Economics

Ok Bernice Slatin

CONTROL DATA

ECONOMIC INFORMATION SYSTEMS
310 Madison Avenue, New York, New York 10017
(212) 697-6080

TELEDYNE INC

INTRODUCTION TO YOUR LINE OF BUSINESS REPORT

An EIS Line of Business Report analyzes the lines of business of a company in terms of its sales, ranking and share of market in each industry in which it participates. The establishments owned by each company are identified by name, address, size, and Standard Industrial Classification (SIC) code.

The Line of Business Report is in two parts:

In Part I, the Report lists all the industries in which the company* has sales; the value of shipments by the company in each industry; the share of market of the company in each industry; the percent of the company's sales in each industry; and the ranking (in order of sales size) of the company in each industry.

In Part II, the Report identifies the establishments that belong to the company, with their addresses, SIC codes, phone numbers and number of employees.

EIS can provide these unique shipments estimates because the individual establishment data which it has developed from its own sources have been constructed to be consistent with the aggregate statistics published by the Bureau of the Census for industry shipments, industry state and county employment, industry concentration, and the number of establishments cross-classified by industry and employment size. The Census aggregates are supplemented by information from corporation annual reports, information reported to EIS from companies listed in EIS data banks, and by feedback from users of EIS reports.

*Public companies are designated with an asterisk (*) as the last letter of the parent company name field. Companies with foreign ownership representing 10% or more of the value of the company are designated with a "+" as the next to last letter in the parent company name field.

The following describes how the EIS Line of Business Reports are produced:

1. Shipments of all establishments are calculated on the basis of number of employees and value of shipments per employee typical for each industry.

2. Establishments are coded so as to assemble them into companies.

3. Shipments of establishments in each company are reconciled to corporate financial reports, and printed out by EIS as SIC summaries of sales for each company.

4. Sales of companies (the sum of the shipments by plants) in each 4-digit SIC industry are reconciled with Census Bureau statistics on industry concentration in each 4-digit SIC industry.

EIS estimates of each company's market share may differ from the company's own estimates. Companies often report their sales along divisional lines, and these are often not compatible with the SIC system that is the basis of EIS calculations of market share.

For instance, special treatment is required for integrated companies (such as oil, auto, primary metals, paper, and chemicals) which, of necessity, adopt a value-added formula in reporting their sales volume on a consolidated basis. To avoid sales duplication and to make full use of the sales figures that companies report, the EIS methodology values output at the primary stages of production at industry market prices and values output at the final stages of production or distribution as value-added. Thus, if a company maintains a captive manufacturing, transportation, wholesaling, or retailing operation, the output of the establishments are accorded values in line with industry wide transportation, wholesaling and retailing margins. While this procedure results in an underestimation of the "actual"

establishment sales in such integrated companies as Exxon, General Motors, etc. in their captive activities, the "value-added" concept corresponds to the company's own method of measuring the contribution in revenues of each division to the parent company as reported in its consolidated annual report.

To compile and retrieve the information appearing in this report, EIS scans, analyzes, and inputs into its data bank tens of thousands of observations per year from:

1. Census Bureau publications on the value of industry shipments, industry concentration, and the size and SIC code of establishments in each state and county in the U.S.

2. Corporate annual reports, press clippings, and other published financial studies on company sales, divisional sales, mergers and acquisitions, and establishment openings and closings.

3. Industrial, trade and telephone directories on establishment addresses, employment size, SIC codes and phone numbers.

4. Feedback from EIS clients about establishments and companies as reported by their sales force.

EIS inputs approximately 100,000 changes per year into its establishment file and company file database. These include establishment and company openings, closings, relocations to new addresses, name changes, ownership changes, telephone number changes, employment changes and changes in SIC or line of business.

EIS exerts all reasonable efforts to achieve accuracy in these reports, but EIS does not assume any liability for the absolute correctness of this information.

06144 TELEDYNE INC • 1901 AVE OF STARS LOS ANGELES CA 90067 213-277-3311

SIC	INDUSTRIES IN WHICH COMPANY OPERATES... SIC DESCRIPTION	ANNUAL SALES ($ MIL)	PCT OF COMPANY SALES	PCT OF INDUSTRY SALES	RANKING WITHIN INDUSTRY
1061	FERROALLOY ORES, EXC VANADIUM	2.1	0.07	0.60	18
1381	DRILLING OIL AND GAS WELLS	1.6	0.06	0.02	732
1382	OIL AND GAS EXPLORATION SERVICES	.8	0.02	0.03	415
1389	OIL AND GAS FIELD SERVICES NEC	5.1	0.18	0.08	150
1731	ELECTRICAL WORK	1.3	0.05	0.02	1623
2752	COMMERCIAL PRINTING, LITHOGRAPHIC	2.2	0.08	0.01	1847
2892	EXPLOSIVES	14.1	0.49	1.59	17
3069	FABRICATED RUBBER PRODUCTS, NEC	17.0	0.59	0.35	59
3079	MISCELLANEOUS PLASTICS PRODUCTS	24.3	0.85	0.09	187
3312	BLAST FURNACES & STEEL MILLS	78.7	2.75	0.23	57
3316	COLD FINISHING OF STEEL SHAPES	91.8	3.21	2.78	4
3317	STEEL PIPE AND TUBES	7.4	0.26	0.19	72
3321	GRAY IRON FOUNDRIES	9.8	0.34	0.14	173
3322	MALLEABLE IRON FOUNDRIES	9.2	0.32	2.14	16
3325	STEEL FOUNDRIES, NEC	27.0	0.94	0.85	27
3339	PRIMARY NONFERROUS METALS, NEC	168.4	5.88	10.95	2
3341	SECONDARY NONFERROUS METALS	3.5	0.12	0.07	218
3356	NONFERROUS ROLLING & DRAWING, NEC	62.7	2.19	1.82	11
3357	NONFERR WIRE DRAWING & INSULATING	63.4	2.21	0.74	31
3361	ALUMINUM FOUNDRIES	22.7	0.79	0.77	19
3423	HAND & EDGE TOOLS, NEC	1.8	0.06	0.06	266
3425	HAND SAWS & SAW BLADES	3.1	0.11	0.49	32
3432	PLUMBING FITTINGS & BRASS GOODS	7.6	0.27	0.54	52
3433	HEATING EQUIP, EXC ELEC & WARM AIR	1.6	0.06	0.07	306
3441	FABRICATED STRUCTURAL METAL	13.8	0.48	0.15	108
3443	FABRICATED PLAT WRK - BOILER SHPS	27.2	0.95	0.27	61
3444	SHEET METAL WORK	1.4	0.05	0.02	1694
3451	SCREW MACHINE PRODUCTS	9.0	0.31	0.34	35
3462	IRON & STEEL FORGINGS	21.1	0.74	0.58	31
3471	PLATING AND POLISHING	2.0	0.07	0.08	448
3494	VALVES & PIPE FITTINGS	31.6	1.10	0.38	66
3496	MISC FABRICATED WIRE PRODUCTS	2.3	0.08	0.12	203
3498	FABRICATED PIPE & FITTINGS	4.3	0.15	0.17	155
3499	FABRICATED METAL PRODUCTS, NEC	10.6	0.37	0.21	111
3519	INTERNAL COMBUSTION ENGINES, NEC	188.8	6.59	2.08	13
3532	MINING MACHINERY	1.4	0.05	0.05	212
3533	OIL FIELD MACHINERY	4.6	0.16	0.05	231
3541	MACHINE TOOLS, METAL CUTTING TYPE	40.1	1.40	0.78	23
3542	MACHINE TOOLS, METAL FORMING TYPE	8.7	0.30	0.51	49
3544	SPECIAL DIES, TOOLS, JIGS, FIXTRS	18.2	0.64	0.30	20
3545	MACHINE TOOL ACCESSORIES	4.9	0.17	0.13	142

ECONOMIC INFORMATION SYSTEMS
LINE OF BUSINESS REPORT
PART 1 - SUMMARY OF SALES BY INOUSTRY

06144 TELEDYNE INC * 1901 AVE OF STARS LOS ANGELES CA 90067 213-277-3311

SIC.	INOUSTRIES IN WHICH COMPANY OPERATES... SIC DESCRIPTION.....	ANNUAL SALES ($ MIL)	PCT OF COMPANY SALES	PCT OF INOUSTRY SALES	RANKING WITHIN INOUSTRY
3559	SPECIAL INOUSTRY MACHINERY, NEC	14.7	0.51	0.27	72
3561	PUMPS & PUMPING EQUIPMENT	7.7	0.27	0.14	124
3567	INDUSTRIAL FURNACES & OVENS	16.8	0.59	1.41	15
3569	GENERAL INDUSTRIAL MACHINERY, NEC	1.7	0.06	0.04	543
3573	ELECTRONIC COMPUTING EQUIPMENT	125.8	4.39	0.38	32
3589	SERVICE INOUSTRY MACHINERY, NEC	10.0	0.35	0.40	63
3599	MACHINERY, EXC ELECTRICAL, NEC	4.6	0.16	0.04	598
3612	TRANSFORMERS	3.8	0.13	0.12	94
3622	INDUSTRIAL CONTROLS	7.4	0.26	0.18	93
3623	WELOING APPARATUS, ELECTRIC	49.4	1.72	3.29	9
3629	ELEC INDUSTRIAL APPARATUS, NEC	1.8	0.06	0.17	138
3634	ELECTRIC HOUSEWARES & FANS	43.2	1.51	1.30	18
3636	SEWING MACHINES	5.0	0.17	1.56	12
3643	CURRENT-CARRYING WIRING OEVICES	14.9	0.52	0.54	45
3646	COMMERCIAL LIGHTING FIXTURES	6.6	0.23	0.43	47
3651	RADIO & TV RECEIVING SETS	17.3	0.60	0.24	64
3662	RADIO & TV COMMUNICATION EQUIPMENT	129.1	4.51	0.50	38
3673	ELECTRON TUBES, TRANSMITTING	6.5	0.23	0.96	16
3674	SEMICONDUCTORS & RELATEO OEVICES	84.8	2.96	0.79	23
3678	ELECTRONIC CONNECTORS	3.5	0.12	0.15	58
3679	ELECTRONIC COMPONENTS, NEC	70.7	2.47	0.64	20
3691	STORAGE 8ATTERIES	2.4	0.08	0.10	62
3724	AIRCRAFT ENGINES & ENGINE PARTS	380.9	13.30	3.90	5
3728	AIRCRAFT EQUIPMENT, NEC	69.6	2.43	0.75	25
3731	SHIP 8UILOING & REPAIRING	39.5	1.38	0.38	33
3769	SPACE VEHICLE EQUIPMENT, NEC	3.8	0.13	0.69	26
3795	TANKS & TANK COMPONENTS	11.8	0.41	1.16	10
3811	ENGINEERING & SCIENTIFIC INSTRMNTS	64.7	2.26	2.24	4
3825	INSTRUMENTS TO MEASURE ELECTRICITY	2.4	0.08	0.05	243
3829	MEASURING & CONTRLLNG OEVICES, NEC	18.8	0.66	1.05	20
3843	OENTAL EQUIPMENT & SUPPLIES	18.8	0.66	1.46	14
3861	PHOTOGRAPHIC EQUIP & SUPPLIES	29.5	1.03	0.19	49
3952	LEAO PENCILS & ART GOOOS	2.1	0.07	0.51	36
4953	REFUSE SYSTEMS	1.3	0.05	0.04	120
4961	STEAM SUPPLY	.7	0.02	0.21	45
5051	METALS SERVICE WHOLESALING	79.9	2.79	0.14	160
5065	ELECTRONIC PARTS & EQUIP WHLSNG	16.8	0.59	0.13	142
5088	TRANSPORTATION EQUIP WHLSNG	15.8	0.55	0.29	74
5113	INOUS & PERSON SVC PAPER WHLSNG	10.8	0.38	0.09	236
5161	CHEMICALS & ALLIEO PROO WHLSNG	10.0	0.35	0.03	672
5961	MAIL ORDER HOUSES	1.2	0.04	0.01	469

LINE OF BUSINESS REPORT

PART 1 - SUMMARY OF SALES BY INDUSTRY -

06144 TELEDYNE INC * 1901 AVE OF STARS LOS ANGELES CA 90067 213-277-3311

SIC.	INDUSTRIES IN WHICH COMPANY OPERATES... SIC DESCRIPTION	ANNUAL SALES ($ MIL)	PCT OF COMPANY SALES	PCT OF INDUSTRY SALES	RANKING WITHIN INDUSTRY
6311	LIFE INSURANCE	175.8	6.14	0.22	73
6321	ACCIDENT & HEALTH INSURANCE	9.5	0.33	0.04	124
6331	FIRE, MARINE, & CASUALTY INS	33.9	1.18	0.07	108
7332	BLUEPRINTING & PHOTOCOPYING	1.7	0.06	0.49	40
7333	COMMERCIAL PHOTOGRAPHY & ART	1.5	0.05	0.70	46
7391	RESEARCH & DEVELOPMENT LABS	3.6	0.13	0.05	236
7394	EQUIPMENT RENTAL & LEASING	1.2	0.04	0.02	790
7397	COMMERCIAL TESTING LABORATORIES	1.9	0.07	0.25	84
7622	RADIO & TELEVISION REPAIR	1.7	0.06	0.81	16
8911	ENGINEERING & ARCHITECTURAL SVCS	10.1	0.35	0.07	167
	TOTAL MANUFACTURING SALES	2,285.2	79.80		
	TOTAL NONMANUFACTURING SALES	378.7	13.22		
	FOREIGN/ALL OTHER SALES	199.9	6.98		
	TOTAL COMPANY SALES	2,863.8	100.00		
	NET INCOME	260.8			

06144 TELEDYNE INC * 1901 AVE OF STARS LOS ANGELES CA 90067 213-277-3311

SIC. SIC DESCRIPTION..... NAME OF ESTABLISHMENT.....	ADDRESS..	CITY.....	ST	ZIP..	PHONE NUMBER	NUMBER OF EMPLOYEES
1061 FERROALLOY ORES, EXC VANADIUM						
TELEDYNE TUNGSTEN	4709 N EL CAPITAN-SU 109	FRESNO	CA	93711	209- -	39
1381 DRILLING OIL AND GAS WELLS						
TELEDYNE MOVIBLE OFFSHORE	1472 S COLLEGE RD	LAFAYETTE	LA	70501	318-232-5120	21
1382 OIL AND GAS EXPLORATION SERVICES						
TELEDYNE EXPLORATION CO	P O BOX 36269	HOUSTON	TX	77036	713-666-2561	20
1389 OIL AND GAS FIELD SERVICES NEC						
TELEDYNE MOVIBLE OFFSHORE	BOX 51936	LAFAYETTE	LA	70505	318-232-5120	89
1731 ELECTRICAL WORK						
TELEDYNE ENGRG SRVCS-INSTR	303 BEAR HILL RD	WALTHAM	MA	02154	617-890-3351	35
2752 COMMERCIAL PRINTING, LITHOGRAPHIC						
TELEDYNE POST	725 CHESTNUT ST	PHILADELPHIA	PA	19106	215-627-6493	29
2892 EXPLOSIVES						
TELEDYNE-MC CORMICK SELPH	3601 UNION RD/BOX 6	HOLLISTER	CA	95023	408-637-3731	250
3069 FABRICATED RUBBER PRODUCTS, NEC						
TELEDYNE MONARCH	10 LINCOLN PARK	HARTVILLE	OH	44632	216-877-1211	550
TELEDYNE MECCA	5919 JESSAMINE/BOX 36393	HOUSTON	TX	77236	713-772-2811	50
3079 MISCELLANEOUS PLASTICS PRODUCTS						
TELEDYNE WATER PIK	1730 E PROSPECT	FORT COLLINS	CO	80521	303-484-1352	25
TELEDYNE WIRZ	20 ASHTON AVE	SWEDESBORO	NJ	08085	609-467-0485	76
TELEDYNE MONO-THANE	3850 GRANGER RD	AKRON	OH	44310	216-633-6100	40
TELEDYNE PACKAGING	4TH & TOWNSEND	CHESTER	PA	19016	215-494-6300	350
3312 BLAST FURNACES & STEEL MILLS						
TELEDYNE VASCO/MID-AMERICA	PO BOX 151	LATROBE	PA	15650	412-537-5551	200
VASCO METALS CORP		MONACA	PA	15061	412-774-3650	516
3316 COLD FINISHING OF STEEL SHAPES						
TELEDYNE RODNEY METALS	1357 RDONEY FRENCH BLVD	NEW BEDFORD	MA	02744	617-996-5691	150
TELEDYNE COLUMBIA-SUMERHIL	WOOOKIN ST/BOX 1557	CARNEGIE	PA	15106	412-923-2040	200
TELEDYNE VASCO/MID-AMERICA	PO BOX 151	LATROBE	PA	15650	412-537-5551	1,000
PITTSBURGH TOOL STEEL	1535 BEAVER	MONACA	PA	15061	412-774-8330	170
3317 STEEL PIPE AND TUBES						
TELEDYNE METAL FORMING	1937 STERLING AVE	ELKHART	IN	46514	219-295-5525	97
TELEDYNE COLUMBIA-SUMMERIL	SCOTTDALE AVE/BOX 302	SCOTTDALE	PA	15683	412-887-9700	70
3321 GRAY IRON FOUNDRIES						
LECTRO CAST DIV TELEDYNE	KINGSBURY IND PK/P O BOX A	LA PORTE	IN	46350	219-393-3595	35
TELEDYNE CASTING SVCE	300 PHILADELPHIA/BOX 488	LA PORTE	IN	46350	219-362-6267	200
3322 MALLEABLE IRON FOUNDRIES						
TELEDYNE OHIO STEEL	W FOURTH ST/PO BOX F	LIMA	OH	45802	419-222-2010	435

06144 TELEDYNE INC * 1901 AVE OF STARS LOS ANGELES CA 90067 213-277-3311

SIC	SIC DESCRIPTION / NAME OF ESTABLISHMENT	ADDRESS	CITY	ST	ZIP	PHONE NUMBER	NUMBER OF EMPLOYEES
3325	STEEL FOUNDRIES, NEC						
	TELEDYNE OHIO STEEL	W FOURTH/PO BOX F	LIMA	OH	45802	419-232-2010	400
	TELEDYNE OHIO CAST DV	1075 JAMES ST BOX 900	SPRINGFIELD	OH	45501	513 325-7631	300
3339	PRIMARY NONFERROUS METALS, NEC						
	TELEDYNE ALLVAC	RT 8/PO BOX 759	MONROE	NC	28110	704-289-4511	309
	TELEDYNE W&H CHANG CORP	1600 OLD SALEM RD NE	ALBANY	OR	97321	503-926-4211	1,300
3341	SECONDARY NONFERROUS METALS						
	TELEDYNE FIRTH STERLING	JONES ST	W ELIZABETH	PA	15134	412-664-6500	25
3356	NONFERROUS ROLLING & DRAWING, NEC						
	TELEDYNE WAH CHANG	7300 HIGHWAY 20 W	HUNTSVILLE	AL	35806	205-837-1311	275
	TELEDYNE ROONEY METALS	1357 RODNEY FRENCH BLVD	NEW BEDFORD	MA	02742	617-996-5691	200
	TELEDYNE FIRTH STERLING CO	TELEDYNE PLACE	LA VERGNE	TN	37086	615-793-7771	150
3357	NONFERR WIRE DRAWING & INSULATING						
	TELEDYNE WESTERN WIRE&CABL	2425 E 30TH	LOS ANGELES	CA	90058	213-587-7103	230
	TELEDYNE A W D	8190 BYRON RD	WHITTIER	CA	90606	213-945-1581	139
	TELEDYNE THERMATICS INC	HWY 301 BYPASS/PO BOX 909	ELM CITY	NC	27822	919-236-4311	346
3361	ALUMINUM FOUNDRIES						
	TELEDYNE CAST PDCTS	4200 W VALLEY BLVD	POMONA	CA	91766	714-595-2252	39
	TELEDYNE/MT VERNON DIE CST	68 SOUTHFIELD AVE	STAMFORD	CT	06902	203-348-5690	306
	TELEDYNE IND DIE CAST	2323 NORTH WAYNE ST	CHICAGO	IL	60614	312-528-1700	150
	ABCO DIE CASTING CORP	2080 NORTH 15 ST	MELROSE PARK	IL	60160	312-345-4850	110
3423	HAND & EDGE TOOLS, NEC						
	TELEDYNE KINETICS-TOOLS	410 S CEDROS AVE/BOX 427	SOLANO BEACH	CA	92075	714-755-1183	45
3425	HAND SAWS & SAW BLADES						
	TELEDYNE FIRTH STERLING	P O BOX 278	GURLEY	AL	35748	205-728-4222	65
3432	PLUMBING FITTINGS & BRASS GOODS						
	TELEDYNE WATER PIK-SHOWER	1730 E PROSPECT	FORT COLLINS	CO	80521	303-484-1353	55
	TELEDYNE ANSONIA MFG	1 RIVERSIDE DR	ANSONIA	CT	06401	203-735-9311	169
3433	HEATING EQUIP, EXC ELEC & WARM AIR						
	TELEDYNE MERLA	300 KIRBY ST/BOX 469010	GARLAND	TX	75046	214-276-8561	50
3441	FABRICATED STRUCTURAL METAL						
	TELEDYNE BROWN ENGRG	CUMMINGS RESRCH PK	HUNTSVILLE	AL	35805	205-536-4458	80
	TELEDYNE BROWN ENGINEERING	HWY 72 W	MADISON	AL	35601	205-355-7360	125
	TELEDYDE OSCO STEEL	2966 E 55TH ST /BOX 486	CLEVELAND	OH	44127	216-441-4000	100
3443	FABRICATED PLAT WRK - BOILER SHPS						
	TELEDYNE BROWN ENGINEERING	CUMMINGS RESEARCH PARK	HUNTSVILLE	AL	35805	205-532-1000	400
	TELEDYNE IRBY STEEL CO	CREOSOTE RD/PO BOX 2275	GULFPORT	MS	39501	601-863-7733	150
3444	SHEET METAL WORK						
	TELEDYNE AERO CAL	528 E MISSION RD	SAN MARCOS	CA	92069	714-744-1131	39

06144 TELEDYNE INC * 1901 AVE OF STARS LOS ANGELES CA 90067 213-277-3311

SIC. SIC DESCRIPTION / NAME OF ESTABLISHMENT	ADDRESS	CITY	ST	ZIP	PHONE NUMBER	NUMBER OF EMPLOYEES
3451 SCREW MACHINE PRODUCTS						
TELEDYNE INC	1 RIVERSIDE DR	ANSONIA	CT	06401	203-735-9315	250
3462 IRON & STEEL FORGINGS						
PORTLAND FORGE INC	MERIDIAN & E LAFAYETTE	PORTLAND	IN	47371	219-726-8121	500
3471 PLATING AND POLISHING						
TELEDYNE METAL FINISHERS	3125 BRINKERHOFF	KANSAS CITY	KS	66115	913-371-8501	32
TELEDYNE METAL FINISHERS	1725 E 27TH ST	CLEVELAND	OH	44114	216-696-0511	30
3494 VALVES & PIPE FITTINGS						
TELEDYNE LINAIR	651 W KNOX ST	GARDENA	CA	90248	213-532-5980	39
TELEDYNE SPRAGUE ENGRG	19300 VERMONT AVE/BOX 630	GARDENA	CA	90247	213-321-1412	30
FARRIS ENGINEERING CORP	400 COMMERCIAL AVE	PALISADES PK	NJ	07650	201-944-6300	230
TELEDYNE-REPUBLIC	15655 BROOKPARK RD	CLEVELAND	OH	44142	216-267-2700	300
3496 MISC FABRICATED WIRE PRODUCTS						
A H WIRZ INC/TELEDYNE	904 HAWKINS	CARROLLTON	KY	41008	502-732-4363	125
3498 FABRICATED PIPE & FITTINGS						
TELEDYNE PIPE	311 27TH/BOX 546	GALVESTON	TX	77550	713-763-2401	75
3499 FABRICATED METAL PRODUCTS, NEC						
TURNER TUBE CORP	CRANBURY RD	CRANBURY	NJ	08512	609-655-1500	100
STANDARD COLLAPSIBLE TUBE	CONNECTICUT AVE EXT	ROCHESTER	PA	15074	412-775-7710	100
3519 INTERNAL COMBUSTION ENGINES, NEC						
TELEDYNE-CONTINENTAL MOTOR	700 TERRACE ST	MUSKEGON	MI	49443	616-724-3441	349
TELEDYNE/CONT GENERAL PROT	76 GETTY ST	MUSKEGON	MI	49443	616-724-2151	209
TELEDYNE WISCONSIN MOTOR	1910 SOUTH 53 ST	MILWAUKEE	WI	53219	414-384-5800	1,250
3532 MINING MACHINERY						
TELEDYNE FIRTH STERLING	829 S 75TH BOX 5357	HOUSTON	TX	77012	713-921-2137	35
3533 OIL FIELD MACHINERY						
MERLA INCORPORATED	300 KIRBY ST/BOX 469010	GARLAND	TX	75046	214-276-8561	50
3541 MACHINE TOOLS, METAL CUTTING TYPE						
TELEDYNE FIRTH STERLING	25 TALCOTT RD	WEST HARTFORD	CT	06110	203-236-0811	25
TELEDYNE DSTER	1340 E 289TH ST	WICKLIFFE	OH	44092	216-943-3500	200
TELEDYNE LANDIS MACHINE	SOUTH CHURCH ST	WAYNESBORO	PA	17268	717-762-3151	690
3542 MACHINE TOOLS, METAL FORMING TYPE						
TELEDYNE PINES	601 W NEW YORK	AURORA	IL	60506	312-896-7701	200
3544 SPECIAL DIES, TOOLS, JIGS, FIXTRS						
TELEDYNE FIRTH STERLING	2900 S VAIL AVE	LOS ANGELES	CA	90040	213-723-6421	30
H & H TOOL/TELEDYNE PINES	430 S NAVAJO	DENVER	CO	80223	303-744-6304	75
TELEDYNE HOWELL-PENNCRAFT	3333 W GRAND RIVER	HOWELL	MI	48843	517-548-2250	77

06144 TELEDYNE INC * 1901 AVE OF STARS LOS ANGELES CA 90067 213-277-3311

SIC	SIC DESCRIPTION / NAME OF ESTABLISHMENT	ADDRESS	CITY	ST	ZIP	PHONE NUMBER	NUMBER OF EMPLOYEES
3544	SPECIAL DIES TOOLS, JIGS, FIXTRS						
	TELEDYNE HYSON	10367 BRECKSVILLE RD	BRECKSVILLE	OH	44141	216-526-5900	40
	TELEDYNE EFFICIENT INDS	5514 OLD BRECKSVILLE RD	INDEPENDENCE	OH	44131	216-524-5250	285
3545	MACHINE TOOL ACCESSORIES						
	TELEDYNE FIRTH STERLING	2900 S VAIL AVE	LOS ANGELES	CA	90040	213-723-6421	60
	TELEDYNE-HOWELL PENNCRAFT	101 N INDUSTRIAL DR	PLYMOUTH	MI	48170	313-453-8800	30
	TELEDYNE FIRTH STERLING	2619 INDUSTRIAL RDW	TROY	MI	48084	313-280-1500	20
3559	SPECIAL INDUSTRY MACHINERY, NEC						
	TELEDYNE METAL FINISHERS	3125 BRINKERHOFF RD	KANSAS CITY	KS	66115	913-371-8501	35
	TELEDYNE TAC	10 FORBES RD	WOBURN	MA	01801	617-935-5400	100
	TELEDYNE READCO	901 SOUTH RICHLAND AVE	YORK	PA	17405	717-848-2801	225
3561	PUMPS & PUMPING EQUIPMENT						
	TELEDYNE SPRAGUE ENGRG	19300 VERMONT AVE/BOX 630	GARDENA	CA	90247	213-321-1411	50
	TELEDYNE HYDRA PWR-DYNO PW	10-12 PINE COURT	NEW ROCHELLE	NY	10801	914-632-2200	89
3567	INDUSTRIAL FURNACES & OVENS						
	TELEDYNE VASCO	BOX 151	LATROBE	PA	15650	412-537-5551	500
3569	GENERAL INDUSTRIAL MACHINERY, NEC						
	TELEDYNE SPRAGUE ENGNEERNG	19300 VERMONT AVE/BOX 630	GARDENA	CA	90248	213-327-1610	45
3573	ELECTRONIC COMPUTING EQUIPMENT						
	TELEDYNE MICROELECTRONICS	12964 PANAMA	LOS ANGELES	CA	90066	213-870-9831	630
	TELEDYNE SYSTEMS	1901 NORDHOFF	NORTHRIDGE	CA	91324	213-886-2211	170
	TELEDYNE INC	ALLIED DR AT RT 128	DEDHAM	MA	02026	617-329-1600	250
	TELEDYNE GEOTECH	3401 SHILOH RD	GARLAND	TX	75041	214-271-2561	239
3589	SERVICE INDUSTRY MACHINERY, NEC						
	TELEDYNE LAARS	13230 SATICOY ST	N HOLLYWOOD	CA	91605	213-875-0201	80
	TELEDYNE WATER PIK	609 SW 14TH ST	LOVELAND	CO	80537	303-669-5670	100
3599	MACHINERY, EXC ELECTRICAL, NEC						
	TELEDYNE AEROSPACE SYSTEMS	1007 E 10 ST	FAIRMONT	MN	56031	507-235-3355	89
3612	TRANSFORMERS						
	TELEDYNE CRITTENDEN	711 WESTKNOX ST	GARDENA	CA	90248	213-321-4355	40
	TELEDYNE INET-POWER SUPPLI	2750 W LIMITA BLVD	TORRANCE	CA	90509	213-325-5041	50
3622	INDUSTRIAL CONTROLS						
	TELEDYNE INET	2750 W LOMITA BLVD	TORRANCE	CA	90509	213-325-5040	200
3623	WELDING APPARATUS, ELECTRIC						
	TELEDYNE INET-WELDG POWER	2750 W LOMITA BLVD/X 2883	TORRANCE	CA	90509	213-325-5042	25
	TELEDYNE/PEER	2100 E EMPIRE	BENTON HARBOR	MI	49022	616-925-8828	65
	TELEDYNE PRECISION	3520 IBSEN	CINCINNATI	OH	45209	513-351-3300	225
	TELEDYNE MCKAY	850 GRANTLEY ROAD	YORK	PA	17405	717-845-7581	600

06144 TELEDYNE INC * 1901 AVE OF STARS LOS ANGELES CA 90067 213-277-3311

SIC. SIC DESCRIPTION..... NAME OF ESTABLISHMENT.....	ADDRESS.....	CITY.....	ST	ZIP..	PHONE NUMBER	NUMBER OF EMPLOYEES
3623 WELDING APPARATUS, ELECTRIC						
TELEDYNE INDUSTRIES INC	1000 RYAN AVE	WALTERBORO	SC	29488	803-538-2121	117
3629 ELEC INDUSTRIAL APPARATUS, NEC						
TELEDYNE ISOTOPES ENRGY SY	110 W TIMONIUM RD	TIMONIUM	MD	21093	301-252-8220	45
3634 ELECTRIC HOUSEWARES & FANS						
TELEDYNE WATER PIK	1730 E PROSPECT	FORT COLLINS	CO	80521	303-484-1352	585
TELEDYNE WATER PIK	609 14TH ST SW	LOVELAND	CO	80537	303-669-5672	50
TELEDYNE STILL-MAN MFG CO	995 TOWBIN AVE	LAKEWOOD	NJ	08701	201-363-5160	231
3636 SEWING MACHINES						
TELEDYNE AMCO	WYOMISSG & WERNER ST	MOHNTON	PA	19540	215-777-1311	100
3643 CURRENT-CARRYING WIRING DEVICES						
TELEDYNE KINETICS	410 S CEDROS AVE/BOX 427	SOLANO BEACH	CA	92075	714-755-1182	25
TELEDYNE POSITIV CONNECTR	ONE RIVERSIDE DR	ANSONIA	CT	06401	203-735-9311	35
PENN UNION ELECTRIC	229 WATERFORD ST	EDINBORO	PA	16412	814-734-1631	370
TELEDYNE MECCA	5919 JESSAMINE/BOX 36393	HOUSTON	TX	77236	713-772-2811	75
3646 COMMERCIAL LIGHTING FIXTURES						
TELEDYNE BIG BEAM	290 E PRAIRIE ST	CRYSTAL LAKE	IL	60014	815-459-6100	100
3651 RADIO & TV RECEIVING SETS						
TELEDYNE SERVICES	6460 CORVETTE ST	LOS ANGELES	CA	90040	213-724-1150	100
ACOUSTIC RESEARCH	TEN AMERICAN DR	NORWOOD	MA	02062	617-769-4200	130
3662 RADIO & TV COMMUNICATION EQUIPMENT						
TELEDYNE BROWN ENG-SYSTEMS	CUMMINGS RESRCH PK	HUNTSVILLE	AL	35807	205-536-4455	300
TELEDYNE SYSTEMS CO	655 S LABREA	HOLLYWOOD	CA	90036	213-936-7137	30
TELEDYNE MEC	3165 PORTER DR	PALO ALTO	CA	94306	415-493-1770	300
RYAN AERONAUTICAL CO INC	2701 HARBOR DRIVE	SAN DIEGO	CA	92112	619-291-7311	900
TELEDYNE MICRONETICS	7155 MISSION GORGE	SAN DIEGO	CA	92120	619-583-3525	60
TELEDYNE RYAN ELECTRONICS	8650 BALBOA AVE	SAN DIEGO	CA	92112	619-560-6400	300
TELEDYNE WATER PIK	609 SW 14TH ST	LOVELAND	CO	80537	303-669-5671	65
TELEDYNE LEWISBURG	1425 HIGGS ROAD	LEWISBURG	TN	37091	615-359-4531	132
TELEDYNE GEOTECH	3401 SHILOH RD	GARLAND	TX	75041	214-271-2561	50
3673 ELECTRON TUBES, TRANSMITTING						
TELEDYNE MEC	3165 PORTER DR	PALO ALTO	CA	94306	415-493-1770	150
3674 SEMICONDUCTORS & RELATED DEVICES						
TELEDYNE INC	12525 DAPHNE	HAWTHORNE	CA	90250	213-777-0077	230
TELEDYNE SEMICONDUCTOR	1300 TERRA BELLA	MOUNTAIN VIEW	CA	94040	415-968-9241	850
TELEDYNE CRYSTALONICS	147 SHERMAN ST	CAMBRIDGE	MA	02140	617-491-1670	130
TELEDYNE PHILBROCK	ALLIED DR AT RT 128	DEDHAM	MA	02026	617-329-1600	200
3678 ELECTRONIC CONNECTORS						
TELEDYNE KINETICS	410 S CEDROS AVE	SOLANA BEACH	CA	92075	714-755-1181	55

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SIC	SIC DESCRIPTION / NAME OF ESTABLISHMENT	ADDRESS	CITY	ST	ZIP	PHONE NUMBER	NUMBER OF EMPLOYEES
3679	ELECTRONIC COMPONENTS NEC						
	TELEDYNE RELAYS INC	12525 DAPHNE AVE	HAWTHORNE	CA	90250	213-777-0077	720
	TELEDYNE MICROELECTRONICS	12964 PANAMA	LOS ANGELES	CA	90066	213-870-9831	280
	TELEDYNE MICROWAVE	1290 TERRA BELLA.	MOUNTAIN VIEW	CA	94043	415-968-3211	200
	TELEDYNE MEC	3165 PORTER DR	PALO ALTO	CA	94304	415-493-7770	400
	TELEDYNE PHILBROCK	ALLIED DR AT RT 128	DEDHAM	MA	02026	617-329-1600	100
	ELECTRO MECHANISMS INC	29 CROWN ST	NASHUA	NH	03060	603-889-6191	250
	TELEDYNE LEWISBURG	1425 HIGGS ROAD	LEWISBURG	TN	37091	615-359-4531	349
3691	STORAGE BATTERIES						
	TELEDYNE BATTERY PRODUCTS	840 W BROCKTON AVE/BOX 431	REDLANDS	CA	92373	714-793-3131	39
3724	AIRCRAFT ENGINES & ENGINE PARTS						
	TELEDYNE CONTINENTAL MOTRS	PDB 90/MOBILE AEROSPACE IN	MOBILE	AL	36601	205-438-3411	950
	TELEDYNE CONTINENTAL MOTOR	76 N GETTY	MUSKEGON	MI	49442	616-724-2151	1,700
	TELEDYNE NEOSHO	P O BX 648	NEOSHO	MO	64850	417-451-1810	491
	TELEDYNE CAE	1330 LASKEY RD	TOLEDO	OH	43612	419-470-3000	500
3728	AIRCRAFT EQUIPMENT, NEC						
	TELEDYNE SPRAGUE ENGRG	19300 VERMONT AVE/BOX 630	GARDENA	CA	90248	213-327-1610	55
	TELEDYNE SYSTEMS CO	19601 NORDHOFF	NORTHRIDGE	CA	91324	213-886-2211	100
	TELEDYNE RYAN AERONAUTCL	2701 HARBOR DR	SAN DIEGO	CA	92112	714-291-7311	1,050
	TELEDYNE CONTROLS	12333 W OLYMPIC BLVD	W LOS ANGELES	CA	90064	213-820-4616	60
3731	SHIP BUILDING & REPAIRING						
	TELEDYNE MOVIBLE OFFSHORE	DEGRAVELLE RD/BOX 67	AMELIA	LA	70340	504-631-2124	160
	TELEDYNE MOVEABLE OFFSHORE	ADMIRAL DOYLE DR/BOX 759	NEW IBERIA	LA	70560	318-365-6681	750
3769	SPACE VEHICLE EQUIPMENT, NEC						
	TELEDYNE BROWN ENGRG	CUMMINGS RESRCH PK	HUNTSVILLE	AL	35805	205-536-4459	120
	TELEDYNE CONTROLS	12333 W OLYMPIC BLVD	W LOS ANGELES	CA	90064	213-820-4616	40
3795	TANKS & TANK COMPONENTS						
	TELEDYNE-CONTINENTAL MOTOR	700 TERRACE ST	MUSKEGON	MI	49443	616-724-3441	59
	TELEDYNE/CONT GENERAL PRDT	76 GETTY ST	MUSKEGON	MI	49443	616-724-2151	25
3811	ENGINEERING & SCIENTIFIC INSTRMNTS						
	TELEDYNE ANALYTCL INSTRUM	16830 CHESTNUT ST	CITY OF INDUS	CA	91748	213-576-1633	200
	TELEDYNE SYSTEMS-GYROSCOPE	19601 NORDHOFF ST	NORTHRIDGE	CA	91324	213-886-2211	80
	TELEDYNE RYAN AERONAUTCL	2701 HARBOR DR	SAN DIEGO	CA	92112	714-291-7313	250
	TELEDYNE POST	700 N W HIGHWAY	DES PLAINES	IL	60016	312-299-1111	500
	TELEDYNE GURLEY	514 FULTON ST	TROY	NY	12180	518-272-6300	250
	TELEDYNE GEOTECH	3401 SHILOH RD/BOX 88-A	GARLAND	TX	75040	214-271-2561	400
	TELEDYNE EXPLORATION	5825 CHIMNEY PK RD/X 36269	HOUSTON	TX	77081	713-666-2561	50
	TELEDYNE AVIONICS	ROUTE 743	EARLYSVILLE	VA	22936	804-973-3311	200
	TELEDYNE HASTINGS RAYDIST	NEWCOMB AVE/PO BOX 1275	HAMPTON	VA	23661	804-723-6531	75
	TELEDYNE OWEN	331 N OAK ST/BOX 398	OWEN	WI	54460	715-229-2126	103
3825	INSTRUMENTS TO MEASURE ELECTRICITY						
	TELEDYNE TAC	10 FORBES RD	WOBURN	MA	01801	617-935-5400	50

06144 TELEOYNE INC * 1901 AVE OF STARS LOS ANGELES CA 90067 213-277-3311

SIC. SIC OESCRIPTION..... NAME OF ESTABLISHMENT.....	AOORESS.....	CITY.....	ST	ZIP..	PHONE NUMBER	NUMBER OF EMPLOYEES
3829 MEASURING & CONTRLLNG OEVICES, NEC						
TELEOYNE, SPRAGUE ENGRG	19300 VERMONT AVE/BOX 630	GAROENA	CA	90248	213-327-1611	35
TELEOYNE ISOTOPES INC	50 VAN BUREN AVE	WESTWOOO	NJ	07675	201-664-7070	100
TELEDYNE TABER CORP	455 BRYANT ST	N TONAWANOA	NY	14120	716-694-4000	100
TELEDYNE STILL-MAN MFG CO	1011 VOLUNTEER RO	COOKEVILLE	TN	38501	615-526-3351	175
TELEDYNE INDUSTRIES INC	1501 WILSON BLVO	ARLINGTON	VA	22209	703-522-2550	27
HASTINGS RAYOIST INC	NEWCOMB AVE/BOX 1275	HAMPTON	VA	23669	804-723-6531	100
3843 DENTAL EQUIPMENT & SUPPLIES						
TELEOYNE-OENSCO	3840 FOREST/BOX 7037	OENVER	CO	80207	303-399-0240	99
TELEDYNE WATER PIK	1730 E PROSPECT	FORT COLLINS	CO	80521	303-484-1352	85
TELEDYNE DENTAL	1550 GREENLEAF AVE	ELK GROVE VLG	IL	60007	312-593-3334	40
TELEDYNE HANAU	80 SONWIL DR	BUFFALO	NY	14225	716-684-0110	90
TELEOYNE OENTAL/BLU WHITE	102 BABCOCK RO	SAN ANTONIO	TX	78201	512-732-2097	35
3861 PHOTOGRAPHIC EQUIP & SUPPLIES						
TELEDYNE CAMERA SYSTEMS	131 N 5TH	ARCAOIA	CA	91006	213-359-6691	139
TELEDYNE PDST CO	2839 TANAGER	LOS ANGELES	CA	90022	213-723-9271	70
TELEOYNE ROTOLITE	150 MT BETHEL RO	WARREN	NJ	07060	201-647-1040	23
3952 LEAO PENCILS & ART GOODS						
TELEOYNE NATL TRACING PAPR	600 E OHIO ST	INDIANAPOLIS	IN	46202	317-639-5186	75
4953 REFUSE SYSTEMS						
NUCLEAR ENGRG CO/TELEDYNE	9200 SHELBYVILLE RD	LOUISVILLE	KY	40222	502-426-7160	25
TELEDYNE NATIONAL-RECYCLE	225 OPPORTUNITY PKWY	AKRON	OH	44307	216-376-5250	23
4961 STEAM SUPPLY						
TELEDYNE NATIONAL-ENERGY	225 OPPORTUNITY PKWY	AKRON	OH	44307	216-376-5250	22
5051 METALS SERVICE WHOLESALING						
TELEDYNE ROONEY METALS	7305 PARAMOUNT BLVD	PICO RIVERA	CA	90660	213-723-3291	25
TELEDYNE VASCO	6632 W OIVERSEY AVE	CHICAGO	IL	60635	312-622-1010	23
TELEOYNE OSCO STEEL	1901 MARSTON AVE	DETROIT	MI	48211	313-874-3121	22
TELEOYNE ROONEY METALS	3000 KINGSBRIOGE AVE	BRONX	NY	10463	212-884-9500	20
TELEOYNE OSCO STEEL	2966 E 55TH ST	CLEVELAND	OH	44127	216-441-4000	32
TELEDYNE RDONEY METALS	1045 PULINSKI RD	IVYLAND	PA	18974	215-441-0205	25
5065 ELECTRONIC PARTS & EQUIP WHLSNG						
TELEOYNE INC	1901 AVE OF STARS	SAN JOSE	CA	90067	408-277-3311	20
TELEOYNE INC	3060 LAWRENCE XWAY	SANTA CLARA	CA	95051	408-733-2700	20
TELEDYNE INC	12601 NE SEVENTH	MIAMI	FL	33161	305-891-4701	20
TELEOYNE INC	4050 E HILLSBOROUGH AV	TAMPA	FL	33610	813-621-2431	20
5088 TRANSPORTATION EQUIP WHLSNG						
TELEOYNE CONTINENTAL MOTOR	950 ARTHUR AVE	ELK GROVE VLG	IL	60007	312-593-2000	59
5113 INOUS & PERSON SVC PAPER WHLSNG						
PRESTO PROOUCTS INC	17291 IRVINE BLVO	HUNTINGTN BCH	CA	92680	714-832-3831	20

06144 TELEDYNE INC * 1901 AVE OF STARS LOS ANGELES CA 90067 213-277-3311

SIC	SIC DESCRIPTION / NAME OF ESTABLISHMENT	ADDRESS	CITY	ST	ZIP	PHONE NUMBER	NUMBER OF EMPLOYEES
5113	INDUS & PERSON SVC PAPER WHLSNG						
	PRESTO PRODUCTS INC	50 N BROCKWAY	PALATINE	IL	60067	312-359-0491	20
5169	CHEMICALS & ALLIED PROD WHLSNG						
	PRESTO PRODUCTS INC	6065 ROSWELL RD NE	ATLANTA	GA	30328	404-256-3550	20
5961	MAIL ORDER HOUSES						
	TELEDYNE WATER PIK	1730 EAST PROSPECT ST	FORT COLLINS	CO	80521	303-484-1352	20
6311	LIFE INSURANCE						
	TELEDYNE LIFE INSURANCE CO	1901 AVE OF THE STARS	LOS ANGELES	CA	90067	213-277-3311	20
	UNITED INSURANCE CO-AMERIC	1 E WACKER DR	CHICAGO	IL	60601	312-266-3500	3,000
	COASTAL PLAINS LIF INS CO	437 FALLS RD	ROCKY MOUNT	NC	27801	919-442-6123	20
	GENERAL LIFE INS CO WI	735 N WATER ST/BPO 349	MILWAUKEE	WI	53202	414-271-5433	147
6321	ACCIDENT & HEALTH INSURANCE						
	TELEDYNE LIFE INSURANCE CO	1901 AVE OF THE STARS	LOS ANGELES	CA	90067	213-277-3311	20
	UNITED INS CO OF AMER INC	1 E WACKER DR	CHICAGO	IL	60601	312-266-3500	94
	COASTAL PLAIN LIFE INSURAN	462 FALLS RD	ROCKY MOUNT	NC	27801	919-977-2975	61
6331	FIRE, MARINE, & CASUALTY INS						
	FINANCIAL INDEMNITY CO	333 N GLENOAKS	BURBANK	CA	91502	213-843-2444	31
	ARGONAUT INSURANCE CO INC	250 MIDDLEFIELD RD	MENLO PARK	CA	94025	415-326-0900	338
	ARGONAUT-NORTHWEST INSURAN	1350 VISTA AVE	BOISE	ID	83705	208-344-8611	20
	ARGONAUT-MIDWEST INSUR CO	150 S WACKER DR	CHICAGO	IL	60606	312-993-9600	33
	GREAT CENTRAL INSURANCE CO	3625 N SHERIDAN RD	PEORIA	IL	61604	309-688-8571	55
	TRINITY COMPANIES	2000 ROSS	DALLAS	TX	75201	214-748-9941	500
7332	BLUEPRINTING & PHOTOCOPYING						
	TELEDYNE-POST	333 W LAKE ST	CHICAGO	IL	60606	312-726-4494	35
	TELEDYNE INC	725 CHESTNUT	PHILADELPHIA	PA	19106	215-627-6493	20
7333	COMMERCIAL PHOTOGRAPHY & ART						
	TELEDYNE-POST	333 W LAKE ST	CHICAGO	IL	60606	312-726-4494	40
7391	RESEARCH & DEVELOPMENT LABS						
	TELEDYNE ELECTRONICS	649 LAWRENCE DR	NEWBURY PARK	CA	91320	805-498-3621	20
	TELEDYNE ISOTOPES ENERGY S	110 W TIMONIUM RD	LTHRVL-TIMNUM	MD	21093	301-252-8220	49
7394	EQUIPMENT RENTAL & LEASING						
	TELEDYNE INC	NEWCOMB AVE	HAMPTON	VA	23669	804-723-6531	20
7397	COMMERCIAL TESTING LABORATORIES						
	TELEDYNE ENGRG SRVCS-TESTG	303 BEAR HILL RD	WALTHAM	MA	02154	617-890-3350	70
7622	RADIO & TELEVISION REPAIR						
	TELEDYNE SERVICE-TV SRVC	PACKARD BELL/2106 W VALLEY	ALHAMBRA	CA	91803	213-282-3195	20
	TELEDYNE SERVICE CO-TV SRV	6833 E ACCO ST	LOS ANGELES	CA	90040	213-685-6714	23
8911	ENGINEERING & ARCHITECTURAL SVCS						
	TELEDYNE ENGINEERING SVC	303 BEAR HILL RD	WALTHAM	MA	02154	617-890-3350	175
						COMPANY TOTAL	42,197

APPENDIX B

Cross Product Index

World Aviation Directory

Identifying Aerospace Subcontractors

Appendix B

Identifying Aerospace Subcontractors

One of the identified tasks of this contract was to attempt to identify subcontractors doing business with the Air Force. Discussion of this task with various Air Force personnel developed the following information. A prime contractor may either make or buy products, components and subassemblies for installation into the prime contract system. If the prime contractor is to buy some products, it was stated that the prime contractor had to notify the DOD concerning "critical subcontractors". We felt that this might be one way of identifying aerospace subcontractors. We were informed that a form, DD1174 made an effort to identify subcontractors. Investigation of this indicated that the form was no longer used.

Further investigation of this problem led to Col. B.E. Voorhis, Director of Subcontractor Management Section at the Air Force Contract Management Division, AFCMD/OG(SM), Albuquerque, New Mexico (See also:AFSCR, DAR Supplement, Section XXIII, 6 August 1982, "Subcontracting Policies and Procedures"). An initial interview with Col. Voorhis indicated that critical subcontractors are designated as a function of the critical nature of the components for a weapons system. A component may be judged to be critical based on: 1) the

contribution of the component to the performance of the system, 2) because of its impact on the delivery schedule of the system, or 3) because of its impact on the cost scheduling of the component (part,component or subassembly) on the system. The decision is made as to the critical nature of the component by the Air Force Program Officer (SPO) in coordination with the prime contractor.

The components judged to be critical constitute the list of the subcontractors who are then monitored for contract compliance by the SPO and the prime contractor. This, then, forms the basis for the list of critical subcontractors and is a dynamic list based on the changing of the "critical" designation of a component from one weapons system to another, and even from one time period to another. It is in this context that one can identify some 7,000 subcontracts with first and second tier firms in relation to the F-16 weapons system. The object is not to monitor a subcontractor, but to be able to monitor the subcontract (for acquisition of a designated "critical" product, component or subassembly).

Further, there is no single list of "critical" or other subcontractors maintained by the Air Force. The one other document that we did find is entitled COMPANIES PARTICIPATING IN THE DEPARTMENT OF DEFENSE SUBCONTRACTING PROGRAM, which is published by the Directorate for Information, Operations and

Reports (DIOR), The Pentagon, Washington, D.C. The report covers the operations of the Army, Navy, Air Force, Defense Logistics Agency and includes commercial product companies participating in the DOD Subcontracting Program. The purpose of this program is to provide summary data on DOD subcontracting program commitments to small and disadvantaged business firms. The report represents subcontract data collected from DOD large business firms that have received at least one award in excess of $500,000 ($1,000,000 for construction). Public Law 95-507 requires that these contractors establish a small business and small disadvantaged business subcontracting program and report to DOD quarterly, using Standard Form 295, on subcontract awards made to these types of firms. The contractors who deal in commercial products are required to report annually, during the fourth quarter of the fiscal year.

There is a second data source, an industry guide entitled World Aviation Directory that is published annually. We have, in previous research, placed the 1981 listing of the World Aviation Directory firms into computer readable form. This listing of firms constitutes approximately 37,000 aerospace firms by the company name, address and identifiable produced system, subassembly, part or component. The earliest version of the DIOR report that we could obtain was for 1982. Assuming that the World Aviation Directory companies would not

significantly change between 1981 and 1982, we placed the DIOR listed companies onto computer readable form. The companies were identified by name and by a code indicating: P = prime contractor, S = subcontractor and B = both. The companies listed in the DIOR report were placed into a single computer readable file.

The information from the WORLD AVIATION DIRECTORY was divided into five separate data groups:

Companies producing aerospace PRODUCTS	8,064
Companies producing aerospace COMPONENTS	13,056
Companies producing aerospace MATERIALS	4,608
Companies producing aerospace SUBASSEMBLIES	8,704
Companies producing aerospace SYSTEMS	5,276

The companies will appear variously in different categories. For instance companies found in the data group for PRODUCTS will also be found in the data groups for COMPONENTS or MATERIALS or SUBASSEMBLIES or SYSTEMS.

The list of companies obtained from the DIOR publication was compared with each of the five data groups indicated above. The purpose was to indicate how satisfactory the WORLD AVIATION DIRECTORY might be in identifying potential or actual subcontractor/vendors. The comparisons were made on the name of the company. As a result of the computer comparisons based on the names, there were a total of 166 companies or

subsidiaries of companies found that were contained in both data sets.

The total number of unique companies (enterprises) available in all five groups of the WORLD AVIATION DIRECTORY was approximately 2,900 of which 500 companies were in the SYSTEMS data group. The other 2400 companies or enterprises were listed in the other four data groups. However, one enterprise can have a large number of associated establishments in its enterprise system of "family tree". Our conclusion was that the WORLD AVIATION DIRECTORY enterprises and establishments would not easily provide DOD identifiable subcontractors as defined by the indicated DOD publication. The results of these activities reinforced our overall conclusion that it was necessary to focus the research on existing databases that covered the entire American industrial base. There are several possible reasons for the limited success in these searches. First, the companies listed in the DOD report are clearly not limited to aerospace companies. Second, it is not clear what the nature of the companies listed in the DOD report actually was, except that the listed companies did have subcontracts. It was not clear, even for the Air Force subcontractors, that the subcontractors identified were aerospace subcontractors.

APPENDIX C

The Development of the Small Business Database: A Working Bibliography

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DRAFT

The Development of the Small Business Data Base of the U.S. Small Business Administration: A Working Bibliography

Bruce D. Phillips
Senior Economist, Office of Advocacy.
Small Business Administration
April 1983

Introduction

The studies below describe the creation, documentation, and applications of the Small Business Data Base of the Office of Advocacy of the U.S. Small Business Administration. The lists below, while comprehensive, examine only the most relevant studies during the years 1980-1983; the bibliography is therefore representative but not necessarily exhaustive. The studies below do, however, provide a recent chronological history on the development of the Small Business Data Base, and examples of some applications using the available data.

Two types of studies have generally been included. First, one collection of papers describes the detailed creation of the three major files of the Small Business Data Base: The USEEM (United States Establishment and Enterprise Microdata) file, the MEL (Master Establishment List), and the FINSTAT (Financial Statistics) file. These files contain approximately 5 million, 8 million , and 1 million records, respectively, on an annual basis, and their development is described in the papers in this bibliography.

In general, the USEEM file is available on both an enterprise and establishment basis by size class, while the MEL includes USEEM, plus and additional 3 million businesses appearing in the yellow page type commercial listings. The Fin/Stat contains end of fiscal year balance sheets for approximately 20% of the 4 million USEEM companies. In general, the USEEM is available for 1976-1980 (1982 by the end of 1983) , the MEL is available only for 1980, and the Fin/Stat is available for 1976-1981.

The second group of studies detailed in this bibliography are research applications either using the data files directly, or comparing them with other government data sources, such as from the Bureau of the Census, the Internal Revenue Service, or the Bureau of Labor Statistics. The papers

contained in these sections are both by staff members of the Office of Economic Research, as well as by SBA contractors.

It is hoped that the source materials listed below will be periodically expanded and updated as new contracts are completed, and as additional years of data become available. For example, some of the papers in the section describing the Dun and Bradstreet Financial Statistics File are quite preliminary, and are the result of initial attempts to assess the overall quality of the data on an industry specific basis. Additional ongoing contracts are editing this data for use by researchers, substituting additional years of publicly available data on large companies for the less comprehensive FINSTAT data, and preparing tabulations on the longitudinal capability of the files. These contracts should be complete by early 1984. In still other ongoing research, development of a longitudinal enterprise field, using the USEEM data base, is expected to commence soon for the years 1976-1982. Finally, several papers from ongoing interagency agreements between SBA and other agencies are described which will augment the Small Business Data Base.

The Policy Analysis and Data Base Divisions would be pleased to receive any comments on these draft materials.

1983

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Applied Systems Institute, "Development and Implementation of Automated Finstat Imputing Algorithms Phase I." Prepared under contract for the Office of Advocacy, Small Business Administration, March 1982
Delta Research Corporation, "Finstat File Retail Sector (SIC Codes 5200-5999): Editing and Analysis Report.: Prepared under contract for the Office of Advocacy, by the Small Business Administration, March 1982
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Bruce D. Phillips, "A Comparison of Three Establishment-Based Data Sources: The Dun and Bradstreet Market Identifier File, County Business Patterns, and Unemployment Insurance (U.I.) Data, 1977-1978." Draft, Office of Economic Research, Small Business Administration, March 1981

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Maureen C. Glebes, "An Economic Profile of the State of Missouri," Office of Advocacy, Small Business Administration, Washington, D.C., November 2, 1981.

Maureen C. Glebes, "An Economic Profile of the State of New Hampshire," Office of Advocacy, Small Business Administration, Washington, D.C., October 26, 1981.

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APPENDIX D

The Dun and Bradstreet Purchasing and Procurement Information System (PPIS)

The Dun and Bradstreet Purchasing and Procurement Information System

In 1981 Dun and Bradstreet initiated a system designated as Purchasing and Procurement Information System (PPIS) using the DMI files.(Luchsinger , May 25, 1982 and James P. McGinty, Dun and Bradstreet , 1983). There are some points of similarity between the PPIS system of Dun and Bradstreet and the PASS system of the Small Business Administration. There appear to be two advantages to the PPIS system: first, it uses a standardized approach to defining the commodities, and that approach uses the four digit SIC code as a basis; second, the PPIS system is based on the Dun & Bradstreet DMI file and could be expanded to that size ifrequired. The SBA PASS system contains approximately 100,000 firms and is based on self-identified products. approximately 100,000. Criticism of the PASS system has been that the key words for the search are too general and are not standardized.

The methodology for using PPIS is as follows. A product would be identified as one that is required for DOD acquisition. Let us say, for example, that it was desired to establish an increased bidding list for cathode-ray-tubes, or monitors. A search of the four digit SIC codes, even

superficially, would indicate that the following four digit SIC codes would be likely suppliers of "monitors:

3651	Radio TV and receiving sets
3661	Telephone, telegraph apparatus
3662	Radio and TV, commercial equipment
3671	Electric Tube, Receiver type
3672	Cathode Ray Picture Tube
3673	Electric Tube Transmitting
3811	Engineering & Scientific Instruments
3823	Process Control Instruments
3825	Instruments, Measuring, Electric
3829	Measurement & Control Devices

Using the Dun and Bradstreet manual for 1982, there are 3,210 establishments in the DMI file in the indicated SIC code categories.
Dun and Bradstreet on the basis or either personal, telephone, or mail contact was to create three additional digits to the existing 4 digit SIC code, where the added digits were then associated with each appropriate establishment.

Thus, on the newly devised PPIS system, the word MONITOR is input to the computer. The computer then prints out the following information:

PRODUCT	PRODUCT DESCRIPTION
3693273	BLOOD LOSS MONITORS, SURGICAL SUPPORT, ELECTRO MEDICAL MONITORS
3662229	BROADCAST, STUDIO AND RELATED ELECTRONIC EQUIPMENT VIDEO EQUIPMENT (EXCLUDES CONSUMER TYPES), OTHER POWER SUPPLIES, SYNCHRONOZATION EQUIPMENT, TERMINAL EQUIPMENT MONITORS, VIDEO TAPE RECORDERS AND PARTS AND ACCESSORIES THEREOF, LIVE CAMERAS, CONTROL CONSOLES AND SWITCHERS, FILM EQUIPMENT AND TV OUTSIDE VANS.
3662241	BROADCAST, STUDIO AND RELATED ELECTRONIC EQUIPMENT CLOSED CIRCUIT TELEVISION SYSTEMS AND EQUIPMENT (EXCLUDES BROADCAST AND CONSUMER PRODUCTS) SPECIALLY DESIGNED CAMERAS, MONITORS, VIDEO RECORDERS, RECEIVERS, SCAN CONVERTERS, CONTROL CONSOLES, OTHER.
3829106	NUCLEAR RADIATION DETECTION AND MONITORING INSTRUMENTS, NUCLEAR MONITORING INSTRUMENTS (INCLUDES ENVIRONMENTAL, PERSONAL DOSIMETERY AND MEDICAL MONITORS, BOTH STATIONARY AND PORTABLE.

The user of the system then examining the initial

information printed and out is able to determine that the probable 7 digit SIC code that is appropriate is: 3662229 .

The user then enters the code "3662229" into the computer system, and the following types of information is printed out. (Notice, for this illustration, only the name of the company is printed out, but modifications could be accomplished to print out name, address, chief executive officer, telephone number. Only a few of the total companies from the actual sample run are shown.)

DUN'S NUMBER	PRIMARY NAME OF ESTABLISHMENT
001306448	SONAR RADIO CORPORATION
001392778	SUPEREX ELECTRONICS CORPORATION
001556976	COMSPACE CORPORATION
002229607	MICROWAVE SYSTEMS INC
003234887	LONG ENGINEERING CO. INC
003262920	MCCARTHY MANUFACTURING CO INC
004203568	HARRIS CORPORATION
005476577	WINEGARD COMPANY
006299648	CRAWFORD ELECTRONICS CORP
...	...

A total of over 75 companies was printed out on this search.

As described the PPIS system may not exactly fit the needs of the DOD. Presently, it is our understanding that the system contains some 10,000 establishments. We were unable to obtain information on the present extent of the system, whether it is being expanded, how often the database is verified to determine that the firms are actually as indicated (changes over time) or the cost of undertaking such a system by Dun and Bradstreet.

However, the important point is that the databases are presently in existence and a methodology is available that would permit the DOD to begin positive action to increase its contractor/subcontractor/vendor bidding lists should that be desired.

Appendix E

Make-or-Buy

Interviews

APPENDIX E, Section 1

ESTABLISHMENTS INTERVIEWED

1. Alan Ballman
   Westinghouse Electric ILSD
   111 Schilling Road
   Hunt Valley, Maryland

2. Victor Stern
   Chairman, Make-Buy
   Sikorsky Aircraft Company
   New Product Development
   Stratford, Connecticut

3. W. F. Kendig
   Sperry Univac DSD
   640 North 2200 West
   Salt Lake City, Utah

4. Thomas Tracey
   Perkins-Elmer
   100 Wooster Heights Road
   Danbury, Connecticut

5. Charles Carnahan
   Vice President, Operations
   Martin Marietta
   Denver, Colorado 80201

6. Mike Moss
   Chairman, Make-Buy
   Grumman Aerospace
   Bethpage, New York

7. Robert L. Smith
   Sperry Gyroscrope
   Great Neck, New York

8. Martin Rubin
   Manager-Operational and Advance Planning
   Litton Data Systems
   8000 Woodley Avenue
   Van Nuys, California

9. Rockwell International
   6049 Calle Cedro
   Anaheim, California

10. John Gavin
    Vice President, Operations
    Lockheed Missiles and Space Company
    Sunnyvale, California

11. William Flick
Vice President
Lockheed Austin Division
Austin, Texas

12. Mr. Grant Lindsay
Morton-Thiokol
Wasatch Division
Brigham Young City, Utah

13. Mr. Noel Hargrove
Cost Analysis
TRW
Space Park
Redondo Beach, CA

14. Mr. Theodore Moore
Bendix-Energy Controls Division
South Bend, Indiana

15. Mr. Clyde Perry
General Dynamics
Pierre LaClede Center
St. Louis, MO

16. Dr. H. Gault
General Dynamics
Pomona Division
Pomona, California

17. Government Division
RCA
Moorestown, New Jersey

18. Michael Dewing
Hewlett Packard (Sales)
Anaheim, CA

19. Eugene Oppenheimer
AM General
South Bend, Indiana

20. Tom Cwalina
Harris Corporation
Melbourne, FL

21. James Chaplin
Rockwell International
Seal Beach, CA

22. Robert Gaffney
General Mills, Inc.
Minneapolis, Minnesota

APPENDIX E Section 2

AIR FORCE PLANT REPRESENTATIVE OFFICES (AFPRO'S) CONTACTED

1. Pratt & Whitney Engine Plant (Capt. M. Simons)
   East Hartford, CT

2. Westinghouse (Major Rigney)
   Baltimore, MD

3. McDonnell-Douglas Plant (Robert Colbeck)
   St. Louis, MO

4. Rockwell International (Eleanor Cox)
   Canoga Park Plant
   Canoga Park, CA

5. General Electric Co. Evandale Plant (Tom Dressman)
   Evandale, Ohio

6. Boeing Co. (Dwayne Erickson)
   Seattle, WA

These contacts were provided through the AMIS Office and the Office of Small Business Management (OG/SM), both located at Kirtland AFB, New Mexico