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(6) INDUSTRIAL PREPAREDNESS IN AN ARMS CONTROL ENVIRONMENT;

A STUDY OF THE POTENTIAL IMPACT OF SHARP INCREASES IN MILITARY PROCUREMENT.

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VOLUME I.

SUMMARY REPORT.

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PREFACE

This is a summary of the full report of a study of the U.S. industrial preparedness system against the background of arms control programs, which was carried out by Arthur D. Little, Inc., under contract with the United States Arms Control and Disarmament Agency between March 7 and November 6, 1974.

The study appears to be the pioneering effort in examining possible relationships between the Government's capacity to mobilize U.S. industry through the Defense Mobilization System and the evolving activities and responsibilities of the Arms Control and Disarmament Agency. It is believed ~~to be methodologically~~ innovative in its use of economic input/output techniques integrated with detailed industry-centered, and weapon-system-centered, studies to gauge the likely impact of sharp increases or decreases in defense procurement on the U.S. industrial system.

The study ~~also~~ pulls together on an unclassified basis a comprehensive, quantitative and qualitative description of current U.S. defense production and procurement programs, covering both conventional and strategic weapon systems. As such, the full report of the study has an encyclopedic aspect that should prove to be useful to analysts in fields other than arms control and preparedness planning.

CONTENTS

I. INTRODUCTION

Arthur D. Little, Inc., (ADL) has recently completed an eight-month exploratory study of U.S. industrial preparedness in an arms control environment, under a contract with the United States Arms Control and Disarmament Agency (ACDA). The backdrop for the study is the international environment in which arms control measures are gradually evolving. Against this backdrop, the fundamental objective of the study was to make an independent appraisal, from the point of view of ACDA, of the present system of U.S. industrial preparedness.

The methodology adopted, evolved after rather extended examination of alternatives, was to concentrate on defining the critical parameters of decisions about industrial preparedness, on examining systematically the interplay of these parameters in an industrial mobilization effort, and on putting the results of the study in a form useful in follow-on analyses in which specific mobilization scenarios related to specific assumed military or diplomatic events could be examined.

II. PRINCIPAL CONCLUSIONS

The principal conclusions validated by the analysis are as follows:

A. U.S. INDUSTRIAL MOBILIZATION CAPABILITY

In sheer physical terms, the capacity of the U.S. industrial economy to supply the goods and services which would be called for by a mobilization at almost any conceivable scale over the next decade, is overwhelming. Weapon system procurement at the 1974 level of less than $20 billion takes place in an economy where the Gross National Product this year will be on the order of $1,370 billion. Weapon system procurement thus represents less than a 2% share. Expanding this share many times over in a mobilization effort would, at first glance, appear to present few problems.

However, as the macroeconomic analysis of the test case demonstrates--and the industry-by-industry, system-by-system studies confirm--even a simple doubling of conventional weapon system procurement in 1975 accompanied by accelerated RDT&E and deployment schedules for key strategic systems would very seriously strain capabilities in aircraft and shipbuilding final assembly, as well as in certain segments of the electronics, castings and forgings, and machine tool supply industries. Such an effort would also encounter bottlenecks in non-ferrous metal production and, in some regions of the country, in the capacity of the construction industry. Other regionally-oriented bottlenecks might also appear in industries which, on a national basis, would have adequate capacity.

The limited mobilization of the test case would, in addition, have undesirable secondary effects under presently foreseeable conditions in the U.S. economy: heightened inflation, pressures to restrict exports, and competition for capital goods needed to deal with critical structural changes in the economy, such as in the energy field. The possibility of a resort to allocation of key items or materials, employing the legal powers of the Defense Production Act and related legislation, would have to be faced. Reluctance of producers to sacrifice relatively profitable civilian business for the uncertainties and narrow margins of defense orders would be a factor. Were the scale of the mobilization increased, or its schedule compressed, the analysis

suggests that most of the strains and secondary effects would be made more severe.

On the other hand, the analysis also suggests that, having passed through the uncomfortable first few years of a mobilization scaled like that of the test case, the economy--and even the overstressed key industries--would find a new equilibrium, with expanded capacity; and inflationary pressures--from this source at least--would subside. The disturbing effects are thus seen primarily as short- rather than long-term in their undesirable consequences.

It appears that the sharpness of a significant step-up, even if the step-up is maintained for a year or two, would be a factor in causing adverse economic side effects. However, significant step-ups maintained for several years may have less adverse effects if initiated more gradually.

In the event that a demobilization effort were to occur as abruptly as the mobilization effort arose, the impacts would, as in the case of mobilization, vary according to the size and rate of change. The test case effort consists of roughly a 20% annual increase in procurement over the base case. This magnitude does not appear to be large enough nor rapid enough to create any major economic problems in the event of even a rapid cutback to the base case.

On the other hand, a number of lingering benefits could be derived from a modest mobilization and a phased demobilization. One benefit would be the additional capacity in currently constrained industries which would be created by the military buildup. Another benefit could be that the mobilization effort would put the economy on a long-term, upward business trend, thereby creating jobs and additional income that would carry over even beyond the demobilization period. The realization of this benefit would depend, to some extent, upon the timing and duration of the phase-out of additional military procurement.

The timing of the mobilization--i.e., at which point in the national economic cycle it occurs--is also a key variable in determining the extent and kind of both macroeconomic and industrial impacts, since the availability or lack of spare capacity will condition the reaction of suppliers of all kinds.

B. THE SIGNIFICANCE OF SOCIOPOLITICAL FACTORS IN MOBILIZATION

While the focus of the study was on the macroeconomic and industrial production parameters of mobilization, it was necessary to take account of other factors. For example, many of the constraints that would make difficult a limited mobilization such as that envisioned in the test case would be eased or removed in a large-scale mobilization such as that which preceded World War II when the society as a whole--after initial doubts--perceived the situation as one posing a fundamental challenge to national survival. The determining factor would be, of course, not the scale of the mobilization but the motivation for it. In fact, increasing the scale of a mobilization much beyond that of the test case in the absence of compelling psychological motivation affecting a very wide segment of the population appears likely to be nearly unmanageable in the kind of society into which the U.S. has evolved over the last decade.

Interviews in the study indicated, for example, that a broad segment of industrial and labor leaders would be reluctant to modify existing operations to accommodate a mobilization program unless there were a clear, widely accepted "national emergency". Many said that they would have to perceive and evaluate the threat for themselves regardless of Presidential or DOD announcements. This attitude exists today even among executives with a lifetime commitment to defense production and personal experience as high-ranking DOD officials. One can speculate that it stems from a combination of factors in recent history--the Vietnam War, disenchantment with what is seen as the cyclical nature and low profitability of defense production, and the attractiveness of civilian markets which have until recently been booming.

These considerations, coupled with the fact of current negative public attitudes toward increased military expenditures; toward increased taxation or decreased welfare expenditures; and toward rationing, allocation or price controls make it foreseeable that a sharp increase in defense spending is likely to be more disturbing and hence likely to meet more opposition in the near future than at any other time in recent history. Observing these facts emphasizes their significance as a basic constraint on the mobilization process: social and political conditions act as productivity factors in the economic system and influence the feasibility of mobilization in other ways as well.

C. THE SIGNIFICANCE OF THE INTERNATIONAL SETTING IN WHICH MOBILIZATION IS BEING CONSIDERED

Another constraint both on freedom to take mobilization action and on the effectiveness of mobilization itself to which the analysis in the study directs attention is the international setting in which the mobilization is assumed to take place. Factors in international relations may, in fact, foreclose the option of making mobilization more effective through diffusing among the affected public the leadership's perception of a serious threat to national security or survival. For example, under some circumstances to do so would simultaneously be provocative to the source of the threat, increasing the risk of conflict escalation. Potential side effects of mobilization, such as restrictions on exports to friendly countries or preclusive buying of scarce materials or energy resources may also be so serious in terms of the impact on alliances or trade as to require abstention from or unwanted moderation in mobilization measures.

D. THE SIGNIFICANCE OF LEAD TIMES

Another set of basic constraints on the pace and scale of mobilization which is identified in the study lies in the massive administrative effort and paperwork of the defense appropriation and procurement process itself, the RDT&E lead times involved in moving to new or modified complex weapons or weapon systems, and the extended supply purchases and assembly periods required in the production of newly-ordered major items such as nuclear propulsion reactors, ships, or strategic missile-launching platforms. These constraints will operate quite independently of the scale of the mobilization and can be relieved only after the passage of one or more years following the decision to move from one level of production, or one system design, to another.

The time necessary for first delivery of additional units of a weapon system beyond current delivery rates generally cannot be shortened significantly by greater expenditures and even by the utilization of Defense Production Act compulsory powers. This is so because the effort to manufacture a modern weapon system such as fighter aircraft or missiles requires the coordination of hundreds or thousands of suppliers. To double the monthly delivery rate under the best of conditions would take roughly one year for tanks, two or more for aircraft and missiles, and even longer for

ships. It is apparent, therefore, that a large [illegible], unless it lasted a minimum of one year, or even two to three years, would have to be fought largely with inventory in existence at the time the war started.

E. REQUIREMENTS FOR IMPROVEMENT IN MOBILIZATION CAPABILITY

As noted, U.S. mobilization capability is physically overwhelming but is hedged about with constraints, only some of which can be relieved by administrative action such as the "Trigger Order" program for machine tools and well-planned stockpiling of materials and standard components. The study's conclusion on this aspect of capability is that the standby system for mobilization is reasonably well-conceived, organized and staffed and that, at most, only interstitial improvements are required. There do appear, however, throughout the analyses of industry, indications of directions in which mobilization management could move to avoid, or reduce the severity of, foreseen constraints.

The more important, and ineluctable, constraints on mobilization capability appear to lie, on the other hand, in areas outside the limits of mere administrative reform or production management, in the realm of Presidential crisis leadership, diplomatic policy-making, and long-range economic planning. Recommendations for mobilization strategy in these areas are largely beyond the reach of a scenario-free analysis and can be produced best in the context of an assumed situation specific as to time of occurrence, international political setting, domestic sociopolitical environment, level and composition of postulated procurement, and state of domestic and international political economies. A recommendation is made for moving on to analyses on these terms.

F. MOBILIZATION AS A TOOL OF ARMS CONTROL SYSTEM MANAGEMENT

The fact that the mobilization mechanism at best is ponderous, with long lead times for achieving strategically significant deliveries, that even a limited mobilization program such as that hypothesized in the test case of the study, while feasible, can send inflationary and destabilizing ripples through the economy, and that both domestic and international sociopolitical side effects of serious

dimensions are foreseeable, suggests that resort to mobilization in response to violation or abrogation of an arms control agreement or as a signalling device/bargaining chip in disarmament negotiation is fraught with far-reaching consequences, not to be lightly dismissed. As in the case of "required" improvements in mobilization capability, however, many of these consequences can be assessed best--and most realistically--within the context of a specific mobilization scenario since their probabilities are intimately dependent on assumptions about the real world in which the mobilization decision is to be made. However, the range of consequences and their potential severity are identified and assessed in parametric terms throughout the study.

G. A NEXT STEP

The study assembles the basic data and demonstrates the techniques that could be the starting point for analyses of specific scenarios involving an arms control problem and a mobilization option. Such analyses, based on the data and methodology presented in the report, could contribute substantially to a better understanding of how mobilization measures could be designed and used, in a real world setting, both to strengthen U.S. security in an environment of controlled disarmament and to influence constructively the bargaining process itself.

III. THE STUDY APPROACH

The basic approach used in this study is "[illegible] analysis", a technique in which important relationships between sharp increases and decreases in military procurement and the functioning of the U.S. economy are identified and quantified where possible[1]. Rather than focus on specific scenarios, the study addresses itself to developing insights of a more broadly applicable nature and to demonstrating techniques that could be used in "testing" specific scenarios in the future.

The major outputs lie in the following areas:

- An approach to systematically analyzing the economic impact of stepped-up defense production efforts;
- Identification of the critical factors (i.e., parameters) that must be considered in an economic analysis of this type;
- An evaluation of industry's ability to respond to sharp increases in military demand; and
- Identification of the impacts which a step-up of military procurement in a short period of time would have on the U.S. economy.

In order to analyze the relationship between military spending and the U.S. economy the problem is put in a systems analysis framework. The system is the U.S. economy. The analysis consists of identifying the possible bottlenecks and significant impacts that are likely to be generated by an event outside that system--sharply increased military procurement.

Although a primary objective is to explore the probable economic impacts of various courses of action, the system that is being analyzed must be described in more than strictly

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[1] Throughout the study the terms "sharp increase in military procurement" and "mobilization" are used interchangeably. There obviously can be many degrees and variances of each. In the test case the study hypothesizes a mobilization far short of the World War II dimension, even though it is scaled to a level that would put considerable stress on the economy.

economic terms. For instance, sociopolitical factors such as society's willingness to support a decision to step-up defense production must be given consideration if one is to test realistically the impact of mobilization on the system.

The basic question can be restated as follows:

- Given:
  - (a) the status of the U.S. economy;
  - (b) the status of specific defense-related industries;
  - (c) the status of specific weapons systems;
  - (d) the domestic sociopolitical environment;
  - (e) the international environment; and
  - (f) the legal and administrative mechanisms for mobilization.
- What constraints would this group of parameters impose on the desired degree of mobilization; and
- What impact would the step-up have, in turn, on the status of the U.S. economy?

The study selects a hypothetical case which can be considered as conceivable and sufficiently intense so as to strain the system to the level where many of its "bottlenecks" become apparent.

The analysis is divided into three parts, reflecting three perspectives on the problem. The first considers the impact of a step-up on the U.S. economy from a macroeconomic perspective. The second part of the analysis considers the impact of a step-up on the major defense industries in the United States from a microeconomic perspective. The third part focuses on production and development problems and lead times for key weapon systems. As shown in Table 1, the program acquisition costs of weapon systems analyzed in the study represent more than 80% of the costs of all key weapon systems currently in procurement.

TABLE 1

PROGRAM ACQUISITION COSTS OF WEAPON SYSTEMS ANALYZED

	FY '74		FY '75 Request	
	Total ($ Billion)	Analyzed In Study (%)	Total ($ Billion)	Analyzed In Study (%)
Strategic Weapon Systems	3.4	95	3.6	95
Minuteman Missile Poseidon/Trident Missile and Submarine B-1 Bomber MARV Safeguard/Site Defense				
Conventional Weapon Systems	12.0	80	12.3	77
Aircraft	4.6	65	4.7	75
Tactical Missiles	1.0	50	1.5	67
Ships	2.7	95	2.2	55
Land Vehicles	0.3	95	0.3	75
Total	15.4	84	15.9	81

Source of cost data: DOD in Program Acquisition Costs by Weapon System (FY '75)

IV. THE BASE CASE

A. CRITICAL PARAMETERS

The setting for the study may be thought of as the initial condition of the system before it is impacted by an exogenous force, stepped-up defense production. The initial condition of the economy in 1974 as projected out to 1980 without a special step-up is the case against which alternative scenarios can be evaluated. In the study the focus is on the U.S. economy but, as noted, the base case must be described in more than strictly economic terms.

The factors used as the critical parameters were selected on the criterion that they are either (a) conditions that could significantly influence the impact that a stepped-up defense production effort would have on the U.S. economy or (b) conditions which are likely to be substantially altered as a result of a step-up.

All parameters were not given equal attention. The status of the economy, of defense industries and of specific major weapons systems were investigated more closely than other parameters.

B. STATUS OF THE U.S. ECONOMY - AN OUTLOOK TO 1980

A projection of the U.S. economic outlook to 1980 forms the economic base case. It is derived primarily from the ADL input/output forecasting model and the judgments of ADL professional staff. Included is the important assumption that unforeseeable future international political and economic events will not influence the economic environment of the United States as presently forecast to any substantial degree[1].

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[1] This assumption is necessary for purposes of analysis even though it may not be entirely realistic. It is not possible, however, to predict short-range phenomena of the types excluded by this assumption with sufficient confidence to provide a basis for analysis. Hence, if such an analysis is to be used as a basis for policy decisions, the existing international environment must be kept under close surveillance and the forecasts modified accordingly.

Annual real growth of the U.S. economy for the remainder of the 1970's is forecast to average 3.7%, well below the real growth rate of 4.5% during the 1960's. This growth rate assumes a gradual recovery from the 1974 supply-induced economic recession. Table 2 presents a summary of the GNP forecast which constitutes the base case. Table 3 contains the assumed levels of national defense budget outlays through 1980.

The impact that defense expenditures have on an economy depends, in part, on the industries called upon to produce defense goods and on the configuration of the country's industrial structure. These considerations are incorporated into the analysis in the form of procurement coefficients and interindustry input/out tables. Table 4, derived from the input/output analysis, presents the percentage of total production in each industry in 1974 that will be produced directly or indirectly for defense procurement programs. Table 5 summarizes the forecast rates of growth for the industries in Table 4.

The base case assumes that the United States Government will maintain its present policy with respect to the stockpiling of critical imported raw materials. It is anticipated, however, that some materials in the stockpile will be sold in open markets periodically throughout the forecast period.

C. STATUS OF SPECIFIC DEFENSE-RELATED INDUSTRIES

The ability of the nation to respond successfully to increasing defense expenditures depends greatly upon the capabilities of the defense production structure.

The final assembly producers are the aerospace[1], shipbuilding, motor vehicle, and weapons and munitions industries. Except for the shipbuilding industry, the final assembly industries are presently operating at below average rates of capacity utilization. In aerospace and weapons and munitions this is primarily due to the recent declines in military equipment expenditures. The motor vehicle industry, unlike the other final assemblers, depends very little on

[1] Fundamentally, the aerospace industry includes aircraft and parts of the ordnance industries.

TABLE 2

BASE CASE FORECAST OF GNP AND ITS COMPONENTS
(Billions of 1974 Dollars)

	1973	1974	1975	1976	1977	1978	1979	1980	Annual Growth Rate 1974-1980
GNP[1]	1394.8	1378.5	1419.6	1467.3	1514.4	1572.6	1640.3	1712.0	3.7 %
Personal Consumption Expenditures	879.5	876.5	903.6	926.9	959.3	995.8	1035.6	1077.0	3.8
Gross Private Domestic Investment	218.4	203.9	215.0	224.9	233.3	242.4	252.1	261.9	4.3
Non-Residential	139.8	146.2	152.3	159.1	164.0	169.2	174.2	181.1	3.6
Structures	47.1	50.0	51.9	54.6	56.3	57.7	59.2	61.3	3.5
Producer Durable Equipment	92.7	96.2	100.4	104.5	107.7	111.5	115.0	119.8	3.8
Residential	63.0	46.9	52.2	54.8	57.5	60.4	64.9	67.8	6.4
Inventory	15.4	10.8	10.5	11.0	11.8	12.8	13.0	13.0	
Net Exports	-5.4	-7.5	-10.1	-4.2	-1.0	0	+2.0	+3.0	
Exports	110.8	120.5	119.9	129.7	135.2	140.1	143.4	146.0	2.2
Imports	116.2	128.0	130.0	133.9	136.2	140.1	141.4	143.0	1.9
Government Purchases	302.5	305.6	311.1	319.7	322.8	334.4	350.6	370.1	3.2
Federal	114.4	114.4	115.2	117.4	118.7	21.4	124.6	128.7	2.0
Defense	78.2	77.4	77.6	78.8	80.1	81.8	83.4	85.1	1.6
Non-Defense	36.2	37.0	37.6	38.6	38.6	39.6	41.2	43.6	2.7
State & Local	188.1	191.2	195.9	202.3	204.1	213.0	226.0	241.4	4.0

Source: ADL Input/Output Model

[1] GNP as estimated in mid-1974; later estimates have a somewhat more pessimistic tone with respect to the short-term economic growth rate.

TABLE 3

ASSUMED NATIONAL DEFENSE BUDGET OUTLAYS FOR THE BASELINE CASE
(Billions of 1974 Dollars)

NATIONAL DEFENSE	1973[1]	1974	1975	1976	1977	1978	1979	1980
DOD: Military								
Military Personnel	23.2	24.1	24.1	24.1	24.5	25.0	24.4	26.0
Retired Military Personnel	4.4	5.1	5.1	5.1	5.2	5.3	5.4	5.5
Operation and Maintenance	21.1	23.3	23.3	23.3	23.7	24.2	24.7	25.2
Procurement	15.7	15.1	15.5	15.9	16.1	16.4	16.8	17.1
Aircraft	4.4	4.4	5.1	4.8	4.9	5.0	5.1	5.2
Missiles	3.2	3.3	2.7	3.1	3.2	3.2	3.3	3.4
Weapons and Tracked Vehicles	.2	.3	.8	.4	.4	.4	.4	.4
Ships	2.0	2.0	2.2	2.2	2.3	2.3	2.3	2.4
Ammunition	1.1	1.0	1.0	1.1	1.1	1.1	1.1	1.2
Other[2]	4.8	4.1	3.7	4.3	4.3	4.4	4.5	4.6
Research and Development	8.2	8.4	8.3	8.5	8.7	8.9	9.0	9.2
Military Construction and Other	.9	2.4	2.0	1.9	1.9	2.0	2.0	2.0
Allowances[3]	-	.1	1.9	.7	.8	.8	.8	.8
Deduction for Offsetting Receipts	- .1	- .2	-	-	-	-	-	-
Subtotal:	73.3	78.4	80.2	79.5	80.9	82.6	84.1	85.8
DOD: Other[4]	2.7	2.2	2.7	2.7	2.7	2.8	2.9	2.9
TOTAL NATIONAL DEFENSE	76.0	80.6	82.9	82.2	83.6	85.4	87.0	88.7
Number of Active Military Personnel (thousands)	2,324	2,218	2,137	2,100	2,050	2,000	2,000	2,000

[1] 1973 figures are presented in 1973 dollars; all others are in 1974 dollars.

[2] Includes electronics and communications and other support equipment such as tactical support vehicles.

[3] Includes allowances for All-Volunteer Armed Forces, military retirement systems reform, and civilian and military pay raises for DOD.

[4] Military assistance, atomic energy, etc.

Source: The United States Budget, FY 1975.

TABLE 4

U.S. INDUSTRIES WHICH SUPPLY DIRECTLY AND INDIRECTLY AT LEAST 1% OF THEIR 1974 DOMESTIC PRODUCTION TO THE DEFENSE PROCUREMENT CATEGORIES[1]

(based on 1974 procurement levels, in percentage form)

Industry	Missiles	Ships	Tanks	Ammunition	Aircraft	Other	Total
Ordnance	15.1	1.2	x	12.6	3.1	11.7	44.2
Ships	x	38.1	x	x	x	1.4	40.0
Aircraft	5.8	x	x	1.2	16.5	1.8	25.7
Communication Equipment	8.2	2.5	x	1.0	5.1	7.3	24.1
Machine Shop Products	4.1	1.1	x	2.9	3.2	4.0	15.3
Eng. & Lab. Instruments	1.3	x	x	x	9.5	1.3	13.2
Other Non-Ferrous Metals (silicon, titanium, uranium)	2.0	x	x	x	4.3	1.8	9.5
Resistors, Transformers	2.3	x	x	x	2.1	2.6	7.9
Dies, Accessories	2.3	x	x	x	2.1	2.1	7.2
Lead	1.2	1.2	x	x	2.3	1.4	6.5
Electric Motors	1.0	x	x	x	1.5	2.9	6.5
Machine Tools - Cutting	2.5	0.9	x	x	1.1	1.5	6.3
Semi-Conductors	1.2	1.2	x	x	2.3	1.4	6.5
Zinc	1.1	x	x	x	1.9	1.6	5.9
Engines & Turbines	x	2.7	x	x	x	2.3	5.6
Non-Ferrous Mining	1.1	x	x	x	1.7	1.5	5.6
Machine Tools - Forming	x	1.0	x	x	x	3.0	5.5
Aluminum	1.1	x	x	x	1.6	1.5	5.3

(cont'd)

x Less than 1%.

[1] See footnote on page

TABLE 4 (Continued)

Industry	Missiles	Ships	Tanks	Ammunition	Aircraft	Other	Total
Mechanical Meas. Instr.	x	x	x	x	1.9	1.9	4.4
Iron Ore Mining	x	0.9	x	x	1.0	1.6	4.4
Pumps	x	2.6	x	x	x	x	4.2
Copper	x	x	x	x	1.0	1.2	4.2
Fabricated Platework	x	3.5	x	x	x	x	4.2
Material Handling Equip.	x	x	x	x	1.1	2.4	4.0
Electronic Tubes	1.1	x	x	x	1.1	1.2	4.0
Valves, Pipe Fittings	x	1.5	x	x	1.1	x	4.0
General Ind. Machinery	x	1.1	x	x	0.9	1.2	3.9
Stamp., Mach. Prods.	x	x	x	x	x	1.5	3.8
Intern. Comb. Engines	x	x	x	x	x	2.4	3.8
Iron & Steel	x	x	x	x	x	1.3	3.6
Motor Vehicles	x	x	x	x	x	3.0	3.3
Metal Work Equip.	x	x	x	x	x	1.9	3.1
Hardware, Plating	x	x	x	x	x	1.2	3.0
Elec., Lighting, Wiring	x	x	x	x	x	1.1	2.8
Miscellaneous Rubber Prods.	x	x	x	x	x	1.1	2.6
Truck Bodies	x	x	x	x	x	1.0	1.2

x Less than 1%.

FOOTNOTE FOR TABLE 4

The data presented in this table indicate the relative share of various industrial sector's domestic production purchased directly and indirectly in each of the major Department of Defense procurement categories. These estimates have been derived from relationships contained within the ADL input/output model supplemented by additional information by the (then) Office of Emergency Preparedness and Research Analysis Corporation. Because of definitional and industrial classification practices associated with input/output tables and a lack of recent sufficiently-detailed public data, certain estimates contained in this table may vary from those published in trade and industry information sources. The case in which this discrepancy is most apparent is in the aircraft industry. In input/output terms, this industry includes only those establishments whose primary activity is aircraft manufacture. Traditionally, industry analysts will define military aircraft manufacture within the aerospace industry which would also include certain portions of the communications equipment and ordnance sectors. In input/output terms, these two industry sectors are separately identified. As a result, the table indicates that approximately 26% of the aircraft industry's production is sold directly and indirectly to the Department of Defense. On the other hand, industry spokesmen often cite a higher estimate of aerospace sales to DOD. If indeed the data in the table were transformed to comply with traditional industry concepts, certain percentages of the ordnance and communications equipment industries' sales to DOD would be combined with aircraft's 26% to yield an estimate that is much greater. One of the prime strengths of an input/output table and approach to an impact analysis is that it offers substantial industry detail on the flow of goods and services among very interdependent sectors. Often such data require careful interpretation, especially when compared with other informational sources.

TABLE 5

BASECASE PRODUCTION GROWTH RATES FOR THE MAJOR INDUSTRIAL PRODUCERS OF DEFENSE-RELATED EQUIPMENT

Industry	Annual Industrial Growth Rates 1974-80	1974-77
Ordnance	1.6	1.7
Ships	4.7	5.7
Aircraft	3.2	3.5
Communications Equipment	4.9	4.8
Misc. Non-Elect. Machine Shop Products	3.3	2.7
Eng. & Lab Instruments	4.5	4.2
Other Non-Ferrous Metals (Silicon, titanium, uranium)	3.9	3.5
Resistors, Transformers	2.9	2.6
Dies, Accessories	3.7	5.0
Lead	1.8	1.7
Electric Motors	3.7	3.7
Machine Tools - Cutting	4.4	5.0
Semiconductors	9.5	8.8
Zinc	2.2	2.1
Engines & Turbines	4.7	4.2
Non-Ferrous Mining	4.3	4.0
Machine Tools - Forming	4.1	4.8
Aluminum	5.3	4.9

defense contracting for its business. However, it is because its commercial business is depressed that there is significant excess capacity. The short-term economic outlook for these industries does not suggest any significant increases in their commercial markets.

Since the passage of the Merchant Marine Act in 1970, the shipbuilding industry has grown rapidly. Presently, the yards are producing at historically high levels with employment levels at the yards at post-World War II highs. Further, the high level of presently unfilled contracts suggests continued vigorous growth for the industry.

The supply industries consist of the electronics, machine tool, chemical, primary metal and energy industries. The ability of these industries to respond to increasing defense expenditure is extremely varied.

Due to the increased sophistication of military equipment, the electronics industries have become key suppliers in the military-industrial complex. The electronics industries consist of two distinct sectors--the equipment manufacturers (e.g., communication equipment) and the component manufacturers (e.g., semiconductors). Since the late 1960's both sectors of the electronics industries, particularly the components sector, have successfully increased the commercial markets for their high-technology production. Consequently, they have become less dependent upon defense contracts for their economic viability. Commercial markets are more profitable and the industry has recognized the commercial markets to be a key to continued growth. A hallmark of the electronics industries has been vigorous growth associated with rapid increases in productivity. The rapid rises in the demand for electronics production has created strains on the physical capacity within certain sectors of the industry. Also, recent chronic shortages of many critical materials have effectively limited the productive capabilities of the industry.

Presently, the machine tool industries are undergoing a boom, primarily because of the large demand for capital equipment in the United States. The production of machine tools utilized in defense production comprises less than 7.5% of the market. Lead times for machine tool deliveries are very long. The industry is operating at high levels of capacity, but increasing production is primarily hampered by a shortage of skilled labor.

The productive capabilities of the primary metals industries were pushed to their limits in 1973. A slack in demand for metals has begun to occur in 1974, although recent capacity increases within the industries have not been great. Numerous sectors of the commercial market are still having difficulty obtaining the appropriate amount of metals. The requirements for defense production are for the more sophisticated types and forms of primary metal products. Still, defense-related production does not comprise a large percentage of metal production in the United States.

The chemical industry supplies less than 1% of its production for defense production-related activities. Even a sizable increase in defense production would not normally strain the overall resources of the industry. However, certain specific categories of chemical processing might be strained by an increasing military demand, only because of the present supply shortages which exist in certain segments of the market. In the first half of 1974, there were shortages of organic chemicals such as benzene, toluene, phenol, polyvinyl chloride, and polystyrene, and of inorganic chemicals such as caustic soda, soda ash, chlorine, phosphatic fertilizers, and titanium dioxide. Principal reasons for current shortages have been lack of capacity, raw materials shortages, and the availability of energy, particularly electrical.

The energy industry is facing rising raw material and capital costs, capacity shortages, environmental and safety constraints, and growing oil imports. Only about 1% of U.S. energy goes for defense production and another 1% for peacetime military operations. The price and availability of imported oil is a key uncertainty in the nation's energy outlook.

The support industries considered are the construction and transportation industries. Both of these two industries are dependent upon defense production for a very small portion of their activities. Presently there is slack capacity for most intercity transportation modes, although shortages in part due to inefficient utilization do exist (e.g. railroad boxcars). The construction industry is in a depression. High capital costs and building material shortages are serious problems.

D. STATUS OF WEAPON SYSTEMS DEVELOPMENT

During FY '74 the United States procured major weapon systems valued at $15.4 billion, most of which was produced by the aerospace industry and its suppliers. The estimated acquisition cost of major U.S. weapon systems during FY '74 and requested for FY '75 are summarized in Table 6. The mid-1974 inventory of selected U.S. weapon systems is presented in Table 7.

The time, cost and effectiveness of a step-up in defense production would be significantly affected by several key factors concerning the status of weapon systems. The study assumes that these parameters will have the same value over the remainder of the 1970's as at present. Each parameter has been analyzed on a case-by-case basis for each weapon system. The parameters include the following:

- Position in the development/production cycle;
- Complexity of the weapon system;
- Lead times for tooling up and obtaining inputs;
- In-process and component inventories;
- Willingness to utilize "off-the-shelf" models; and
- Relationship between time, performance, and cost factors.

When weapons are still in the development stage, the time to complete development, design exact specifications, place orders with suppliers, and manufacture is generally several years. Examples of systems still in development are the XM-1 tank, Trident strategic missile, and the B-1 bomber. It may also take a long time to reestablish a supply network for weapons already in operation but no longer being produced. As a result of this time lag, stepping up production of systems currently being manufactured is the most rapid alternative. It generally is easier to step up production when the production level is increasing or at a high level because the prime contractor and its suppliers are experienced and have already committed a great deal of human, tooling, and other resources to the effort. For weapons nearing the end of their production cycle, much of the supply pipeline may be drying up and the effort to expand production would take longer.

TABLE 6

PROGRAM ACQUISITION COSTS OF MAJOR WEAPON SYSTEMS

	FY '74		FY '75 Request	
	Quantity	$ Billion	Quantity	$ Billion
Strategic Weapon Systems	--	3.4	--	3.6
Conventional Weapon Systems	--	12.0	--	12.3
Combat Aircraft and Helicopters	750	4.6	700	4.7
Tactical Missiles	39,000	1.0	57,000	1.5
Combat Ships	14	2.7	30	2.2
Land Vehicles (Tanks)	613	0.3	664	0.3
Total		15.4		15.9

Source: Program Acquisition Costs by Weapon System (FY '75), U.S. Department of Defense

TABLE 7

ESTIMATED U.S. INVENTORY OF SELECTED WEAPON SYSTEMS
(July, 1974)

	Total Inventory	Procurement FY '74	Procurement FY '75 Request
Land-Based Strategic Missiles	1,054	115[1]	61[1]
Submarine-Launched Strategic Missiles	656	<100[1]	0
Strategic Bombers	504	0[2]	0[2]
Combat Aircraft	7,000	500	400
Helicopters	10,000	250	300
Tactical Missiles	300,000	39,000	57,000
Major Combat Ships	250	14	30
Tanks	8,500	613	664

Source: Department of Defense; Institute for Strategic Studies, The Military Balance 1974-1975

[1] Replacing older missiles in inventory.

[2] Excluding B-1 bomber prototypes.

Weapon systems may differ widely in their complexity and the production effort required to make them. Ships, (especially nuclear submarines), strategic missiles and bombers, and air superiority fighters take several years to produce under the best of conditions because the electronics, castings and forgings, and other components are very sophisticated and large in quantity per weapon system. It is difficult to reduce the usual time to produce these systems even if more money and Government compulsory powers over suppliers were made available.

The lead times needed for tooling up are a function of factors such as (a) the existence of underutilized facilities (including unutilized multi-shift potential) for a prime contractor, for alternate primes, and for suppliers, and (b) delivery times for facilities and tooling that are needed to expand existing capacity. Deliveries of long lead time items from suppliers generally take longer then the time for the prime contractor to tool up because there are several hundred suppliers involved which may have their own tooling and supplier problems. Lead times for supplies in 1974 are especially long.

Manufacturers generally have an in-process inventory of partially finished goods and inventories of components, materials, and sub-systems to be used in manufacturing which are somewhat greater than current needs. The component inventories are built up with some excess as a hedge against supply disruptions or inflation. A rapid step up in production could benefit from an accelerated completion of in-process inventory and faster utilization of other inventories. However, this effect of "pumping out" what is already in the supplier "pipeline" is only an initial acceleration of limited dimensions which cannot substitute for the placing of entirely new orders with their lengthy production schedules.

The complexity of modern weapons makes their redesign and testing of the new components quite time consuming. A change in one part may require redesign and testing of several interrelated items. An example is the fact that even a small change in a strategic missile's length, width, or weight would require extensive modifications in its on-board electronics, launch control, and other equipment. Significant changes in components after orders to suppliers have been placed are especially disruptive since it requires

coordination of redesign, production, and testing activity of many organizations. A willingness by the U.S.Government to commit itself to the procurement of weapon system versions which have already been produced would reduce delivery times.

The time to produce a large number of weapons can be reduced if prime contractor and supplier facilities are built up extensively for a large, but short, burst of activity. However, the cost of these redundant facilities will be much higher than if the delivery schedule permitted a gradual build-up followed by extended manufacturing activity with less equipment. There are many such trade-offs between time and cost. Likewise there can be trade-offs between performance and cost. The military requires a very high level of performance and reliability as a minumum. Improving a system's performance from "very high" to "very, very high" may be essential in certain combat situations, yet production time and cost may be increased.

E. THE DOMESTIC SOCIOPOLITICAL SITUATION

The vigor with which the United States can respond to a threat to its national interest, and hence its "preparedness", is not only a function of economic factors but social and political conditions as well. Social and political conditions act as productivity factors in an economic system and are influential in other ways. If the conditions are favorable, the system's capacity and capabilities can be extended a significant amount over what it can produce under unfavorable conditions.

The analysis introduces four factors that can be used to describe the sociopolitical conditions which are pertinent to evaluating the country's capability to absorb a sharp increase in defense spending. These factors include society's attitude toward increased military expenditures, its attitude toward increased taxes or cuts in social programs, society's willingness to experience governmental controls, and politicians' willingness to risk being associated with such efforts.

As a consequence of both the present economic as well as the sociopolitical environment, a sharp increase in defense spending in response to a national emergency is likely to be more disturbing and hence to meet more opposi-

tion than at any other time in recent history. Furthermore, it appears likely that this situation will continue for at least the remainder of the decade. However, if the national interest were very clearly threatened and public opinion became supportive of a stepped-up defense production effort, inflation could be dealt with by wage and price controls and increased taxes; materials shortages could be handled by utilizing existing stockpiles and rationing. The various social priorities, which have become so important, such as improved health programs, energy self-sufficiency, environmental protection, and improved mass transportation could all be held in abeyance for future attention.

F. THE INTERNATIONAL SETTING

In an age when the world is becoming increasingly more interdependent a number of factors which relate to the international setting can be critical in determining the response capabilities of the United States to threats of military hostility. An analysis of the dynamic nature of these external constraints on U.S. mobilization planning is presented in this report.

While the analysis does not explicitly incorporate external factors into the evaluation of the test case, they are important considerations that must eventually become a part of a fully realistic analysis. Among these are:

- The overall state of international relations, which both contains the cause of the mobilization and will also be the source of reactions to it;
- The existing patterns of international treaties, particularly in the arms control field;
- International interdependencies in such matters as the need for critical mineral resources or food.

The scenario-free analysis of the study was not carried to a level of specificity where any of these factors was considered explicitly as a constraint. In a more comprehensive analysis of a specific scenario they would have to be looked into carefully. However, the study contains a suggestive exploration of a number of such possibilities.

G. LEGAL AND ADMINISTRATIVE MECHANISMS FOR INDUSTRIAL MOBILIZATION

For almost three decades, since the closing years of World War II, the U.S. Government has maintained a standby management structure, and the underlying legal framework to enable it to intervene in the economy if necessary to assure priority treatment for defense-related production. The Office of Preparedness, in the General Services Administration, functions as the coordinator of mobilization planning and implementation; the Department of Commerce and the Department of Defense have primary responsibility for the civilian and military sectors. This apparatus has been activated from time to time to break minor bottlenecks in the flow of defense-related production, and during the Korean and Vietnam conflicts, for more far-reaching purposes. Its existence represents a resource in being which can be called upon by relatively routine administrative decisions at subcabinet level if needed in the kinds of industrial mobilization which are considered in this study. It is subject only to the continuing approval of the President and does not require separate Congressional action, at least during the initial stages of a mobilization effort. The Congress, however, has established watchdog procedures to keep these far-reaching powers of the Administration under surveillance and, to put teeth in its surveillance, extends the basic legal authority only two years at a time. It also has established a Joint Committee on Defense Production which holds annual hearings on the Executive Agencies' stewardship with respect to these powers.

The capacity of this standby system to function at a level of activity which would put it under stress has not been tested since the Korean War. The Vietnam conflict, despite its dimensions in other ways, created relatively modest production problems for the U.S. manufacturing and supply economy. Our necessarily cursory review of the administrative system suggests that it has the capacity to react in a timely and comprehensive fashion to almost any foreseeable range of need for priorities and allocations linked to mobilization programs. The regular Congressional reviews of performance and readiness, coupled with occasional special studies which have been initiated by the Executive, indicate the standby managerial and legal machinery for mobilization is not likely

to represent an important constraint in the areas which are the focus of this study. However, in the course of our interviews with officials responsible for maintaining the system, we detected some concerns over divisions of responsibility, possible gaps between agencies, and other indications of a lack of full coordination. We were not, however, in a position to pursue these matters in the present study since they would require a searching and extensive inquiry as a basis for evaluation.

V. THE TEST CASE

A. THE POLITICAL/MILITARY CONTEXT

The political/military context for the economic test case was defined as follows:

During mid-1974, the United States Government perceives a deterioration in the international situation, such as rising tension with the USSR, arms control agreement violations, a growing USSR-PRC rapprochement, or an increasing need to supply allies in the Third World with weapons due to regional rivalries. A re-evaluation is made of the inventory of the most sophisticated strategic and/or conventional weapons systems. The inventory is determined to be inadequate in various serious respects within the new international context.

A decision is made to step-up defense procurement during the coming year. This involves speeding up and raising quantities of deliveries of leading conventional and strategic systems now in production, and accelerating RDT&E and deployment schedules of key strategic systems now under development or for which production has been halted since SALT. War is not perceived to be immediately impending, and economic conditions of mid-1974 exist. In order to analyze stepped-up RDT&E and production schedules for a wide range of strategic systems, it is necessary to assume that the restrictions embodied in the SALT agreements are not in force beyond 1977. Key basic parameters facing American leaders include the overall magnitude of the step-up, the weapon system procurement mix, the delivery schedule, and the cost to be paid (which is related to the national will).

B. DEFINITION OF THE TEST CASE

The study then describes a hypothetical case designed to disturb the base case. It is defined parametrically without a specific scenario associated with it beyond the "situation" described in Section A. The only assumption made that differs from the base case refers to defense procurement. It is also assumed that the Government has no desire to disrupt the national economy by imposing widespread and total allocation controls to assure defense production where bottlenecks may occur.

The assumption that widespread and total government intervention is not imposed on the private sector is very important. It is highly unlikely that the Government would intervene (except in a few instances as has occurred from time to time under "normal" defense procurement conditions) unless the external event leading to the increased spending were a major threat and so perceived throughout the United States. If this were the case, the U.S. economy could perform at significantly higher defense production levels than can be measured under peacetime assumptions, although at higher cost to the civilian sector.

The test case is composed of two procurement phases--conventional and strategic procurement. The conventional phase consists of a doubling of all 1974 conventional procurement programs. This represents increased procurement expenditures of $15 billion above the base case, beginning in 1975. It is assumed that the rate of additional expenditure for the conventional procurement programs corresponds to production/delivery schedules for the various procurement categories as estimated by industry executives. The number of years assumed to be required for each category is as follows:

- munitions - 1 year
- weapons and tracked vehicles - 2 years
- aircraft and tectical missiles - 3 years
- ships - 4 years
- other procurement - 2 years

Thus, the expenditures for an additional $15 billion of conventional procurement programs have been spread out over four years. Further, because very precise information on the actual assembly cycle for procurement categories is not available, it is assumed that expenditures for any year are distributed with respect to the total inputs of the final product. It has also been assumed that industrial purchases in the operations and maintenance category will be 20% higher each year than in the base case in order to insure adequate maintenance for the additional inventory.

There has also been an assumption of no significant increase in military personnel over the base case because no military conflict is assumed to be imminent. Some selective increases in skilled personnel, however, would in fact be necessary to handle the enlarged inventory.

The strategic phase of the test case consists of an additional $15 billion procurement program for the B-1 bomber and Trident and Minuteman missiles with spending to begin in 1977. The strategic purchases break down into $5 billion for each missile and $5 billion for the aircraft, all expenditures distributed equally over the 1977-80 period. The conventional phase emphasizes a broad step-up in defense spending involving diverse industries. The strategic phase emphasizes a step-up impacting upon the aerospace industry and its suppliers. It is intended to focus on possible saturation effects.

If classified and detailed information were available, we could have included in the input/output analysis of the strategic phase expenditures for silo complexes and submarines necessary as platforms for the missiles. However, that data was unavailable, so we have analyzed the production and deployment problems of those platforms in a broad sense in Chapter VI (Shipbuilding, Electronics, Construction) and very specifically in Chapter VII (Minuteman, Poseidon/ Trident).

Table 8 presents a summary of the military procurement expenditure outlays assumed for the baseline and test cases. It should be noted that the percentage increases of the test case over the base case decrease after 1977. Therefore, on average, the stepped-up procurement program will have less and less impact on the economy as the decade progresses after 1977. Also, the economy will be growing, which will increase the absorptive capabilities of the industrial structure to meet additional demands.

The study assumes that financing the additional procurement will be primarily through increases in personal income tax.

TABLE 8

MILITARY PROCUREMENT PURCHASES FOR THE BASELINE CASE AND THE TEST CASE
(Billions of 1974 Dollars)

	1974		1975			1976			1977			1978			1979			1980		
	BC*	TC**	BC*	TC**	%***	BC*	TC**	%***	BC*	TC**	%***	BC*	TC**	%***	BC*	TC**	%***	BC*	TC**	%***
Aircraft	$ 4.10	$ 4.40	$ 4.80	$ 6.05	26	$ 4.80	$ 6.05	25	$ 4.90	$ 7.27	48	$ 5.00	$ 6.24	25	$ 5.10	$ 6.34	24	$ 5.19	$ 6.44	24
Ships	2.00	2.00	2.20	2.70	23	2.20	2.80	27	2.30	2.80	22	2.30	2.80	22	2.30	2.30	0	2.39	2.39	0
Missiles	3.60	3.60	3.60	3.89	30	3.09	3.89	26	3.21	6.40	99	3.21	5.91	84	3.30	5.91	79	3.30	5.91	79
Ammunition	.99	.99	.99	1.98	100	1.11	1.11	0	1.11	1.11	0	1.11	1.11	0	1.11	1.11	0	1.20	1.20	0
Vehicles[1]	.29	.29	.29	.45	55	.41	.54	32	.41	.41	0	.41	.41	0	.41	.41	0	.41	.41	0
Other Proc.[2]	4.10	4.10	4.10	6.16	50	4.30	6.36	48	4.30	4.30	0	4.40	4.40	0	4.49	4.49	0	4.61	4.61	0
Oper/Maint.[3]	11.70	11.70	11.65	14.04	21	11.65	14.04	21	11.84	14.28	21	12.10	14.52	20	12.35	14.77	20	12.65	15.12	20
R & D	10.36	10.36	10.64	10.64	0	10.36	10.36	0	10.92	10.92	0	11.20	11.20	0	11.34	11.34	0	11.62	11.62	0
TOTAL	37.14	37.14	37.67	45.91	22	37.92	45.12	19	38.99	47.49	22	39.73	46.59	17	40.40	46.67	16	41.32	47.70	15

1. Includes tracked vehicles.
2. Includes electronics and communication and other support equipment such as tactical support vehicles.
3. Purchases do not include salary expenditures for military and non-military personnel.

* Baseline Case.
** Test Case.
*** Percentage difference between baseline case and test case.

VI. EVALUATION OF THE TEST CASE

A. INTRODUCTION

The test case described in Chapter V was then evaluated using the ADL Input/Output Model. The results show that the total additional demand on the U.S. economy over the base case created by the test case is, at first glance, relatively small. As indicated in Table 9, total industrial output would increase only 1.2% over the base case through 1977, and less thereafter. If economic resources (capital and labor) were completely mobile and substitutable in the short-run, the United States could most likely produce the additional defense equipment without any significant adverse effects on its economy. However, economic resources are not particularly mobile or substitutable in the short-run. Further, because of the special nature of military procurement, very few firms provide the final product and final assembly has become highly concentrated, geographically. Therefore, if constraints or adverse effects do occur within the economy, they are likely to occur in particular industries or regions at first. The ripple effects of these constraints may, subsequently, lead to other bottlenecks on a national level.

The study summarizes the impacts of the test case on final assembly industries, such as shipbuilding, on supply industries, such as machine tools, and support industries, such as transportation. The demands created in each industry by the intensified defense expenditures were also reviewed by industry executives and ADL industry specialists familiar with the current and anticipated capacities in these industries.

The study assumes that the conditions used to describe the base case remain true for this case. It also assumes that defense expenditures are distributed among input industries each year in the same proportion of inputs to the final product. This assumption produces estimates that can differ from actual demands for specific industrial products in any given year, particularly in the primary metals and capital goods industries which are more likely to represent a larger proportion of the total program in

TABLE 9

OVERALL DEMANDS ON THE ECONOMY UNDER THE BASE CASE AND TEST CASE

	1975	1976	1977	1978	1979	1980
TOTAL INDUSTRIAL SALES[1] (Billions of 1974 Dollars)						
Test Case	2,623	2,725	2,827	2,922	3,043	3,156
Base Case	2,591	2,694	2,799	2,897	3,021	3,136
Test Case/Base Case	101.2%	101.1%	101.0%	100.8%	100.7%	100.6%
INDUSTRIAL EMPLOYMENT (in millions)						
Test Case	69.10	70.07	71.15	71.76	73.07	74.59
Base Case	68.25	69.23	70.24	71.14	72.56	74.02
Additional Manpower	.85	.84	.81	162	.51	.57

Source: ADL Input/Output Model

[1] "Total Industrial Sales" represents the aggregate of final and intermediate output, as opposed to Gross National Product which measures only final output.

the earlier periods than in the later periods. Adjustments for this shortcoming have been made wherever possible.

B. EFFECTS ON FINAL ASSEMBLY INDUSTRIES

The industries which are final assemblers of military hardware include the aircraft, shipbuilding, ordnance, and motor vehicles industries[1]. Table 10 summarizes the incremental production and employment demands upon these final assemblers arising from the test case.

1. Aircraft

As shown in Table 10, the test case calls for a rate of increase in production three times greater than that of the base case. Judging from its current and expected capabilities, it would appear that the industry would be hard pressed to meet the production schedule set forth in the test case. Although there is at present idle physical capacity in the aircraft industry, the additional manpower of 250,000 required by 1977 for the test case would be an increase of approximately 40% over the industry's present work force. While this level of employment barely exceeds that achieved in the late 1960's, the industry is highly concentrated geographically and would find it difficult to locate and bring that many new workers on stream. Since the employment in the industry has been dropping quite rapidly since 1970, it is likely that the industry might not be able to reattract former workers.

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[1] In the microeconomic analysis in the study the final assemblers are analyzed as aerospace, shipbuilding, automobile, and weapons and munitions industries. The slight difference in classification is because the input/output model is based on Department of Commerce industrial classifications. The aerospace industry discussed in the microeconomic analysis includes parts of the electronics industry, and parts of the ordnance industry, particularly missiles, as defined by the Department of Commerce. Other parts of the ordnance industry, such as ammunition, generally are discussed in the microeconomic analysis as portions of the weapons and munitions industry.

TABLE 10

PRODUCTION AND EMPLOYMENT DEMANDS ON FINAL ASSEMBLERS

	Production (Millions of 1974 dollars)			Employment (000's)	
	1974	1977	Annual Growth Rate 1974-1977 (%)	1974	1977
Aircraft					
Test Case	26,433	39,635	10.6	600	860
Base Case	26,433	29,306	3.5	600	610
Difference	--	10,329	7.1	--	250
Shipbuilding					
Test Case	3,843	6,668	20.0	132	218
Base Case	3,843	4,576	5.9	132	150
Difference	--	2,092	14.1	--	68
Ordnance					
Test Case	8,265	13,220	16.9	163	237
Base Case	8,265	8,694	1.7	163	156
Difference	--	4,526	15.2	--	81
Motor Vehicles					
Test Case	68,446	73,063	2.0	796	821
Base Case	68,446	72,635	2.0	796	815
Difference	--	428	--	--	6

Source: ADL Input/Output Model

Not only would the traditional aircraft companies be affected by such a step-up, but also many of the supporting and feeder industries would have serious problems im meeting the demands for rapid increases in capacity. Lead times for many key supplies have already lengthened appreciably, such as for electronics, castings and forgings.

This leads to a number of tentative conclusions. The first is that if the test case production schedules were met, the cost of materials, added facilities and worker training would offset many of the economies of scale. Second, the Government might have to offer financial incentives for the industry to increase the production of military aircraft at the expense of commercial production. Third, the Government might restrict exports of military hardware, although at a cost. Aircraft executives are reluctant, however, to divert resources from civilian to military contracts without a clear and publicly recognized national emergency. If export production facilities were "converted", political as well as balance of payments problems would be created.

2. Shipbuilding

Shipbuilding industry bottlenecks created by the test case levels of production would prove to be more difficult to overcome than in the aircraft industry. The industry is presently solidly booked for civilian and Navy business,and the short-term baseline forecast indicates continued strong growth in shipyard activity.

Manpower would appear to be the most serious constraint to rapid increases in shipbuilding demand. Employment levels in the industry have reached post-World War II highs, and it can be assumed that there is no reservoir of former employees from which to draw. Nevertheless, since there is a degree of interchangeability between the construction trades and the shipbuilding trades, the bleak forecast for the construction industry over the next few years may enlarge the labor pool from which shipbuilding could draw. However, the regional nature of the shipbuilding industry would serve as a deterrent for massive, large-scale hiring from the construction industry. A number of major shipyards in the United States are located in small metropolitan areas such as Bath, Maine and Pascagoula, Mississippi, and mobility in the construction trades is inhibited by local union practices. In addition, the need

to attract a new pool of employees would undoubtedly require wage incentives which would result in increased costs.

The shipbuilding industry is highly susceptible to the secondary effects of shortages in its supplier industries, both in regard to labor and materials, and is strongly dependent on long-lead time components, including nuclear propulsion plant elements.

In the materials field, the potential shortages would appear to lie in the area of manufactured components rather than in raw materials as such. In many items, sporadic shortages would occur. An accelerated program would in itself aggravate these shortages and extend the already long lead times existing in the industry. Facilities would appear to be of least concern. For the most part, their utilization could be increased provided the manpower could be found.

Although manpower problems and shortages would undoubtedly extend some lead times, the industry would appear to be able to handle the increase envisioned in the test case. Requests for shorter lead times or more ships would, however, be progressively more difficult.

3. Ordnance

The ordnance industry, under the assumptions of the test cases, would receive a significant boost in growth over the base case forecast. The analysis of the missile manufacturing portion of the industry is similar to the findings regarding the aircraft industry described above.

Of all the defense-related industries, the munitions portion of the ordnance industry is the one in which the Government is most involved as a producer. This is done through arsenals and Government-owned, contractor-operated (GOCO) plants producing ammunition, bombs, explosives and torpedoes. A large, rapid increase in munitions output would appear possible for several reasons:

- Although safety precautions to avoid explosions are an important concern, the manufacturing processes are relatively simple;
- GOCO plants have substantial production capacity, except for a small number of low-

demand, high-production cost items. As recently as the late 1960's, munitions procurement was $7 billion per year during the height of the Vietnam War; although some facilities are no longer in operation, this total is three and one-half times larger than current procurement of total munitions;

- A number of U.S. corporations have the necessary production know-how;

- Military demand for the chemicals and metals needed is a very small portion of total domestic supply. For example, only 1% of the current supply of ammonia, a key basic material for explosives and propellants, goes for military munitions needs.

4. Motor Vehicles

The motor vehicle industry has enormous productive capacity and only an extremely small production of this sector's output goes to military procurement programs. From an overall industry perspective, it would not likely experience production problems under the conditions of the test case. However, production capacity for civilian goods is not easily converted to defense production of specialized weapon systems such as tanks. Furthermore, key supplies of tank turret and hull castings are already difficult to obtain. Therefore, a step up can be expected to create certain tooling, supply and other problems.

C. EFFECTS ON SUPPLY INDUSTRIES

The primary supply industries for defense production are the electronics industries, machine tools industries, primary metals industries, chemical industries, and the energy producers. Table 11 is a presentation of the additional demands created by the test case upon several specific major intermediate supplying industries. Industries not presented in Table 11 would, of course, have to increase their production over the base case, but the incremental demands are generally not significant and, therefore, not presented in the Table. The primary difficulties would arise from chronic raw material shortages, current high levels of capacity utilization and long delivery backlogs. It should be noted that small levels of increased

TABLE 11

ANNUAL GROWTH RATE FOR PRODUCTION, 1974-77
FOR SPECIFIC MAJOR INTERMEDIATE SUPPLIERS
FOR THE TEST CASE AND THE BASE CASE

Industry	Test Case (%)	Base Case (%)	Incremental Difference (%)
Engineering and Laboratory Instruments	13.9	4.2	9.7
Miscellaneous Non-Electrical Machine Shop Products	11.8	2.7	9.1
Radio and TV Communications Equipment	13.8	4.8	9.0
Resistors, Transformers	6.7	2.6	4.9
Non-Ferrous Metals (Silicon, Titanium and Uranium)	8.1	4.0	4.1
Lead	5.1	1.7	3.4
Dies, Accessories	8.2	5.0	3.2
Machine Tools - Cutting	8.2	5.0	3.2
Aluminum	7.9	4.9	3.0
Zinc	4.8	2.1	2.7
Semiconductors	10.9	8.8	2.1
Machine Tools - Forming	6.6	4.8	1.8
Engines and Turbines	5.9	4.2	1.7
Electrical Motors	5.3	3.7	1.6

demand could, in fact, be absorbed by even those industries that are operating at full capacity, because of the extra production capabilities and efficiencies that can be induced through patriotism and other motivational stimulants. Even so, increases in demand on limited supplies and productive capacity would not only add fuel to the inflation cycle, but also to the total cost of the program, which would offset many of the economies of scale arising from stepped up procurement.

1. Electronics

The electronics industry would face a large incremental demand generated by the test case because it is already heavily involved in defense markets. Difficulties in its responding would arise from selected raw material shortages, current high levels of capacity utilization, long delivery backlogs, and the profit appeal of civilian markets.

The electronics industry could expand or accelerate production of two or three major strategic or conventional systems without serious problems, particularly if the increases entailed only the production of existing systems, or equipment currently in production. However, if final assemblers were hard pressed to obtain additional supplies from the existing defense supply network, "new" suppliers would be needed within particular industries. Establishing additional suppliers is a very complicated and time-consuming process because of the paperwork and testing required for defense-related production. Because of the small volume of defense sales with respect to their total sales, and the cyclical nature of defense contracting, many intermediate supply industries would be extremely reluctant to divert resources from civilian to military contracts. Furthermore, they consider civilian contracts to be generally more profitable than defense contracts. Thus many intermediate supply firms would not divert production to defense contracts without some sort of inducement, particularly financial. Shortages of electronic components would have an adverse impact on accelerated delivery schedules unless Defense Production Act reallocations of shipments were to be applied to component suppliers. This is probably the key mobilization problem for electronics.

If, on the other hand, the simultaneous step-up of six to ten major strategic or conventional programs were to take place, or if major modifications of present

systems were called for, such as a Minuteman [illegible] Minuteman III, or if entirely new systems were required to replace existing systems, major problems would be encountered by the electronics industry. These problems would be mostly in the areas of component supplies, availability of production and assembly facilities, and shortage of skilled and trained personnel in both engineering and manufacturing disciplines.

Since the electronics industry, at both the equipment manufacturing and component stages, has substantial civilian demand, diversion of capacity away from civilian customers as well as expansion of overall capacity would be necessary to meet a large step-up in defense production.

2. Machine Tools

Less than 10% of total machine tool output currently goes to defense production. Despite the existence of government-owned equipment and government machine tool programs, additional machine tool production for a significantly larger defense effort would be necessary. Expanded machine tool production could come from two sources; namely, increased total production, or commercial production or export production diverted to the defense effort. To some degree domestic supply could be supplemented by imports.

The machine tool industry is experiencing heavy civilian demand and delivery lead times have become very long. The main bottleneck in increasing defense output is the shortage of skilled machinists willing to work in machine tool manufacturing. Also, the capital goods producing industries may continue to face significant civilian demand pressures over the immediate term as a result of high business outlays for new equipment.

The manufacture of the bulk of military hardware can be accomplished with general purpose machine tools as opposed to the very large or special machine tools such as the huge turning machines used in the forging industry for work-in-progress machining and the very special large 5-axis "skin mills" for the aircraft industry. Even if the industry could not supply more than the number of general purpose machines it is now producing, at this high level of metalworking machine tool production, a mobilization effort could draw on the large supply of new tools being produced for less critical industries to fill its general purpose needs.

The aircraft manufacturing industry and its subcontracting machine shops are currently quite well supplied with the large, very special machines that it needs and could sustain moderately higher production rates. However, at high levels of activity, such as a one-year doubling of military procurement, new large and special purpose machinery would be required. Diversion of production of these machines away from less critical industries would be of limited value since little production of the very large machine tools goes on for nondefense industry anyhow. However, some are imported from overseas sources, such as West Germany, and this source might be utilized to some degree. This lack of additional large and special machine capacity could limit our ability to raise weapon system production levels quickly. The problem would be most acute in the large forging industry where limited work-in-process machining capability might limit the increased production of large forgings in the short term. The airframe and aircraft engine industries might be next in line to feel such a constraint.

3. Primary Metals

Relatively modest percentages of the nation's primary metal industries' output are procured directly or indirectly for weapon systems. Defense procurement is expected in 1974 to consume only 3.6% of domestic iron and steel production and 5.3% of the domestic aluminum production. Since the U.S. is a net importer of both iron and steel, and aluminum, defense usage represents an even smaller percentage of total domestic consumption.

There appears to be adequate capacity in the primary iron and steel industry to supply whatever needs might be required for defense applications including even specialty alloy steel. However, it might well be that certain non-essential civilian end uses for iron and steel would not be able to get all of the steel needed were the government to divert certain production units already operating at capacity to satisfy increased defense requirements assuming foreign-sourced materials were not available. As far as aluminum is concerned, much the same situation prevails as in the case of iron and steel.

Within the primary metals industry, the nonferrous metals and mining (which includes titanium and uranium) would be the only sector measurably affected by the increase in defense spending associated with the test

case. Yet, total defense-related production would not have to increase by more than 4% of total output. However, given the present tight supply/demand situation within the primary metals industries, increasing defense demand by even a small amount could further accelerate inflationary price rises under free market conditions. A potential solution for eradicating shortages or accelerated inflation which may occur within the non-ferrous sector is to sell materials from the U.S. stockpile. Sales of excess inventory are permissible under the law which established the stockpile. However, throughout 1973 and 1974, the government accelerated sales of stockpile inventory without having an appreciable effect on the substantial price increases which have occured throughout the raw material sector. A very large increase in military demand for titanium metal used in aircraft, aircraft engines, and other hardware might require significant growth in titanium sponge imports, or diversion of metal used for commercial aircraft production. Either alternative, particularly the latter, would have adverse balance of payments effects.

This study assumes continued access to imports, although at this time world demand is already pressing on world supply of many minerals. Incremental imports for military production would probably come in part at the expense of the demand of U.S. civilians or U.S. Allies. A recent study by Arthur D. Little for the U.S. Government indicates that the U.S. economy could continue to function effectively even if there were a total, one-year cutoff of all mineral imports if allocations were made away from less essential civilian uses and the national stockpile were utilized. Cutoffs lasting more than one year, but involving at least partial imports of any mineral, could probably be handled.

Forging and casting is a major activity conducted primarily by large, specialized forging companies and separate casting companies, which forge or cast many different metals but do not generally produce metals themselves. Military aircraft and propulsion systems require large forgings and castings which can be produced by relatively few suppliers. Such components are used for civilian and military aircraft, aircraft engines, naval nuclear reactors, tank hulls, turrets, and strategic systems. A broad step-up in defense production would put great pressure on leading forging and casting companies.

4. Chemicals

Although the chemical industry supplies a wide variety of products to the Department of Defense, they still represent only a small percentage of total chemical industry sales. About 1%, or $1 billion, is sold directly to the Department of Defense. Another few percent are sold to other industries involved in defense production, such as plastics for military hardware, synthetic rubber for tires, and propellants for munitions and rockets. What is sold to DOD or to defense producers is very rarely specific to military needs. Rather, the same chemicals are almost always produced in volumes many times larger for civilian applications.

Even a sizable increase in defense production would probably not strain the overall resources of the industry. Several qualifications to this generalization should, however, be noted. There is limited flexibility in converting equipment from the processing of one type of chemical to the processing of others. During boom times, such as during the 1973-1974 period, specific products have been in short supply and capacity has been strained. In recent years, feedstocks have become limited. Certain specific categories of chemical processing might be strained in response to increased defense production, while the industry as a whole remained only marginally affected.

D. EFFECTS ON SUPPORT INDUSTRIES

1. Construction

Most industries would meet increased defense production needs, short of long-term massive mobilization, with their existing plants. This factor plus the large total capacity of the construction industry indicates that on an overall national basis, the industry could handle most potential increases in defense production, but not without some difficulties. Existing problems of building material cost and availability, as well as energy, manpower, and capital availability, would be exacerbated, and some dislocations would occur in certain regions of the country. If a step-up in defense-related construction were concurrent with a general pick-up in the national construction industry from its current depressed state, consideration might be given to building supply and distribution controls.

2. Transportation

Within the transportation industry, each mode (railroads, trucking, pipelines, inland waterways, airlines) could absorb the very small incremental demand arising from the projected increase in defense production. Yet the U.S. Government may need to intervene occasionally to overcome bottlenecks such as facilities' deterioration and boxcar shortages in the case of the railroads.

E. OVERALL EFFECTS

Overall macroeconomic and industrial effects of the test case can be summarized as follows:

- The resulting increased production would require only a small increase in total U.S. manufacturing activity and few specific industries would find more than 10% of their output going directly or indirectly to defense uses.

- Several final assembly industries (automobiles, weapons and munitions) have excess capacity and only in aerospace and shipbuilding would manpower and to some extent facilities be a serious problem.

- Supply industries (electronics, metals, machine tools, energy, chemicals) which, despite current recurring trends, are likely to be responding to short civilian demand could not step up production quickly, so defense production increases would have to come in part at the expense of the civilian sector (for example, through shortages of integrated circuits and other electronic components); bottlenecks would appear selectively in supply industries and would have to be broken by the use of Defense Production Act powers.

- Assuming the continuation of imports, raw materials for most metals would be adequate, but increased defense production and peacetime military operations (training, etc.) might cause some shortfalls for the civilian economy in jet fuel, petrochemical feedstocks, and/or other petroleum products, and non-ferrous metals.

- Support industries such as transportation and construction could respond with limited difficulties nationwide, but regional dislocations in construction could occur.

- Assuming no buildup in active military service personnel, labor dislocations would not generally be great on a nationwide basis (despite existing skilled manpower shortages in shipbuilding and machine tool manufacturing). The unemployment rate would go down to some degree, with the largest impacts occurring in industrialized regions with traditional defense production activity (e.g., California) or in rural areas affected by strategic systems construction projects (e.g., Montana, Wyoming); if a draft were reinstituted, the availability of young skilled workers (17-25 years) might be of some concern.

- Balance of payments deterioration would occur as imports of raw materials rose and exports of manufactured goods were limited by diversion of civilian production to defense needs and by likely restrictions on military export sales of systems needed by the United States (there were $8 billion of military export sales in 1974).

- Sharp price increases for specific goods already in tight supply would occur even if there were relatively small increases in defense demand compared with that in the economy as a whole and the ripple effects might lead to the need for widespread government price and wage controls.

- The dimensions of the resultant national price inflation would be sensitive to the government financing mechanism used, whether tax increases, reductions in alternate Federal/civilian programs, and/or deficit financing.

In sum, the test case would create further short-run inflationary pressures; it could have long-run detrimental effects by diverting capital-producing equipment from civilian-oriented investment and could dampen the long-run growth rate of GNP.

VII. STRATEGIC WEAPON PRODUCTION AND DEPLOYMENT

Many of the bottlenecks to stepped-up defense production, and the side effects of a step-up on the civilian economy, can be illustrated by analyses of the production problems of specific weapon systems. The study therefore made such an analysis of the leading offensive and defensive strategic systems and, in addition, considered in less depth twenty-five key conventional weapon systems, including aircraft, tactical missiles, ships, and land vehicles. Systems studied are listed in Table 12. The analyses are based upon meetings with prime contractors and suppliers at the program manager level or higher, as well as the judgments of ADL staff professionally knowledgeably about these weapon systems.

In Chapter VII of the full report there is a discussion of the production and deployment problems of each of the following five strategic programs, based on unclassified meetings with top executives and military officers. The text relating to each program has been reviewed by knowledgeable experts involved in them. The analysis covers:

- the Minuteman missile
- the Poseidon/Trident missile and submarine
- the B-1 bomber
- the MARV re-entry vehicle
- the Safeguard/Site Defense ballistic missile defense

A brief discussion of each conventional weapon system will also be found in Appendix B of the full report.

The production and deployment of strategic systems is a complex subject. We do not believe that a short summary can do justice to the issues involved. Rather than present such a discussion here, we refer the reader to the complete text in Chapter VII.

TABLE 12

WEAPON SYSTEMS ANALYZED IN THIS STUDY

System	Prime Contractor	Category	Procurement FY '74 Quantity	FY '74 $ Million	FY '75 Request Quantity	FY '75 Request $ Million
		STRATEGIC PROGRAMS				
I. Offensive (Triad)						
Minuteman	Boeing/GE	Air Force Land-Based Missile	115	712	61	731
Poseidon	Lockheed	Navy Submarine-Launched Missile	<100	187	0	48
Trident C-4	Lockheed	Navy Submarine-Launched Missile	RDT&E	533	RDT&E	661
Trident Submarine	General Dynamics	Navy Missile-Launching Submarine	1	902	2	1381
B-1	Rockwell	Air Force Bomber	RDT&E	448	RDT&E	499
MARV	Lockheed/G.E./ McDonnell Douglas	Air Force and Navy Maneuverable Re-entry Vehicle Study	RDT&E	90	RDT&E	120
II. Defensive						
Safeguard (* Continuation at 1 Site)	Western Electric	Army Anti-Ballistic Missile Defense	0*	341	0*	61
Site Defense	McDonnell Douglas	Army Anti-Ballistic Missile Defense	RDT&E	110	RDT&E	160
		CONVENTIONAL PROGRAMS				
I. Aircraft						
E-3A AWACS	Boeing	Air Force Communications Command Plane	RDT&E	163	12	770
F-4 Phantom	McDonnell Douglas	Air Force/Navy Fighter	24	100	0	16
F-15 Eagle	McDonnell Douglas	Air Force Fighter	62	1129	72	1076
F-14 Tomcat	Grumman	Navy Fighter	50	737	50	756
P-3C Orion	Lockheed	Navy Patrol Plane	18	202	12	151
S-3A Viking	Lockheed	Navy Patrol Plane	45	553	45	574
AH-1Q Cobra TOW	Textron (Bell Helicopter)	Army Attack Helicopter	RDT&E	7	21	29
AH-1J Sea Cobra	Textron (Bell Helicopter)	Navy Attack Helicopter	15	26	20	31
UH-1H Iroquois	Textron (Bell Helicopter)	Army Utility Helicopter	180	61	205	69
UH-1N Iroquois	Textron (Bell Helicopter)	Navy Utility Helicopter	24	23	20	17

TABLE 12 (Continued)

System	Prime Contractor	Category	Procurement FY '74 Quantity	Procurement FY '74 $ Million	Procurement FY '75 Request Quantity	Procurement FY '75 Request $ Million
II. Missiles		**CONVENTIONAL PROGRAMS (CONTINUED)**				
Hawk	Raytheon	Army Ground-to-Air Missile	950	131	--	101
Maverick	Hughes	Air Force Ground-to-Air Missile	3000	59	[illegible]	88
Phoenix	Hughes	Navy Air-to-Air Missile	240	92	[illegible]	--
Sidewinder	Raytheon, Philco-Ford	Navy Air-to-Air Missile	850	15		16
Sparrow	Raytheon, General Dynamics	Air Force Air-to-Air Missile	175	46	600	10
TOW	Hughes	Army Ground-to-Ground Missile	23,425	143	30,819	137
III. Ships						
CVN-70	Tenneco (Newport News)	Navy Nuclear Aircraft Carrier	1	931	2	
DD-963	Litton (Ingalls)	Navy Destroyer	7	590	7	497
DLGN-38	Tenneco (Newport News)	Navy Nuclear Escort	0	81	1	240
SSN-688	Tenneco (Newport News)/ General Dynamics (Electric Boat Div.)	Navy Nuclear Attack Submarine	5	91[illegible]	3	5[illegible]
IV. Tracked Combat Vehicles						
M60A1 Tank	Chrysler	Army Tank	613	2[illegible]	8[illegible]	[illegible]
XM-1 Tank	G.M./Chrysler	Army Tank	RDT&E	54	RDT&E	[illegible]
ARSV	FMC/Lockheed	Army Reconnaissance Vehicle	0	[illegible]	[illegible]	[illegible]
M113A1	FMC	Army Personnel Carrier	923	[illegible]	[illegible]	[illegible]
M125A1	FMC	Army Mortar Carrier	105	6	13	1