

An Assessment of the U.S. Telecommunications Industry Dependence on Foreign Sources as it Impacts the U.S. Telecommunications Infrastructure

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PREFACE

This report was submitted as a prime deliverable for a study conducted for the National Communications System (NCS), Office of the Manager, Technology and Standards Office, Washington, DC, under Reimbursable Order DNRO 26081. The study is an update to previous work done by the Joint Industry-Government Telecommunications Industry Mobilization (TIM) Group, a subcommittee of the National Security Telecommunications Advisory Committee (NSTAC). The TIM Group made an initial assessment, in 1987, of the telecommunications industry's dependence on foreign sources in light of the potential requirement for mobilization.

The objectives of this study were to update the 1987 assessment, and to develop an assessment mechanism that can be used to perform future assessments of foreign source dependence. This report contains data compiled from interviews of representatives of industry, the Government, and available literature. Certain commercial products and company names are mentioned in this report to specify and describe some of the necessary information. Such identification does not imply exclusive recommendation or endorsement of the companies or the products by NTIA or NCS. The views, opinions, and/or findings contained in this report are those of the authors and should not be construed as an official NTIA or NCS position unless designated by other official documentation.

This report is issued in two volumes. Volume I contains a summary of findings during this study. Volume II contains more detailed background information.

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ACRONYMS

ASIC	Application Specific Integrated Circuit
BXA	Bureau of Export Administration
COP	Committee of Principals
DOC	Department of Commerce
DQ	Dataquest, Inc.
DRAM	Dynamic Random Access Memory
DSP	Digital Signal Processor
EOP	Executive Office of the President
E/M	Electromechanical
EPA	Environmental Protection Agency
GDP	Gross Domestic Product
GNP	Gross National Product
IDA	Institute for Defense Analyses
Int	Interconnect
ITA	International Trade Administration
ITC	Initial Tax Credit
ITS	Institute for Telecommunication Sciences
Mech	Mechanical
NAFTA	North American Free Trade Act
NCS	National Communications System
NSTAC	National Security Telecommunications Advisory Committee
NTPANCS	Telecommunications Plan of Action
NTIA	National Telecommunications and Information Administration
NS/EP	National Security and Emergency Preparedness
PCB	Printed Circuit Board
RBOC	Regional Bell Operating Company
SMT	Surface Mount Technology
TIM	Joint Industry-Government Telecommunications Industry Mobilization Group
U.S.	United States
USDA	United States Department of Agriculture

AN ASSESSMENT OF THE U.S. TELECOMMUNICATIONS INDUSTRY DEPENDENCE ON FOREIGN SOURCES AS IT IMPACTS THE U.S. TELECOMMUNICATIONS INFRASTRUCTURE

Volume II: Background Information

David F. Peach and Michael D. Meister¹

The National Communications System (NCS) is responsible for defining operational infrastructures and processes that could be detrimental to the provision of telecommunications equipment and services necessary to the National Security and Emergency Preparedness (NS/EP) needs of the Nation. To this end, the President's National Security Telecommunications Advisory Committee (NSTAC) studied the industry's dependence on various infrastructures within the United States to (1) identify possible impediments to effective telecommunications industry mobilization, and to (2) assist in the development of corrective actions to overcome any identified impediments. This study was published in 1989. The information presented in this report is a result of follow-on investigations that attempt to determine those components and materials used in the telecommunications equipment manufacturing process that are obtained from foreign sources. This report lists those components that are primarily procured from foreign sources. For example, plastic-coated relays, printed circuit mounted transformers, and some types of semiconductors are a few of the components that represent vulnerabilities in the telecommunications switch (Class 5) manufacturing process. A result of this study is an analysis of the trends that are evident between the 1989 study results and the results of this report. This report shows an increase in the components that are obtained almost exclusively from sources outside the U.S. and Canada. A contributing factor to the trend toward more foreign sourcing of components is the general trend toward a more global economy. In the final analysis, one must determine the components, and their sources, that could be the most detrimental to the mobilization of the Nation's telecommunications resources if these sources were no longer available. A determination of the sources that are most likely to be cut off is also important. An analysis of the circumstances that could result in the cut off of foreign sources is not a part of this study.

Key words: telecommunications; telecommunications switch; Class 5 switch, telecommunications manufacturing; foreign source; foreign source dependence

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1. INTRODUCTION

The telecommunication industry plays a critical role in assuring the Nation's ability to maintain continuity of Government and essential private sector functions when faced with national security or emergency preparedness (NS/EP) challenges. The National Communications System (NCS) is the Federal Government's primary agent for planning and coordinating the Nation's NS/EP telecommunication activities. The NCS NS/EP Telecommunications Plan of Action (NTPA) calls for

- The identification of possible impediments to effective telecommunication industry mobilization and mobilization planning, and the recommendation of corrective actions, and
- The identification and recommendation of any Federal Government actions needed to support the telecommunication industry mobilization planning activities.

The Institute for Telecommunication Sciences (ITS) is assisting NCS in fulfilling its NS/EP responsibilities by conducting a study to determine the extent and nature of U.S. dependence on foreign sources for telecommunications systems and components that could affect U.S. telecommunications in a NS/EP scenario. The work involves both identifying current system and component dependencies, and developing mechanisms for assessing ongoing and long-term dependence.

Foreign dependency under a condition of mobility makes sense only if the scenario under which mobility is required is defined. To determine the dependence based on mobility becomes a matter of judging the applicable situation rather than that of applying known or fixed objective parameters to a particular situation. Although the precise type of national security emergency that the U.S. may face may be impossible to predict, it may be beneficial if the general economic and production problems likely to be encountered in any such emergency can be anticipated with some degree of certainty. Effective peacetime planning, focused on the problems likely to arise during a national emergency, and on methods to deal with these problems, can increase the effectiveness of subsequent preparatory and response actions. Different levels and types of response measures will be appropriate depending on the nature of the crisis or emergency and the stage of its development.

Mobilization is fundamentally a civilian agency activity, and as a result the civilian agencies control many of the resources (e.g., critical materials, energy, and transportation), programs (i.e., priorities and allocations and voluntary agreements), and policy decisions (i.e., fiscal, monetary, trade, and regulatory policies) necessary to support increased defense production.

The response time necessary to increase significant production of defense end-items has militated against reliance on production capabilities in a crisis or conflict. Even if major investments were made in industrial base enhancement measures, the industrial base could not respond immediately to mobilization requirements. Some time would be needed to refine plans and focus them on the crisis; develop new production requirements; adjust

existing procurement plans; identify and qualify new sources of supply; let new contracts; and increase the flow of parts and components to end-item assembly and manufacture (FEMA, 1989). This study does recognize a very general definition of mobilization (see Section 2; Definitions) that does not rely on a mobilization scenario to gain a time-based insight into potential shortfalls.

It is difficult to assess on an empirical basis, the extent of dependence on foreign sources in the telecommunications infrastructure, despite the wealth of evidence that the problem exists. Data collection based on varying methodologies limits our ability to identify dependency trends in critical industrial sectors. One of the impediments in this process is the reluctance of the manufacturers to divulge the supply sources.

The results of a Government study, published in 1989²(NCS,1987, and NCS,1989), were compared to the information acquired during ITS's 1992 study. Several items that were foreign sourced in 1987, are still predominately procured from outside the U.S., such as plastic coated relays, ferrites and ferrite-based devices, connectors using precious metals, and semiconductors. According to reliable sources, there will be little change in the sourcing of any of these items during the next two years. Suppliers in the U.S. will improve their competitive position in the market of 256 kbit and 1 Mbit DRAM memories; however, the usage trend is toward 4 Mbit and 16 Mbit DRAMs, components that are primarily produced in volume outside the U.S.

It is apparent, after discussion with U.S. companies, that to fully understand their foreign dependence and foreign sourcing issues, one must recognize the integral and complex U.S. policies and issues related to economics, politics, technology, import and export laws, taxes, and labor.

2. DEFINITIONS

The definition of terms used in this report is consistent with the definitions in the background reports, upon which some of this report relies. For the purpose of this report, the following terms are herein defined.

Foreign--Foreign refers to those geographical areas not included within the United States and Canada. Areas within the United States and Canada are referred to as North American.

Foreign Dependence--Foreign dependency is defined as a material, part, component, assembly, or subassembly sourced abroad because it is not produced or otherwise available in the U.S. or Canada.

² A National Security Telecommunications Advisory Committee (NSTAC) report entitled "Final Report of the Joint Industry-Government Telecommunications Industry Mobilization (TIM) Group," was published in April 1989. This report consists of two volumes.

Foreign Sourcing--Foreign-sourced items are defined as materials, parts, components, assemblies, or subassemblies manufactured, assembled, or otherwise processed outside the United States and Canada. The distinction should be noted between the issue of *dependence on* foreign sources and the broader, more inclusive issue of *procurement from* foreign sources. Foreign source procurement does not necessarily equate to foreign source dependence. Both foreign dependence and foreign sourcing involve consideration of a range of trade, economic, national security, and foreign relations issues.

Mobilization--The process of marshalling those telecommunications resources needed to make the transition from a normal state to a state of readiness for war or other national emergency.

Mobilization is considered to encompass the interval from peacetime/disaster/crisis through any subsequent conventional military actions external to the continental United States. The impact on the telecommunications industry of a nuclear attack upon the United States was judged by the Group to be outside the scope of its study. The following mobilization time periods are being used for the purpose of analyses:

- (1) Pre-Mobilization: Planning and Pre-Positioning
- (2) Short-Term: 0 to 90 Days (Reallocation and Reprioritization of Existing Capability and Service)
- (3) Mid-Term: 90 to 180 Days (Reallocation and Reprioritization of Products and Services in the Pipeline)
- (4) Long-Term: Over 180 Days (Expanded Production of Capacity and Services).

3. BACKGROUND

According to a study performed in 1987 (NCS, 1987), and published in a Government report (NCS, 1989), the extent of the telecommunications industry's dependence on foreign sources for raw materials, components, parts, and equipment is a key area of concern in evaluating the industry's ability to maintain service and production capabilities and accommodate increased service and equipment demands under mobilization conditions. The Joint Industry-Government Telecommunications Industry Mobilization (TIM) Group was established by the President's National Security Telecommunications Advisory Committee (NSTAC) and the National Communications System (NCS) Committee of Principals (COP) to: (1) identify possible impediments to effective telecommunications industry mobilization and (2) assist in the development of corrective actions to overcome any identified impediments. The report entitled Final Report of the Joint Industry-Government Telecommunications Industry Mobilization (TIM) Group (NCS, 1989), documents the Joint Group's final findings, conclusions, and recommendations regarding the industry's overall dependence on foreign sources.

The Joint TIM Group sought information from Federal Government and private research organizations that had previously studied the issue of foreign procurement or foreign dependence. The Group focused initially on the telecommunications industry's dependence on foreign-sourced semiconductors, providing recommendations on semiconductor dependency to the NSTAC in February 1987 and to the COP in March 1987. The Joint TIM Group reached the following conclusions concerning semiconductors:

- At this time, if foreign-sourced semiconductors became unavailable, it would not have significant impact upon the provision of telecommunications service during Short-Term (0 to 90 days) and Mid-Term (90 to 180 days) mobilization. While production of telecommunications equipment would be adversely affected in the Short and Mid-Terms, available equipment could be allocated to meet mobilization-related national security emergency preparedness (NS/EP) needs.
- At this time, to the extent that foreign-sourced semiconductors became unavailable, expansion of telecommunications service capacity would be constrained during Short- and Mid-Term mobilization, and overall capacity would be reduced in the Long-Term because the telecommunications industry would be competing with other entities (e.g., the Department of Defense) for the allocation of available supplies.

The subsequent focus of the Group's study was equipment, materials, and components other than semiconductors. It was determined by the NSTAC that semiconductors were a problem area based on DoC and National Defense University data. A survey of NSTAC member companies was conducted to support this aspect of the study. The Dependence on Foreign Sources Survey was designed to elicit the views of NSTAC companies concerning their own, as well as the industry's, dependence on foreign sources for materials, equipment, and components other than semiconductors. The survey focused on four major types of equipment: digital central office switching equipment, fiber optic electronic terminal equipment, telephone sets, and satellite ground stations. Nineteen NSTAC companies provided responses to the survey.

On the basis of the survey results and other information obtained from the literature, briefings, and consultation with experts in the Federal Government and the private sector, the Joint TIM Group developed its findings, conclusions, and recommendations. The increasing dependence of the telecommunication industry on foreign sources raises significant questions about the industry's ability to respond to and sustain mobilization requirements. The Joint TIM Group reached the following conclusions concerning equipment, materials, and components other than semiconductors:

- In the Short-Term and Mid-Term, the service sector of the U.S. telecommunications industry would not be immediately or severely affected by disruption of the supply of foreign items. Adverse effects would be felt as foreign equipment fails or requires repair parts.
- The manufacturing sector of the U.S. telecommunications industry could be immediately affected by a cut-off of critical foreign-sourced supplies, equip-

ment, or materials. The effects on production would depend, in part, on the quantities of foreign-sourced items in domestic inventories and in the supply pipeline.

- The U.S. industry's foreign dependence presents a changing picture in terms of the specific equipment, components, and materials for which dependency exists as well as the degree of dependence for each. Today's list of foreign dependence items is different from last year's, and next year's will differ from today's. The following conclusions and observations reflect the picture as drawn by the NSTAC Foreign Dependence Survey and related studies in their 1987 report for the period addressed:

- (1) In view of the large number of foreign-made optic terminals embedded in U.S. telecommunications systems (about 35 percent foreign according to some estimates) and the inherent incompatibility between terminals made by different manufacturers, the foreign-made terminals and their interfacing connectors could become a problem if maintenance or expanded capacity is required.
- (2) The U.S. currently imports over 60 percent of the telephone sets it uses. Although the demand for telephone sets during mobilization is not known, the fact that imports have risen to this level suggests that telephone sets could be a problem during mobilization. Therefore, the Joint TIM Group concluded that domestic production and imports status of telephone sets should be periodically monitored.
- (3) The foreign dependence status of ceramic resonators should be studied in depth, with a view toward identifying possible steps to reduce the degree of foreign dependence. The availability status of four other critical items—fiber optic terminals, fiber optic connectors, telephone sets, and ferrite cores should be periodically monitored for the same purpose.

On the basis of its conclusion regarding the impact of semiconductor foreign dependency on the telecommunications industry the Joint TIM Group offered the following recommendation:

Semiconductors are major components of the equipment used by the telecommunications industry, and industry is almost totally dependent on foreign-sourced semiconductors. Accordingly, the ongoing National Security Council and Defense Science Board efforts in this area are strongly supported. The President should direct action to identify steps to mitigate the impact of the loss of foreign-sourced semiconductors on the telecommunications industry.

Further, on the basis of its collective assessment of the responses to the NSTAC-wide Dependence on Foreign Sources Survey, the Joint Group has identified other dependencies of concern from a mobilization perspective. While these dependencies may not have the same wide-ranging significance to the telecommunications industry as semiconductor

dependency, they are important. Accordingly, the Joint TIM Group offers the following recommendations:

- The Government, in conjunction with NSTAC, should establish a mechanism to periodically assess industry dependence on foreign sources in light of identified Government mobilization needs.
- The NCS and NSTAC should jointly keep the Executive Office of the President (EOP) apprised of any specific foreign dependency issues relating to telecommunications, and identify, if necessary, possible measures for reducing or mitigating these foreign dependencies.
- In conjunction with the above Government action, the NSTAC member firms should ensure that their appropriate internal organizations are made aware of the findings of the Joint TIM Group. Further, their internal organizations should be apprised of the need to plan for contingencies such as cut-off of non-North American supplied material during a mobilization.

In its study, the Joint Group has recognized that concerns about foreign source dependency grow out of the possibility that foreign sources of supply could be cut off under a variety of mobilization conditions. The Group has thus assumed, for purposes of its general investigation, that a cut-off of foreign supplies would occur coincident with the beginning of mobilization.

4. STUDY METHODOLOGY

This ITS study was undertaken in response to the Joint TIM Group's recommendations that the Government (1) investigate more fully U.S. dependence on specific foreign-sourced telecommunications equipment critical to the telecommunications infrastructure, and (2) develop a mechanism to periodically assess foreign source dependence. ITS proposed a three-phase approach to identifying such dependencies:

Phase I-Systems Level Analysis. Analyze each major telecommunications system or group of systems to determine the amount of production within the U.S., the imported quantities, exported quantities, and the U.S. consumption (Appendix A). Flag the cases where significant portions of U.S. consumption come from foreign sources as a possible problem area.

Phase II-Component Level Analysis. Identify specific components of those Phase I systems that are procured primarily from foreign sources. The components included those consumables used in the manufacture of the equipment. For purposes of this study, the systems investigated were limited to Class 5 central office switch equipment manufactured in the U.S.

Phase III-Identification and Prioritization of Vulnerabilities. Investigate the vulnerabilities of U.S. telecommunications infrastructure due to de-

pendence on the identified systems and components. The vulnerabilities are only possible problem areas, and will become problems if that component supply is cut off or in some way reduced. The identification of problem areas is left to Government representatives who can identify the specific supply pipelines that may be eliminated.

The Institute's FY91 activities and accomplishments in Phase I and Phase II of the study are summarized in Appendix B. After evaluating the available data and data sources, ITS and NCS limited the scope of the study to telephone switching equipment (specifically, Class 5 switches) to develop a working approach and then apply this approach to other areas as appropriate. The Class 5 telephone switch was selected because of its widespread use and its significant importance within the telecommunications infrastructure.

4.1 Phase I—Systems Level Analysis

Using import/export data published by the Bureau of the Census³ (see Appendix A), the general category *Telephone Switching and Switchboard Equipment* was selected to begin the study. Figures 1 and 2 are graphical representations of the data for the *Telephone Switching and Switchboard Equipment* for 1989 and 1990, respectively.

Apparent U.S. consumption is based on monetary values of U.S. production, imports, and exports according to the following formula:

$$\text{U.S. Production} + \text{Imports} - \text{Exports} = \text{Apparent U.S. consumption}$$

The category, *Telephone Switching and Switchboard Equipment*, includes an overwhelming number of systems. After evaluating the available data and data sources, ITS and NCS limited the scope of the study to the area of telephone switching equipment (specifically, Class 5 central office switches) to develop a working approach and then to apply this approach to other areas as appropriate. The Class 5 central office telephone switch was selected because of its widespread use, its significant importance within the telecommunications infrastructure, the limited number of U.S. manufacturers of this switch, and the perceived ease of collection of component and system-level data. In addition, a fully configured Class 5 central office switch system utilizes nearly all of the components that are used to manufacture smaller telecommunications systems and thus provides a very good representation of the component profile.

³ The Bureau of the Census is an organization of the U.S. Department of Commerce. The data used in this report was obtained from the published report entitled "Communication Equipment and Other Electronic Systems and Equipment." The report was published in 1991 for the period of 1984 through 1989. Appendix A contains a copy of this report.

3 - PHASE APPROACH

PHASE I - System Level Analysis

Identify → Imported quantities
Exported quantities
U.S. Consumption

EXAMPLES
1989

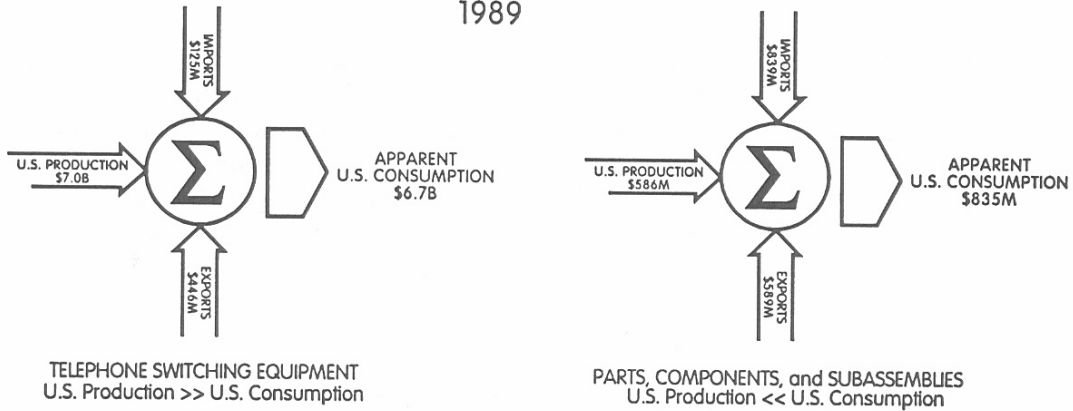


Figure 1. A 1989 analysis taken from the Bureau of the Census Report (Appendix A).

3 - PHASE APPROACH

PHASE I - System Level Analysis

Identify → Imported quantities
Exported quantities
U.S. Consumption

EXAMPLES
1990

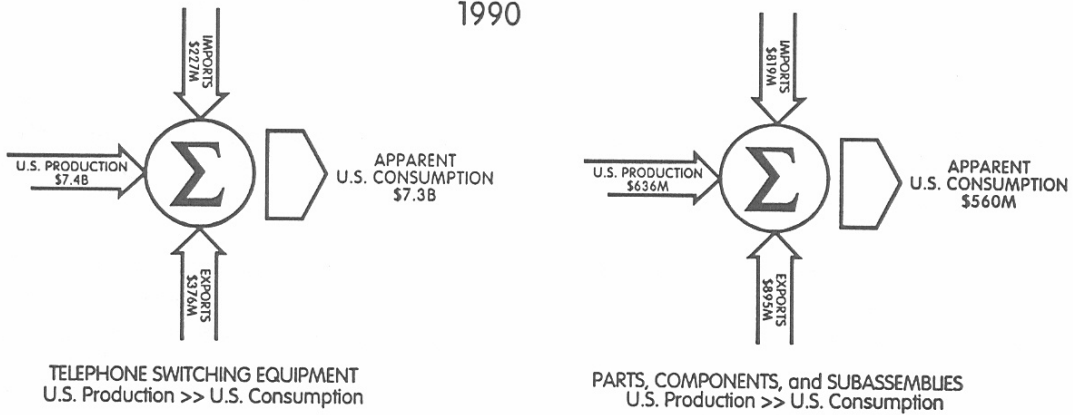


Figure 2. A 1990 analysis taken from the Bureau of the Census Report (Appendix A).

4.2 Phase II—Component Level Analysis

At the component level of the analysis, the goal was to identify components of the Class 5 switch that are wholly or primarily obtained from foreign sources. Published data on specific components is not available from either industry data research firms or Federal Government agencies such as the Bureau of the Census and the International Trade Administration.

The Institute for Telecommunication Sciences teamed with Dataquest Incorporated⁴ to develop a method of obtaining the required data at the component level. The Institute and Dataquest Incorporated established points of contact with the manufacturers and developed a questionnaire for collection of data. Manufacturers participating in the study were provided with a brief background report highlighting the background of the project, its purpose, goals, and current status. A copy of the questionnaire is available in Appendix C. The manufacturers reviewed the questionnaire and background report and prepared their response. The Institute and Dataquest Incorporated were then invited to the manufacturer's offices to discuss the information.

Two digital switch manufacturers participated in the pilot study. The names of the particular manufacturers cannot be disclosed due to the nature of the data. It was requested by the manufacturers not to disclose proprietary and sensitive information, which was required for us to know in order to understand the impact of foreign dependency on the manufacturer's products. The Institute signed nondisclosure agreements to this effect. The questionnaire was developed to be sensitive to the limitations related to the release of this information.

At the outset of this project, information was collected from Government and private research organizations that had previously studied the foreign dependency issue, to provide insight in preparing our survey questions and final report. The methods for data collection used during the period 1987-1989 were also investigated. It was not possible to use the Defense Production Act (DPA) for this study as it expired in March 1992, and has not been re-enacted by Congress.

The use of questionnaires to gather such information have proved ineffective. The information needed is considered proprietary, companies are reluctant to release such information without the DPA, requiring release of specific information if justified for Government purposes.

From published data, it is not possible to accurately determine overlap within the Bureau of the Census categories. As an example, a U.S.-manufactured component exported to a foreign source may be used in a subassembly. That subassembly is then imported to the

⁴ Dataquest Incorporated (DQ) specializes in market studies, research, and report writing in several telecommunications areas.

U.S. and then exported for use as a component in system-level equipment. The equipment is then imported to the U.S. for use by the customer. In this case the dollar value of the component has been included three times in the import/export data. Appendix D contains raw import data from an internal report produced by the U.S. Department of Commerce.

Sample responses from the two manufacturers surveyed follows. The manufacturers are referred to as Manufacturer A and Manufacturer B.

4.2.1 Manufacturer A

KEY:

E/M Electromechanical

Mech Mechanical

Int InterConnect

QUESTIONS

1. Of the assemblies and subassemblies identified in the block diagram, what percentage are manufactured by foreign sources?

E/M 60-70%

Mech 1%

Int 10%

2. What percentage of the components in the subassemblies are manufactured by foreign sources?

E/M 50-60%

Mech 2%

Int 40%

3. What percentage of the components and subassemblies are designed by foreign sources?

E/M components - 70-90% sub-assemblies - 0%

Mech none

Int 0%

4. What percentage of the subassemblies are assembled offshore?

E/M sub-assemblies - 10-15% silicon - 70-80%

Mech none

Int none

5. In your estimation, how would the unavailability of foreign component and subassembly design affect your company's ability to continue to produce and maintain the switch equipment under consideration?

E/M Impact up front 12-16 weeks - provided parts could be established domestically. Severely impacted for memory devices due to inability to obtain sufficient memory devices.

Mech Little or no impact

Int Significant short-term availability problem and long-term cost

6. Could you identify alternative sources for the identified subassemblies that would sustain production? Do North American suppliers exist?

E/M yes

Mech yes

Int yes

7. In your estimation, how would the unavailability of foreign sourced materials and components for these types of equipment constrain or impair the telecommunications industry's ability to mobilize and/or sustain a long-term (beyond six months) mobilization efforts?

E/M Short-term impact: significant Long-term: minimal

Mech none

Int minimal impact

8. What would be the impact to Said Manufacturer if the supply of consumables were cut off? Consumables would include (as an example):

Solder Paste great impact

Fiberglass and ceramics minimal impact

Connectors (copper/ gold) great impact; in-house capability

Adhesives great impact; short-term only

9. What impact does/would foreign source dependency have on the following business and financial operations:

Just-in-time policy	more inventory and difficult to maintain; cost issue
Warehousing policy	more inventory and cost increase
Warehousing locations	no impact (E/M, Mech), possible increase
Leadtime requirements	longer leadtimes

10. What, if any, assemblies, subassemblies, or components should not be foreign sourced under any circumstances?

None; all proprietary components manufactured internally

11. Other comments or suggestions (i.e., what other important aspects or dimensions of the dependence on foreign sources issue should be addressed by the joint ITS/DQ study group?)

ICs Memory; Ferrite Cores - Magnetics

12. Are there identifiable trends toward greater or lesser reliance on foreign sources?

E/M No; foreign or domestic suppliers are not the sole criteria for making buying decisions - cost reasons usually prevail

Mech greater for cost reasons

Int greater for cost reasons

4.2.2 Manufacturer B

1. Of the assemblies and subassemblies identified in the block diagram, what percentage are manufactured by foreign sources?

Reply: The percent of foreign dependency for assemblies and subassemblies is less than 1%. The only significant assemblies which are not multiple sourced through U.S.A. manufacturing sites are Seagate Disk Drives (100% Singapore), Cooling Fans (Pabst, 80% Germany; Rotron, 20% Mexico), Cable Assemblies (80% Mexico).

2. What percentage of the components in the subassemblies are manufactured by foreign sources?

Reply: Based on economic content, approximately 4.7% of the systems value is attributed to components from foreign

sources. This is made up of U.S.A. suppliers with off-shore factories and U.S. affiliates of foreign suppliers using some or all manufacturing off-shore.

3. What percentage of the components and subassemblies are designed by foreign sources?

Reply: Design of system subassemblies are controlled by U.S.A. based R&D organizations. We do not have visibility into the percentage of off-shore produced discrete components as to which components are procured from U.S. based sources that have assembly and test facilities off-shore, we believe the percentage may be extremely small. Lastly, 1.5 % of the system value is purchased integrated circuits (ICs) which have foreign design sources.

4. What percentage of the subassemblies are assembled offshore?

Reply: The major subassemblies which are assembled off-shore are:

Disk Drives	100%
Cooling Fans	100%
Cable Assemblies	80%

Assembly capability is duplicated in U.S.A. facilities but needs expansion.

5. In your estimation, how would the unavailability of foreign component and subassembly design affect your company's ability to continue to produce and maintain the switch equipment under consideration?

Reply: Lack of sub-assembly design from foreign sources would have no effect on the system. Unavailability of off-shore components would impair our ability to produce and/or maintain the system. This is especially true for select discrete semiconductor and dynamic memory ICs.

6. Could you identify alternative sources for the identified subassemblies that would sustain production? Do North American suppliers exist?

Reply: Alternate sources exist for most components, disk drives, cooling fans, cables, and ICs. North American suppliers also exist with the exception of select discrete semiconductors and limited IC volume capabilities.

7. In your estimation, how would the unavailability of foreign-sourced materials and components for these types of equipment constrain or impair the telecom-

munications industry's ability to mobilize and/or sustain a long-term (beyond six months) mobilization efforts?

Reply: Generally we perceive that there is adequate worldwide capacity of most components to sustain system manufacturing. However, if there are specific restrictions by country, technology, etc., it may take considerable resources to develop domestic capability.

8. What would be the impact to Said Manufacturer if the supply of consumables were cut off? Consumables would include (as an example):

Solder Paste

Fiberglass and ceramics

Connectors (copper/gold)

Adhesives

Reply: Since all consumables are obtained from U.S.A. sources, there would be no negative impact to our company.

9. What impact does/would foreign source dependency have on the following business and financial operations:

Just-in-time (JIT) policy

Warehousing policy

Warehousing locations

Leadtime requirements

Reply: JIT with foreign sourced is not validated for ICs. Other material impact is none.

10. What, if any, assemblies, subassemblies or components should not be foreign sourced under any circumstances?

Reply: None

11. Other comments or suggestions (i.e., what other important aspects or dimensions of the dependence on foreign sources issues should be addressed by the ITS study?)

Reply: There is a specific issue related to Mexican manufacturing relying on and/or resourcing with Asian sources. One of the latest developments in the North American Free Trade Agreement (NAFTA) negotiations is a proposed tariff of up to 20 percent on components/sub-assemblies imported into

Mexico from Asian sources. This issue must be monitored very closely to assure flexible alternative sourcing is maintained.

12. Are there identifiable trends toward greater or lesser reliance on foreign sources?

Reply: The trend has been to procure material globally from multiple sources. This strategy is enforced to minimize sole source reliance and support our customer's need for low-cost high-reliability products.

A portion of the results, obtained from data gathered during this survey, is summarized in Figure 3. The actual proportion for each segment of the graph will vary for each company. The foreign source dependence discovered in this study is concentrated in the "Pacific Rim" area, as noted in the sample replies from the manufacturers shown above.

GLOBAL COMPONENT SOURCING - SWITCHING (PERCENT OF TOTAL MATERIAL COST BY ORIGIN)

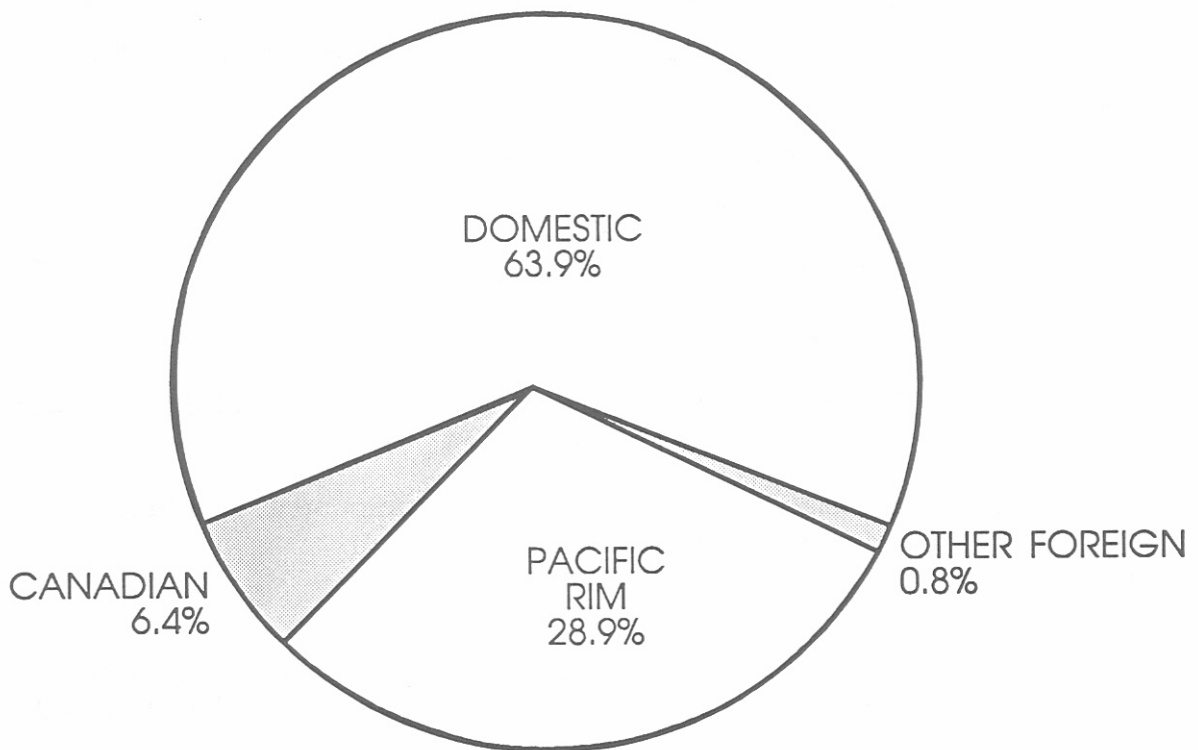


Figure 3. A global source analysis for Class 5 switch equipment.

4.3 Phase III—Identification and Prioritization of Vulnerabilities

The primary thrust of this report is mobilization rather than the trade or economic implications of foreign dependency, however, several of the responses have served to emphasize the strong and complex interrelationships between telecommunications industry economics and foreign sourcing. For example, one reason U.S. companies buy from foreign and domestic sources is price advantage. The competition among several foreign and domestic sources for the same market tends to minimize the cost of fielding new facilities and capabilities. The stimulation of technological development by the diverse foreign competition was also mentioned by the companies interviewed.

The identification of components, subassemblies, and consumables used to manufacture the Class 5 central office switch equipment does not indicate a problem--only a possible problem. If world conditions (e.g., a natural disaster, a hostile action, or a political action) should exist that cut off supply of one or more of the predominately foreign-sourced items, a problem may exist. In some cases, an immediate U.S. source may be available--but, probably at a cost penalty. This report will point out those items (components, subassemblies, consumables, and technology) that can be identified as predominately foreign sourced by at least one company. Some items are clearly foreign sourced by one company, but primarily U.S.-sourced by another company.

4.4 Study Limitations

The data obtained by this study is limited in two distinct ways: in its accuracy over time and by the quantity of manufacturers polled. The information obtained from the manufacturers changes quickly based on several national and international factors, some of which include foreign trade policy, economic issues (both national and manufacturer based), technology, etc. It is necessary to collect and assess data on a periodic basis to be accurate. This study is a pilot project, intended to develop an assessment mechanism. The study limited the number of manufacturers and the area of study. Although the number of manufacturers visited was limited in number, the data is representative of the industry.

Despite these limitations, we believe the study contains significant and valuable information. It is representative of the manufacturer's viewpoint. In some cases, the facts received from two different sources within the same company are in conflict--requiring a judgement of the quality of the source of communication within the company. The ITS staff feels that some company representatives were not in a position to supply the "whole story," thus the difference in responses from sources within the same company.

Data available from Government reporting points is rarely in the form that can be used to extract foreign source dependence data. The coding is such that one cannot separate data in a way that will allow an analysis of a specific telecommunications equipment, or a more narrow hardware classification.

Frequently the data that is periodically published by Government agencies is in the publication process so long that the information in the report is two years old by the time the report is available. The telecommunications technology is a fast paced industry, with technology turn-over of 1 to 2 years. If the data compiled is two years old when available, one is hard pressed to make corrections in strategy using data that has been overcome by time.

The information required to determine foreign source dependence is very guarded (frequently considered proprietary) by most of the companies. Data collected for a specific purpose is often limited by the resources available to perform the collection of data. The data limitations can lead one to arrive at a false conclusion—and frequently the information is interpreted wrongly. Instances like this cause the companies to be reluctant to release information unless they can derive benefit from furnishing the information.

The analysis that is the basis for this report is by no means an exhaustive assessment of all foreign source dependencies for all manufacturers of Class 5 central office switches. ITS did not collect data from all manufacturers of Class 5 switches—only U.S./Canadian manufacturers. This is, however, the first time that data specific to the Class S switch has been collected. The data required for this study was not available as a published report from the manufacturer; however, each manufacturer offered to collect the data necessary for the analysis.

5. A MECHANISM TO ASSESS FOREIGN DEPENDENCE

Any study must be guided by a systematic approach that is designed to fulfill the goals of the task. The staff at ITS has taken a research-oriented approach for this task. The approach was designed to be flexible so that it could be modified and redirected as necessary to achieve the objectives of the study.

5.1 Purpose of the Assessment Mechanism

The approach used by the ITS staff is designed to overcome the reluctance of the companies to release information that, in some cases, is considered to be company proprietary. Justification of the need for the information and the building of credibility with the company representatives is the key to the success of this effort. The company representatives must be convinced that the Government is not just doing another "frivolous" study.

5.2 The Assessment Mechanism

The Assessment Mechanism requires face-to-face conversation with appropriate representatives of the company in question. The questions asked during the visit (1) are of a nature that generates fruitful discussion of the problem, (2) are not too specific, (3) will

result in continued involvement from the company, and (4) are of a nature that result in real and intelligible conclusions with limited statistical information.

5.3 The Reasons for Use of This Assessment Mechanism

Statistics are not meaningful and appropriate unless the conditions under which they are compiled are specified in a way to discover specific results. For example, the use of the data compiled for this study for any other purpose is dangerous without a complete understanding of the data. Collections of general types of statistical data are compiled annually by several Government Agencies [e.g., Bureau of the Census, Department of Labor Statistics (BLS), the National Agriculture Statistical Service, and others] in an attempt to provide the Nation with data that can be used to measure the economy [e.g., the Gross National Product (GNP), replaced recently by the Gross Domestic Product (GDP)], the size and variance of the labor force (e.g., the unemployment rate), and more specific items [e.g., the U.S. Department of Agriculture (USDA) assessment of crop yield]. The use of this data for those specific needs is appropriate; however, this data may not be appropriate for other purposes.

Current sampling techniques used by the Government are limited by the meager budgets for compiling data (Appendix E; Kaminow, 1992); frequently yielding inaccurate results. In addition, the Paperwork Reduction Act limits the number of inquiries that can be made by mail to nine and only about one half of those will respond. This situation suggests a more directed approach such as the one used for this study. Dr. Kaminow also states that response to Government surveys is declining; perhaps due to fatigue in filling out Government forms, or a revolt against Government intrusion, or an effort by businesses to cut costs.

Telecommunications manufacturing is complex and rapidly changing. By the time information is gathered and processed it is most likely out of date. Statistics lose meaning and become convoluted when you consider the assumptions used in developing the statistics. Respondents to questionnaires make assumptions as to the scope of a question when answering the question.

The respondent to a surveyor questionnaire may decline to answer the inquiry, therefore deselecting their input and skewing the results. The Government discourages the use of the Defense Production Act of 1950 that can require a company to participate in a Government survey, under certain circumstances.

The ITS staff decided at the conclusion of Phase I of this study that the data required to perform this analysis is not available from any statistical source. A 1989 report written by the Office of Technology Assessment supports this observation (Appendix E; Kaminow, 1992). Based upon the limited tools available to collect the data, the ITS staff selected a research oriented approach for the study. The reason for the study can be explained to each respondent, in an attempt to obtain specific information that would be helpful in understanding the foreign source vulnerabilities within the telecommunications manufacturing infrastructure.

5.4 Factors That Affect the Assessment Mechanism

The gathering of proprietary data from manufacturers is a delicate process. The researcher's credibility must be established with the source, when marketing the needs of the Government. A justification of need for the information is based primarily upon the benefits to the Nation.

The following are summaries of discussions with manufacturers of Class 5 switches. This report does not propose to be exhaustive with respect to all switch manufacturers, as only a limited number of manufacturers (only U.S. major manufacturers of Class 5 switches) were interviewed for this pilot project.

Technical expertise. It is necessary that the interviewer have a technical background—preferably in the telecommunications field. The technical knowledge is helpful in collecting the appropriate information by asking the correct questions and conversing, in depth, about the technical aspects of the manufacturer's product.

Establishment of rapport. A research-oriented approach proved to be necessary in obtaining reliable, useful, and timely information. The use of questionnaires or surveys was not fruitful in obtaining this information, primarily because the companies consider the information sensitive. The Defense Production Act (DPA) of 1950 had expired on March 1, 1992 and was inactive during this study. The DPA allows the Government to require a full response to questions under certain circumstances. The approach began by making contact by telephone with personnel who were directly concerned with U.S. Government procurements to obtain a referral to the appropriate person within the organization who could provide the necessary information. An on-site visit was made to build a rapport with that person and their staff after a set of sample questions was transmitted to the company. In a face-to-face meeting with the manufacturer representatives, up-to-date and accurate information was imparted, and an understanding was gained of the "real" foreign dependency issues faced by the manufacturer.

Information volatility. Foreign dependency information associated with areas of high technology is quite volatile. It is difficult to determine the stability of a sourcing situation—in some cases the sourcing of a particular component may be in a "transition state," i.e., a foreign-sourced component may now be available in the U.S., or a technology turnover may obsolete a component that is foreign sourced. For example, the replacement of plastic coated relays with solid state relays; a transition that is on the horizon.

Availability of accurate information. Statistical data, published in periodic reports by the Government [e.g., The Bureau of the Census, DoC International Trade Administration (ITA), DoC Bureau of Export Administration (BXA)], cannot be segregated to obtain specific information about the telecommunications industry. Appendix A contains a sample of the global data that is available from The Bureau of the Census.

Currently, the Government-published information is obtained using a global type of gathering mechanism (i.e., questionnaire or request), and reports only end-user products.

The component makeup of each telecommunications product is not reported by anyone in the Government or industry. Private-held companies in the U.S. specialize in data analysis that is directed toward a specific use, e.g., gauging the size of a particular market either within the U.S. or a specific area of the world (e.g., the Pacific Rim, the European Community, South America). Numerous reports are available; however, none of them are of value in determining the source of components used to build any of the equipment integral to the U.S. NS/EP telecommunications networks. "Statistical Stagnation" is the title of a candid analysis of the limitations of statistical programs that are funded by the U.S. Government (Appendix E; Kaminow, 1992).

6. FINDINGS

The components that are sourced primarily from foreign sources were found to be the same for all manufacturers. There are cases where a U.S. manufacturer is dependent on the components from foreign sources due to lack of implementation of a particular technology in the U.S. However, only very isolated cases exist where there are no suppliers of a component or subassembly in the U.S.

U.S. companies are capable in the high-tech arena, and are used as sources for components during the prototype development of a product. However, when a company is looking for a source for procurement of larger numbers of these components, the U.S. supplier is frequently not competitive. The result is that a foreign supplier becomes the source for high-volume supply of some components. The good news in this scenario is that if the foreign supplier is no longer available for some reason, the U.S. supplier can be used as a source—of course, at a cost penalty.

This report lists the components that were designated as primarily foreign sourced by the manufacturers interviewed. The effort to determine the availability of sufficient U.S. capability to provide those components was not a part of the tasking for this study.

6.1 The Erosion of Technology

The U.S. is not as competitive in production of products using emerging technologies, resulting in a predominance of foreign sources for high-end components. These areas include large capacity DRAMs, and RISC technology, narrow line width photolithography, and flat panel displays (Heginbotham et al; 1990). For the most part, U.S. organizations developed these technologies, and foreign companies have applied the technologies and have subsequently developed the process for high-volume production.

The DoD is concerned about the competitiveness of the U.S. with respect to the commercial technology base at a time when the DoD is more reliant on commercial off-the-shelf components and technologies (Appendix F; Van Atta and White, 1992).

The DoC has put in place procedures and personnel to support the DoD in times of NS/EP mobilization situations. Their implementation procedure has been upgraded and further

defined as reported in a recent "white paper" (see Appendix G) in response to a request from the TIM Group. This paper describes the manner in which DoC will use the Defense and Priorities Allocations System (DPAS) as a vehicle for resolution of provisioning conflicts under national security emergency conditions.

A DoC report (DoC, 1990) suggests that the U.S. lags behind Japan in putting in practice most emerging technologies and trails the European Community (EC) in several of them. It is not the intent of the authors of this report to concentrate on the reasons for the lag in development of the emerging technologies or the technology drain from the U.S. Choate provides a discussion of possible reasons for the trend in his book (Choate, 1991).

6.2 The Class 5 Switch Equipment

When analyzing the Class 5 Switch, it was found that there is foreign source dependency on

- Semiconductors (only some types of memory devices),
- Printed circuit board (PCB) mounted transformers,
- PCB assemblies (circuit cards),
- Bare PCBs (substrate),
- Plastic-coated relays,
- Ceramic packages, and
- Ferrites.

Semiconductors. The foreign source dependence for semiconductors varies with the type of device. In mid 1992, when this study was completed, volume shipments of Application Specific Integrated Circuits (ASICs), microprocessors, and memory devices up to 1 Mbit were readily available from U.S. manufacturers at competitive prices. Memory devices with larger than 1 Mbit storage capacity were primarily sourced from outside the U.S. However, U.S. manufacturers are able to produce devices with capacities of 4 Mbits and larger in prototype quantities. It is uncertain who has the lead in the 256 Mbit memory chip race (Appendix E; Pollack, 1992). Japan is a primary supplier of microcontrollers used for automobile antilock brake systems and air bags actuators (conversation with a representative of the DoC International Trade Administration).

PCB mounted transformers. There is near 100-percent dependency on foreign sources for PCB mounted transformers. The assembly of these components is very labor-intensive, thus countries with significantly lower labor rates are able to produce the PCB mounted transformer, in volume quantities, at a lower cost.

Plastic coated relays. The plastic block (encapsulated) packaged relay replaces the older version commonly called a "reed relay." At present, all U.S. manufacturers of the Class 5 switch state that they are purchasing nearly 100 percent of their relays from the Pacific Rim countries.

Bare PCB substrate. A slightly less than 100-percent dependence on foreign sources was noted for PCB substrates (fiberglass material). U.S. manufacturers are capable of producing this material in quantity. No explanation was discovered that would explain the reason that U.S. companies cannot compete.

Ferrites. Ferrite cores (used for transformers, ferrite beads, and noise blocking devices).

Ceramic packages. This type of package is used for ruggedized semiconductor devices used in high-reliability applications. There is recent concern by U.S. manufacturers that the U.S. military is dependent on foreign sources of ceramic packages (Appendix E; Leopold, 1992).

PCB assemblies. The foreign sourcing of PCB assemblies is a result of the use of contractors (or manufacturing plants) outside the U.S. to perform the assembly and test of the PCB subassemblies that become components of the Class 5 switch.

6.3 The Class 5 Switch Manufacturing Process

The manufacturing process used to produce the Class 5 switch equipment consists of the manual and automatic equipment used to assemble and test the hardware, and the consumables used in the process. These items are integral to the capability of the Class 5 switch manufacturer to produce product at a competitive price. In fact, without the automated assembly and test equipment, most manufacturers would not be able to produce any significant quantities of product.

The analysis of manufacturing equipment (i.e., equipment used to assemble and test basic subassemblies of the Class 5 Switch assemblies) noted some dependence on foreign-source conveyors, robotics, test equipment, surface mount technology (SMT) PCB process equipment, certain machine tools, and photolithography equipment (required to manufacture microelectronic chips). The technology necessary for design and use of these equipments is typically U.S. developed, but in some cases the actual manufacturing and implementation of the technology takes place in other countries.

The manufacturing process is dependent on certain consumable materials (i.e., solvents, adhesives, paper products, plastics, specially formulated compounds, and raw materials). The specific items found to be dependent on foreign sources included solder paste, raw silicon ingots, adhesives, gold/silver/copper coated connectors and contacts, copper wire, aluminum, gallium arsenide, and filter glass.

6.4 Other Related Findings

Some foreign-sourced items, identified in Section 7 (e.g., some types of consumables, raw materials, and precious metals), can be critical to the manufacturing process of other items within the telecommunications infrastructure. For example, components such as copper wire, aluminum cable sheath, telephone poles, dies used to color parts within the cable, and the polyethylene used for the cable sheath, all require foreign-sourced raw materials. The manufacturing process for many of the components listed above is dependent on raw materials that are petrochemical based. For example, petrochemicals are used to formulate the creosote used to treat (to retard decay of the wood) telephone poles. Zinc is an important raw material required in the process of galvanizing the mounting hardware used to assemble a telephone pole assembly and attach cable to the pole.

An item as simple as a telephone pole can be a "show stopper." A recent example illustrates this point: the Regional Bell Operating Companies (RBOCs) providing service in the geographic area affected during Hurricane Hugo (along the East Coast in 1990) experienced shortages of telephone poles and the associated hardware. The hurricane traversed through three RBOCs as it passed up the coast. The first RBOC that was hit placed replenishment orders for telephone poles, depleting the supply. Subsequent orders to suppliers required production of more poles, resulting in a depletion of the creosote used to treat the poles. As the chain of events progressed, the resulting shortage was that of petrochemicals to manufacture the creosote. This story illustrates the complexity of the supply chain and the difficulty in identifying possible foreign source problems.

7. SUMMARY OF DEPENDENCIES

This study is an analysis of U.S. dependence on foreign components, assemblies, and subassemblies used to manufacture the Class 5 telecommunications switch. The analysis of data collected from the various manufacturers during this study is collated and presented in summary here. The information is not identified with a particular manufacturer for reasons of confidentiality. In separating the data from its source we are able to provide a more clear picture of foreign dependencies and the reasoning for the dependence based on the manufacturer's perspective.

In general, the dependency, as a total dollar value of components, is not getting any worse (Figure 4). However, several isolated components continue to present a foreign source vulnerability as shown below.

An analysis of the semiconductor market is shown in Figure 5. The penetration of U.S. companies in the Japanese market is slightly lower than the reverse, the penetration of Japanese companies in the U.S. market. The problem is not evident until one discovers that the difference is primarily in the emerging technologies area (i.e., the high-end memory and some types of microelectronic devices).

The foreign-source dependencies are classified in two categories, noting the components that are predominantly (over 50 percent) supplied by foreign sources to at least one

Material Purchases (domestic vs offshore)

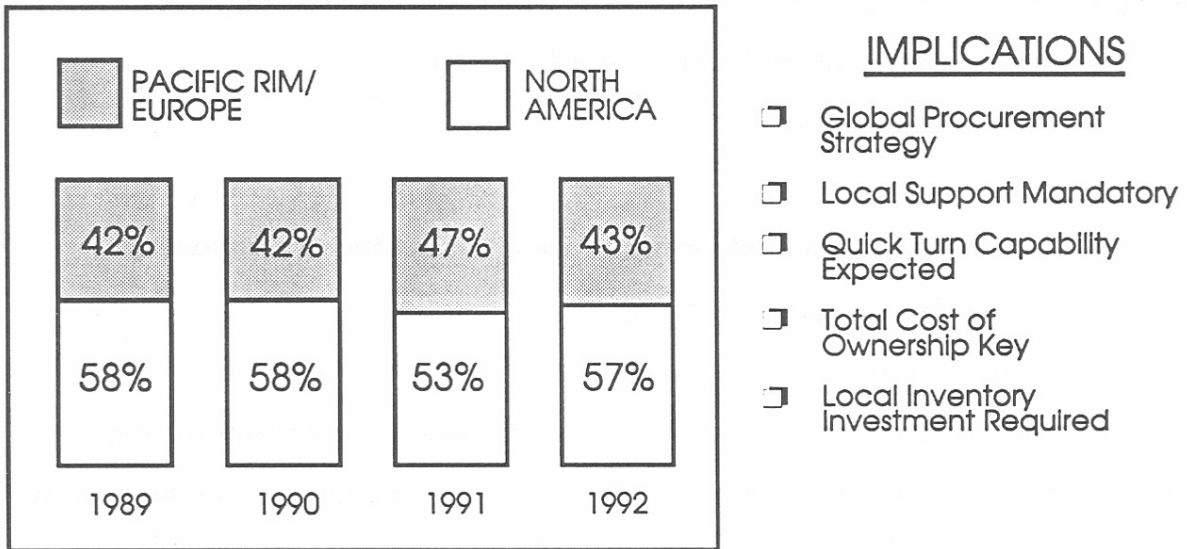


Figure 4. Material purchase source trend analysis for Class 5 telecommunication switch equipment.

U.S. vs JAPANESE VENDORS' SHARE OF REGIONAL SEMICONDUCTOR MARKETS, 1991

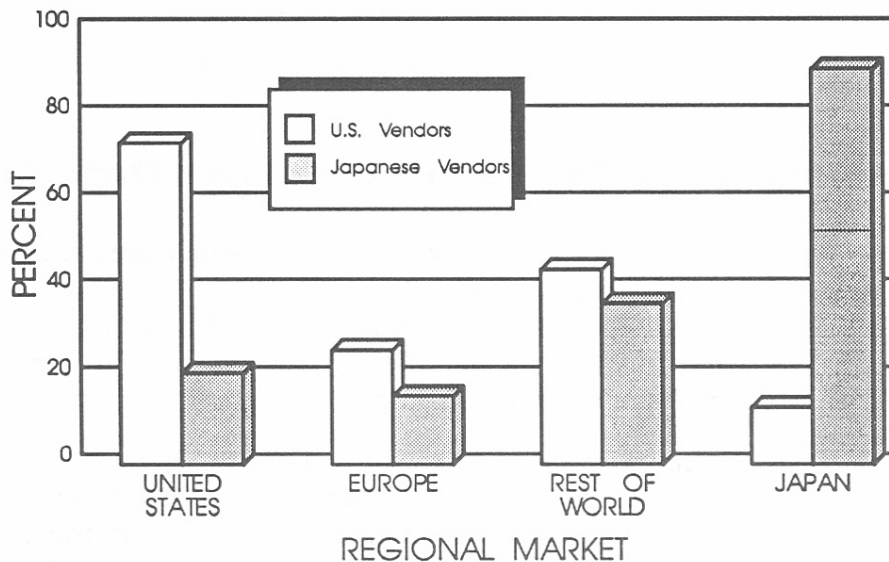


Figure 5. U.S. vs Japanese penetration of various makers.

manufacturer. In some cases, a manufacturer may own a subsidiary or division that manufactures a component "in house" while a competitor must procure from outside the U.S. An attempt was made to list the components below in a descending order of percent of volume from foreign sources.

Category 1—Foreign dependency on Class 5 switch equipment components

- a. Printed circuit board (PCB) mounted transformers
- b. Plastic coated relays
- c. PCB assemblies
- d. Ceramic packages used for ruggedized semiconductor components
- e. Bare PCBs (fiberglass substrate)
- f. Ferrite products
- g. Semiconductors (high-capacity memory chips and microcontrollers).

Category 2—Foreign sourcing of materials and technology used in the manufacturing process for the Class 5 switch

- a. Consumables (petrochemical-based items such as solvents, solder paste, adhesives, etc.)
- b. Raw Silicon (silicon ingots or wafers)
- c. Manufacturing Process Equipment (primarily for the microelectronic manufacturing process)
- d. Photolithography Equipment and Technology
- e. Metals (such as copper, aluminum, gold, silver, and zinc).

7.1 Factors That Affect Levels of Foreign Dependence

Foreign source dependencies in the areas discussed in this study are generally a result of a U.S. company's inability to compete with foreign companies. The answer is not obvious. However, some of the experts contend that U.S. companies, Pacific Rim companies, and European companies are competing on an "uneven playing field." A conspectus of the reasons why U.S. companies are not able to compete follows.

Technology outflow. Commonly referred to as "technology giveaway." A number of examples can be cited illustrating the acquisition of technology by organizations outside the U.S., resulting in a loss of technology and subsequently a loss in the U.S. lead in the system level technology development. A study completed by the Institute for Defense Analyses (IDA) in 1990 (Heginbotham et al; 1990) summarizes the situation very well. The

IDA report states that "dependence on foreign sources should be viewed less in terms of risk of potential foreign denial or disruption, and more in terms of risk of U.S. ability to remain in the lead in system development."

Environmental Protection Agency (EPA) requirements. Many of the countries that are competing successfully (offering components at lower cost) do not have the same restrictions on procedures such as toxic waste disposal, disposal of solvents and other chemicals, safety of employees, etc. that inflate the overhead of doing business in the U.S. The additional overhead must be reflected in the cost to produce the product (DoC, 1992).

Tax laws. Most companies operating in countries outside the U.S. are subject to more favorable tax depreciation limitations than companies in the U.S. For example, a U.S. manufacturer must depreciate a capitalized asset (in this case a factory production line) in no less than 7 years, and there is no Initial Tax Credit (ITC). A foreign counterpart (competitor) can depreciate the full capitalized asset value the first year (similar to a 100-percent ITC), or over whatever period provides the greatest tax benefit. The telecommunications equipment technology turnover (a combination of product technology enhancement and factory automation enhancement) is about 18 months, at present, requiring recapitalization of the production line every 18 months. As a result, the U.S. manufacturer is not able to take full advantage of the depreciation tax benefit.

A similar situation exists for the user of telecommunications equipment (e.g., a Class 5 switch). A major feature turnover (similar to a technology turnover) or upgrade is necessary on a 4- to 6-year cycle. The user is obliged to upgrade to keep up with the latest technology, and remain competitive. Tax law allows the user to depreciate the equipment over no less than 15 years. Recapitalization is required at every major upgrade (major expenditure), or every 4 to 6 years. The end user is in a similar predicament to that of the factory; the full advantage of tax depreciation cannot be realized.

The "hot toy" problem. Commercial products have become increasingly more "high-tech," and frequently use the same type of electronic devices [e.g., microprocessors, memory chips, digital signal processors (DSPs), and displays] that are used in the latest technology telecommunications equipment. Manufacturers of these products compete for the supply (and inventory) of these devices throughout the year. Usually distributors and manufacturers of these devices can factor in the inventory required to supply all of the demand requirements. However, at certain times of the year the demand for these devices is increased to meet the seasonal requirements—for example, during the late summer the decisions are made as to which toys and other commercial products will be "hot items" during the holiday shopping period (December-January). Inventories during this period become very low, or in some cases, may be depleted. If a sudden demand, due to a disaster or hostile activity, for more telecommunications equipment or spare parts coincides with the "hot toy" manufacturing period, the telecommunication production requirement may not be met. Certain manufacturers have stated that their manufacturing process has been affected by a "glitch" of this type in the supply system.

8. CONCLUSIONS

The objectives of this report were developed in response to the NS/EP needs of the Government, including NS/EP telecommunications equipment provisioning, and the resolution of any provisioning conflicts. A significant percentage of dependence on foreign sources, for any component or subassembly, has been identified by the NSTAC to be an area of possible provisioning conflict. The authors of this report recognize that national security emergencies can be vastly different in terms of scope and magnitude. Some may place an intense, short-term demand on a few production sectors while others may require a major mobilization of the entire U.S. economy. Defining the situations relative to the causes for mobilization is not included in the tasking for this study.

The objectives, as defined by the tasking for this study, were twofold: (1) Develop an assessment of the current state of foreign source dependence within the telecommunications manufacturing area, and (2) develop an assessment mechanism that could be used for a periodic update of foreign source dependence. The general conclusions that have been developed, as a result of this study, are presented in the context of the two objectives as follows.

Objective 1—Status of Foreign Source Dependence. When compared to the result of the 1987 report (NCS, 1987), the results of this study can be summarized as stated below:

- The level of dependence on semiconductors from foreign sources to manufacture high-end (i.e., Class 5 switch systems) telecommunications equipment has diminished. U.S. manufacturers have the capability to manufacture all types of microelectronic devices (i.e., memory devices, ASICs, microprocessors, microcontrollers, etc.) in prototype quantities. However, the Pacific Rim countries continue to supply a larger share of the large-capacity memory devices and microcontrollers.
- In most cases, there are U.S. companies that have the capability to manufacture all of the stated foreign source dependent components; however, they are not currently competitive in supply of volume quantities of these components.
- The dependence on consumables, or the raw materials to manufacture them, is an area that wasn't completely analyzed in this study. Preliminary studies show that some of these items are dependent upon the supply of petrochemicals from outside the U.S. A more in-depth study of this problem is needed.
- The market in which our telecommunications companies are working is becoming global. U.S. suppliers are pursuing partnerships and agreements with foreign entities, making it impossible to recognize whether one is dealing with a U.S. or a foreign company. Figure 6 illustrates, in a simple way, the merging of U.S. and foreign organizations to form a global market. This trend is most prevalent in the semiconductor market, especially for high-end microelectronic devices. This trend will mitigate the risk of a semiconductor foreign source dependence problem.

THE SEMICONDUCTOR WORLD OF PARTNERSHIPS/AGREEMENTS

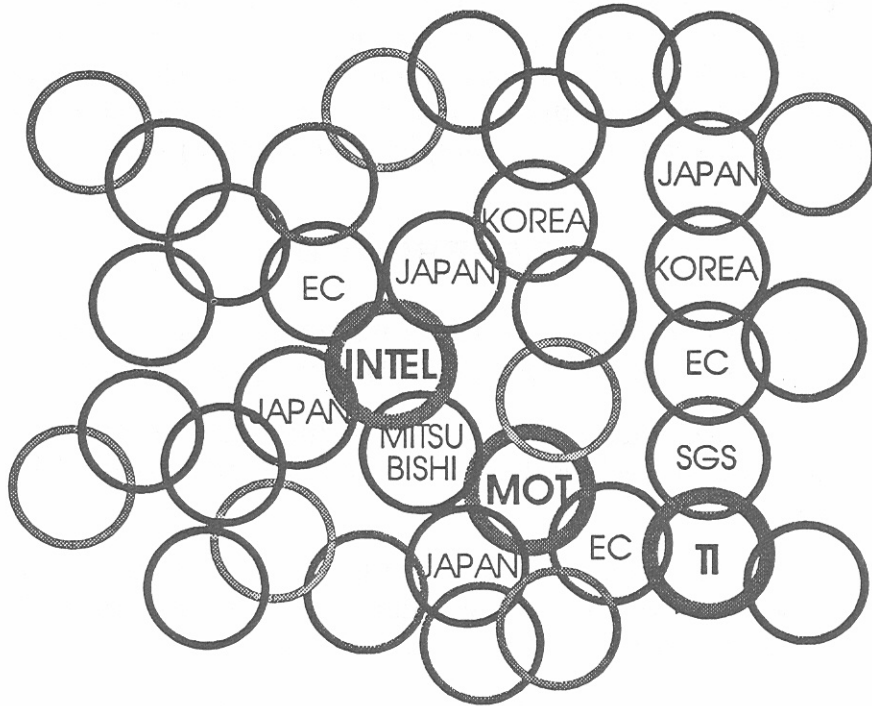


Figure 6. The semiconductor company global alliances.

Objective 2—The Assessment Mechanism. The authors of this study have concluded that the mechanism used to perform this analysis is a successful method to perform the assessment of dependence on foreign sources. The success is attributed to the following factors:

- A research-oriented approach was used to obtain the raw information. An in-depth understanding of the company's process and the telecommunications equipment is necessary to determine which items are truly dependent on foreign sources and why. The transfer of information was done face-to-face, rather than solely via a surveyor questionnaire. A technical understanding is important, so that during the interview of the manufacturer's representatives, an in-depth discussion can take place concerning technical aspects of the product hardware. A structured approach is necessary when interviewing the company representatives. The representatives were furnished with advance information about the visit (i.e., a set of questions to introduce them to the kind of information desired). This technique ensured that the appropriate personnel were made available during the on-site visit.
- Companies released guarded information. A typical telephone survey or mail survey of industry is not effective in identifying true item dependency. Procurement information is considered sensitive, and for some companies, company proprietary because the knowledge of this information by a competitor

could compromise their position in the marketplace. Face-to-face interviews with industry representatives allows the researcher to explain the benefits of the foreign dependence study to the Nation, and to build a rapport with the company personnel (by demonstrating a knowledge of their product, their company, and a concern for the country). The confrontation usually results in release of information that would otherwise not be made available. The research process can be a very complex and delicate process.

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