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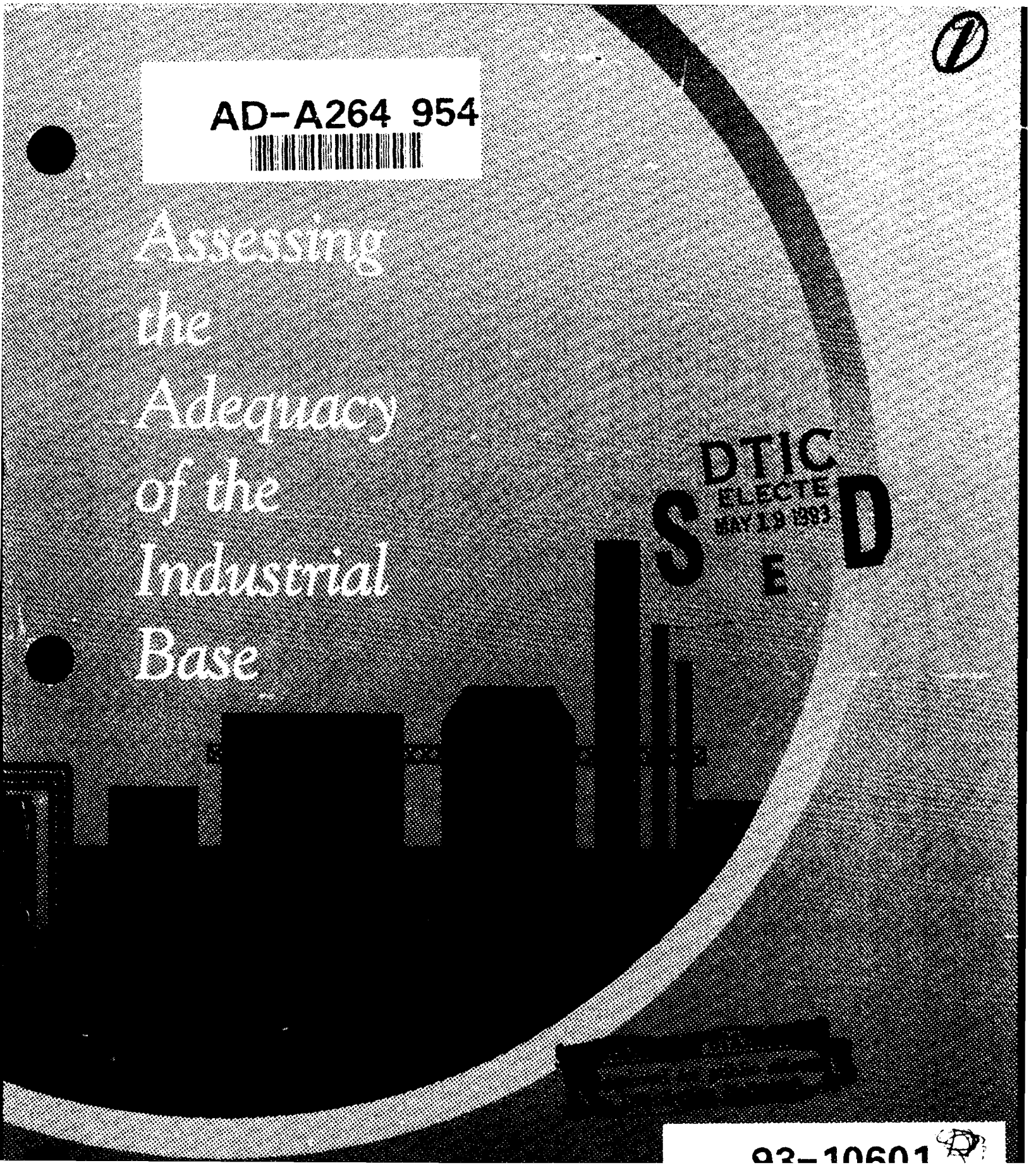

# Assessing the Adequacy of the Industrial Base

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Facing declining procurement budgets and termination of production runs, the Army was concerned with the ability of the industrial base to satisfy future warfighting materiel requirements. The four performing organizations addressed distinct segments of the issue. This report provides their results.

The Logistics Management Institute identified the major industrial base lessons learned from Operation Desert Shield/Desert Storm and congressional interest in industrial base issues pertinent to the Army. Recommendations for improving industrial base planning to link industrial responsiveness and warfighting materiel requirements are provided.

The Army's Logistics Evaluation Agency performed a sustainability analysis on 21 major end items and 40 munitions to support the Integrated Army Mobilization Study (IAMS) scenarios set in 1999. Their results are in the classified version of this report.

To assess cost/quantity production tradeoffs, the Institute for Defense Analyses analyzed four weapon systems: the Abrams tank; Apache helicopter; TOW missile; and Multiple Launch Rocket System.

The Analytic Sciences Corporation studied Desert Shield/Desert Storm from the Graduated Mobilization Response (GMR) concept perspective and developed a list of prototype actions that the Army could take during each GMR stage to improve industrial base responsiveness.


**14. SUBJECT TERMS**

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In the midst of Operation Desert Shield/Desert Storm (ODS), the Department of the Army initiated the Integrated Army Mobilization Study to identify the major impediments to mobilizing the Army to meet future contingencies. As part of that effort, an assessment was conducted of the industrial base's ability to support ODS and similar contingencies.

The enclosed assessment identifies and analyzes major industrial base lessons learned from ODS. The assessment also addresses the Graduated Mobilization Response planning process from an industrial base perspective.

Recognizing the changed strategic environment and continued fiscal constraints, the recommendations contained in the assessment form the basis for sound application to peacetime planning and crisis operations at all levels of execution.

The HQDA point of contact for the assessment is Lieutenant Colonel William Hand, DSN 227-5183.

Susan Livingstone
Assistant Secretary of the Army
(Installations, Logistics and Environment)

Enclosure

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# *Assessing the Adequacy of the Industrial Base*

May 1992

Prepared by:
Logistics Management Institute – Part I
U.S. Army Logistics Evaluation Agency – Part II
The Institute for Defense Analyses – Part III
The Analytic Sciences Corporation – Part IV

# PREFACE

In the wake of Operation Desert Shield/Desert Storm and as a means of preparing to meet the challenges confronting it over the next 10 years, the Army chartered the Integrated Army Mobilization Study (IAMS) in January 1991 to identify the major impediments to mobilizing U.S. forces to meet future contingencies.

Facing declining procurement budgets, termination of production runs, and possible loss of critical subtier vendors, the Army was especially concerned with the adequacy of the industrial base to satisfy future warfighting materiel requirements. Accordingly, as part of the total IAMS effort, the Assistant Secretary of the Army for Installations, Logistics, and Environment asked the Deputy Chief of Staff for Logistics to sponsor a study to assess the adequacy of the industrial base to support Operation Desert Storm and similar contingencies in FY99.

As the study evolved, the Army defined its desired taskings more clearly and assigned tasks to separate organizations. In all, four contracts were authorized to address distinct segments of the issue.

The Logistics Management Institute (LMI) primarily focused on identifying the major industrial base lessons learned from Operation Desert Shield/Desert Storm. On the basis of that task, LMI provides recommendations on the direction industrial base planning should take to meet future contingencies. As part of developing a future investment strategy for industrial responsiveness, LMI also developed the Production Expansion/Acceleration Capability Enhancement (PEACE) computer program to facilitate the analysis of tradeoffs between procuring complete items and investing in industrial preparedness measures (IPMs). In addition, LMI was asked to review recent congressional interest in the impact of budget reductions on the industrial base and the Army's response. The results of the LMI analysis are presented in Part I of this report.

The Army's Logistics Evaluation Agency (LEA) was tasked with performing a logistics unit capability assessment and sustainability analysis on the 21 major end items modeled in the warfighting simulations conducted by the U.S. Army Concepts

Analysis Agency (USACAA) using the Combat Evaluation Model (CEM). LEA also addressed the need for conventional munitions to support those major weapon systems and other selected items critical to combat effectiveness of deployed forces. The primary purpose of the analysis was to determine the supportability of the forces within the respective scenarios based upon the anticipated stockage levels provided by the earlier program objective memorandums (POMs). LEA identified areas of concern with respect to items that need to be replenished during or after the conflicts to restore the inventory to pre-D-day levels. The details of the LEA analysis are presented in a classified section, Part II, of this report.

To assist the Army in framing resource options, the Institute for Defense Analyses (IDA) developed a means of assessing cost/quantity production tradeoffs for key weapon systems. Its methodology is useful in assessing and depicting production possibilities and associated costs over a wide range of planning assumptions. For this study, IDA tested the methodology on four major Army systems: the Abrams tank, the Apache helicopter, the TOW missile, and the Multiple Launch Rocket System. An explanation of IDA methodology and trade-off analysis for each of these systems is presented in Part III of this report.

The response to Operation Desert Shield/Desert Storm and the changing strategic situation highlight the need to change the traditional approach toward mobilization planning. In anticipation of the changing environment, over the past few years, a new way of approaching mobilization planning has evolved. The resulting process is known as the Graduated Mobilization Response (GMR) concept. For this study, The Analytic Sciences Corporation (TASC) was tasked with identifying the extent to which the GMR concept was used in responding to the Persian Gulf crisis and its possible usefulness for responding to future crises, especially from an industrial base perspective. Their results are presented in Part IV.

These seemingly diverse efforts are included in this report as a means of presenting a comprehensive framework for analyzing the major issues confronting the Army in dealing with the industrial base. In the original tasking, the Army emphasized the development of an investment strategy to address major issues of the future defense industrial base. While this study has not identified specific resource amounts for use in the current program objective memorandum (POM) development, it calls attention to major areas of concern and recommends ways to improve future

industrial base planning and force sustainability. The two computer-based models developed by LMI and IDA should aid in that endeavor.

Although the issues of materiel replenishment following conflict and force reconstitution capabilities were not specifically tasked as study areas, the LMI, LEA, and IDA analyses do address them.

## Executive Summary

## ASSESSING THE ADEQUACY OF THE INDUSTRIAL BASE

In the wake of Operation Desert Shield/Desert Storm (ODS) and the rapidly changing strategic situation, the Army chartered the Integrated Army Mobilization Study (IAMS) to identify the major impediments to mobilizing U.S. forces to meet future contingencies in FY99.

Because of the impending severe decline in procurement budgets, the termination of production runs, and the resulting possible loss of critical subtier vendors, the Army was especially concerned with the ability of the industrial base to satisfy the warfighting requirements of future contingencies. To address that concern and its ramifications, as part of the IAMS effort, the Army authorized four separate efforts for analyzing industrial base issues, each with distinct perspectives. This report presents the results of those four efforts.

First, the Logistics Management Institute (LMI) was tasked to identify the major industrial base lessons learned from ODS. On the basis of its observations, LMI provides recommendations on the future direction industrial base planning should take in order to strengthen the link between the capabilities of the industrial base and the peacetime procurement of war materiel. To facilitate improving these linkages, a methodology, the Production Expansion/Acceleration Capability Enhancement (PEACE) model, was developed for use by program/project/item managers during future program objective memorandum (POM) cycles. The model allocates expected available funds between procuring items and industrial preparedness measures, e.g., long-lead-time components or additional equipment, for possible crises responsiveness. The Army is currently evaluating the model in its formal accreditation process. In addition, LMI was asked to review recent congressional interest in the impact of budget reductions on the industrial base and the Army's responses.

The Army's Logistics Evaluation Agency (LEA) analyzed logistics unit capabilities, 21 major end items and associated munitions, and other selected items critical to combat effectiveness in the context of the warfighting scenarios used in the

Integrated Army Mobilization Study. LEA compared attrition data with anticipated stock availability in 1999, using documents on the projected Army asset availability and identified areas of possible concern. In addition to providing a sustainability analysis for the scenarios, LEA-derived data raise possible concerns about replenishment issues following the conflicts.

The Institute for Defense Analyses (IDA) developed a means of assessing cost/quantity production tradeoffs for key weapon systems. In the study, IDA tested the methodology on four major Army systems: the Abrams tank, the Apache helicopter, the TOW missile, and the Multiple Launch Rocket System. The methodology is useful in assessing and depicting production possibilities and associated lead times and costs over a wide range of planning assumptions. The result was to present a set of production options with associated costs, based upon various initial production levels and desired increased production amounts. The methodology serves to highlight the level of detail and assumptions necessary to determine resource allocation issues during the POM process.

In the fourth effort, The Analytic Sciences Corporation (TASC) was tasked to analyze ODS from the perspective of the Graduated Mobilization Response (GMR) concept and using that analysis, to develop an action plan for implementing GMR in Army logistics activities. TASC identified the extent to which the GMR concept was used in responding to the Persian Gulf crisis by analyzing 70 specific actions that fit the GMR model. Based on that analysis, TASC developed a list of prototype actions that the Army could take during each GMR stage to improve industrial base responsiveness.

The four studies resulted in the following key points:

- The industrial base response for ODS was largely successful for the following reasons:
  - Primarily, it was an acceleration of a warm industrial base for secondary items[1] and ammunition already under contract or in production. Except for production of troop support items such as clothing and rations, additional producers generally were not placed under contract.

[1]In the context of this report, secondary items consist of consumables, reparables, and troop support items.

- Production of major end items, with few exceptions [e.g., Patriot (PAC-2) and Army Tactical Missile System], was not accelerated.
- The 6-month buildup period provided time for the limited industrial response. However, even then, production could not have met demand for such items as batteries and other electronic items had it been a longer war.

- The industrial base response to ODS reinforced the need to refocus industrial base planning.
  - Of immediate concern is the need to develop a crisis response[2] orientation to satisfy the needs of major regional contingencies that occur with little advance warning.
  - The Army should not depend on bringing up cold production lines for producing ammunition or principal end items to sustain the Army in major regional contingencies.
  - The Army must plan to replenish supplies and equipment following a conflict.
  - More complete industrial planning data must be available to support the refocused orientation.
  - Finally, because of the declining industrial base, the Army must concentrate on ensuring that a reconstitution capability remains.
- Response to ODS showed that assumed industrial base responsiveness cannot substitute for war reserve stocks. Even with a prolonged buildup period, many U.S. contractors could not responsively meet the surge requirements for selected items, especially electronics.
  - Most items whose production was accelerated for ODS were secondary items, reinforcing the need for increased emphasis in industrial base planning for such items and increased integration of industrial base planning into the Army's secondary item procurement policy.
  - Industrial base planning for major end items appears to be of little value in responding to major regional contingencies although appropriate in planning for replenishment and reconstitution.
  - The historical Department of Army Critical Items List and the Industrial Preparedness Planning List do not represent the universe of items for which accelerated production was necessary to support ODS; production

[2]In the context of this report, crisis response denotes situations in which little time is available for response, in contrast to situations that allow extended response, e.g., a future possible threat with potential for global conflict.

of a great number of items not included on those lists had to be accelerated.

- To prepare for crises that occur with limited warning, the Army must place greater emphasis upon adequately funding war reserve stocks that can not be supplied by the industrial base during the emergency. Industrial base planning should focus on those secondary items still in production, which have unfilled war reserve requirements and can be produced to satisfy war reserves shortfalls.

- The Army has not fully examined tradeoffs between restarting production of currently fielded systems and accelerating the development of new systems (e.g., the Block III tank). The Army needs improved industrial engineering data on ramp-up and restart times as well as costs under varying conditions.

- On the basis of the analysis of ODS actions from a GMR perspective, the studies drew the following consensus:

  - Because the Army was structured and provisioned to fight a NATO war, the benefits of an active GMR were minimized.

  - Army personnel were not sufficiently indoctrinated in GMR to have used it effectively.

  - At least 10 percent of the ODS response activities should have been completed before August 1990 if GMR had been used.

  - Many of the preparedness activities could have been accelerated if GMR guidelines and procedures had been implemented.

  - That the Army did not use the available warning to evaluate and prepare for highly likely future occurrences was evidenced by the absence of a postconflict asset recovery policy.

In addition to the recommendations included above, this study makes the following additional recommendations. That the Army:

- Improve the linkage between war reserve stockage policies and industrial responsiveness planning.

- Consider establishing a two-tier approach to industrial base planning, focusing crisis response planning on items that have a warm production base and an unsatisfied war reserve stockage requirement. Planning for replenishment and reconstitution should be oriented more toward major end items and munitions that are no longer in production.

- Support improving the PEACE model so that it can determine the most economical mix of funded end items and investments in industrial preparedness measures[3] based upon warfighting requirements.
- Continue the accreditation process for the methodology developed by IDA and the PEACE model developed by LMI. The latter is especially important for linking industrial responsiveness to the procurement of items; it may enable wartime requirements to be satisfied at minimum peacetime cost.
- Develop policies and procedures to enhance the use and effectiveness of GMR procedures for improving industrial responsiveness.
- Consider increasing the authorized level of organization of logistics units to improve their readiness and to ensure the availability of support for deployed forces.
- Explore the use of alternatives to standard substitutes for potentially critical ammunition shortfalls.
- Investigate the feasibility of converting Government-operated manufacturing and repair operations to contractor operations, similar to contractor-operated ammunition plants, for possible dual military and commercial use.
- Investigate the possibility of transferring some depot repair operations to commercial industry as a means of preserving commercial industrial capabilities and reducing Government investments in facilities and equipment.

[3]Industrial preparedness measures are actions (e.g., procurement of long-lead time components or additional production equipment, waivers of regulations) designed to improve the ability of the industrial base to meet increased production requirements. Thus, IPMs may be used to mitigate legal, procedural, financial, or physical constraints.

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# Part I

## *Linking the Industrial Base to Warfighting Requirements*

David P. Garner
Salvatore J. Culosi

Logistics Management Institute

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# CHAPTER 1

# INTRODUCTION

## BACKGROUND

Operation Desert Shield/Desert Storm (ODS), as the largest military operation since the Vietnam war, provided industry with a major opportunity for demonstrating its responsiveness and capabilities during a critical period. However, the unique aspects of Desert Storm raised serious questions about the overall ability of the U.S. industrial base to support armed forces in future major regional crises.

Declining procurement budgets, curtailment of major weapon system production lines, and the attendant possible loss of critical subtier vendors create concerns about industry's ability to meet future warfighting materiel requirements. Planners are also concerned about the remaining industrial base's ability to either replenish depleted stocks within a reasonable time following a conflict or to reconstitute forces and their supplies and equipment in response to a renewed global threat. These concerns are especially germane if what remains is a significantly diminished defense production base resulting from severely reduced military spending. The extent to which a sufficiently responsive industrial base can be maintained during the next "decade of development" in the face of emphasis on maintaining technological superiority while minimizing actual production remains to be seen.

## TASKING

The Assistant Secretary of the Army for Installations, Logistics, and Environment, through the Deputy Chief of Staff for Logistics, tasked the Logistics Management Institute (LMI) with examining several concerns about the industrial base. We were to identify the major lessons learned from the industrial base's responsiveness to ODS, to identify key congressional interest items, and to recommend a methodology and strategy for establishing and maintaining an optimum balance of procurement programs, war reserve stocks, and industrial base capacity to support requirements for multiple contingencies.

The results of our efforts were to be incorporated in the Integrated Army Mobilization Study (IAMS) – the Army's umbrella study for identifying major impediments to meeting future contingencies.

## SCOPE OF WORK

At the outset, we realized that many variables affect the future of the industrial base. From a planning perspective, we believed that the prevailing models for industrial base planning predicated on scenarios reminiscent of World War II were no longer applicable.

One of our tasks was to determine the lessons learned from the industrial base's support for ODS. Because ODS was unique in many respects – e.g., it had a 6-month buildup phase between initial deployment and combat, relatively short ground combat phase, and minimal attrition of major end items – we were sensitive to the need to avoid drawing inappropriate conclusions from that experience.

To place the Army's future planning efforts within the context of what we observed, we reviewed the current and projected changes to industrial base planning guidance documents, especially the draft Army and DoD industrial base planning directives. We also reviewed various drafts of the industrial base strategy being developed by the Army Materiel Command (AMC).

As part of establishing a future investment strategy, we created a methodology for linking industrial base planning efforts, namely investing in industrial preparedness measures (IPMs),[1] with the procurement of complete items. Our intent was to optimize the value of procurement resources while improving industrial responsiveness for either crisis response[2] or regeneration of depleted assets.

---

[1]Industrial preparedness measures are actions (e.g., procurement of long-lead time components or additional production equipment, waivers of regulations) designed to improve the ability of the industrial base to meet increased production requirements. Thus, IPMs may be used to mitigate legal, procedural, financial, or physical constraints.

[2]In the context of this report, crisis response is meant to denote situations in which little time is available for responding, in contrast to situations which would allow extended response, e.g., a future possible threat with potential for global conflict.

## ORGANIZATION OF PART I

Our findings, conclusions, and recommendations on our overall analysis of the industrial base are presented in Chapter 2. We have emphasized linking the industrial base contributions to warfighting requirements.

Chapter 3 serves as the primary basis for the material contained in Chapter 2. In Chapter 3, we present our observations of both industry and Government's responses for ODS. Those observations resulted from reviewing after-action reports generated following the conflict and from interviewing key personnel responsible for monitoring industrial base support for ODS; those personnel were located at AMC and its subordinate commands and at the Defense Logistics Agency (DLA).

Chapter 4 is a review of the major industrial base issues raised by successive congressional committees during its authorization and appropriations hearings on the Army's FY89 through FY93 budgets.

Chapter 5 presents a brief description of the Production Expansion/Acceleration Capability Enhancement (PEACE) model developed in conjunction with this project. The model is designed to provide program/project/item managers with the ability to incorporate industrial preparedness planning into their procurement programs and acquisition strategies. While still undergoing formal accreditation by the Army, the prototype model and a users manual are available for distribution to selected field elements for use as a means of integrating industrial preparedness planning into ongoing procurement programs.

# CHAPTER 2

# FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

## BACKGROUND

The general context for this study was defined by three major considerations: the U.S. industrial base response to ODS, a major regional conflict; the drastically changed strategic environment; and the sharply declining defense procurements and their corresponding impacts upon the defense industrial base.

It is dangerous to generalize in an area as complex and varied as the industrial base. Nearly every conclusion one draws must be supplemented by numerous exceptions or qualifiers. Nonetheless, we believe that we have captured the general tenor of the Government organizations and industry's involvement in supporting ODS and reflect them in this report.

## FINDINGS

### 1. Herculean efforts produced a successful industrial response to Operation Desert Shield.

In ODS, industry's response was successful because people, not necessary policies and procedures, made it happen. People throughout both industry and the Army, especially senior executives, were the key to success. Reflecting the broad base of public support for the operation, industry was especially proactive in many cases, e.g., providing the Heavy Equipment Transporter System (HETS) tires, M1 Abrams tank V-pack filters, and track vehicle pivot arms. Often, industry did not wait for the formal procurement process to provide funded delivery orders.

As a result of participating in earlier exercises, organizations generally had plans and policies for determining items to be accelerated and quantities needed. In many cases, crisis response teams were established on an almost ad hoc basis with few detailed procedures firmly developed. As the crisis evolved, highly successful crisis management procedures were developed and implemented. To avoid similar start-up problems in responding to future crises, many of the innovative plans and

procedures should be converted into Standing Operating Procedures and regularly exercised with appropriate representatives.

**2. The industrial base's response to Operation Desert Shield should not mask the base's underlying limitations.**

Industry can be justly proud of its response for Operation Desert Shield. However, its response also highlighted four aspects of industry's ability to meet the needs of potential future crises, where the scenarios might differ in significant respects.

First, no industry-wide response was necessary for supporting ODS. With very few exceptions, e.g., the Patriot PAC-2 and the Army Tactical Missile System, production of major weapon systems was not accelerated. Most of the items whose production was accelerated were ammunition, secondary items (Class IX spares and repair parts and consumables), and troop support items.[1] While industry had producibility problems with some of these items, they were, for the most part, less difficult to produce than items not accelerated (i.e., major weapon systems). For the Aviation Systems Command, industry was able to meet 63 percent of the requested acceleration demands. For the Tank-Automotive Command, industry successfully accelerated production of 109 (72 percent) of the 152 critical Class IX consumable items for which acceleration was requested. Requirements for most of the remaining 43 items were partially filled.

Second, except for some troop support items, e.g., desert camouflage uniforms, boots, and chemical protective equipment, most of the accelerated items were already in production or under contract. This meant that lead time problems otherwise associated with obtaining raw materials and components to accelerate production were minimized. In addition, in most cases, the accelerated production of items already ordered was requested, not production of additional items.

For those items not under contract, expeditious contracting procedures, including use of the Paperless Ordering Procurement System, were used. This was especially true for troop support items. Contracts for critically needed chemical protective suits were awarded to two new firms within just 6 days. Innovative contracting initiatives also assisted in increasing the production of meals-ready-to-

[1]In the context of this report, secondary items consists of consumables, reparables, and troop support items.

eat. In all, 10,600 contracts and 2,100 contract modifications were administered by the Defense Contract Management Center. However, in meeting the exigencies of the situations, coordination was not always completed with appropriate contract administration offices.

The need for additional producers of the troop support items was accommodated partially by the availability of excess production capacity because of the downturn in the economy and the use of "tiger teams" dispatched to contractors' sites to resolve problems. These teams consisted of specialists in contracting, manufacturing, and supply and item technical experts. This type of initiative was instrumental in reducing some normal contract lead times of 9 to 12 months to 10 to 14 days. In addition, first article test and technical data package waivers were selectively granted to facilitate production and delivery of new items.

Third, with few exceptions [e.g., some precision guided munitions (PGMs)] the short war did not consume significant amounts of munitions or end items. Accordingly, there was little need to replenish war reserve stocks (WRS) except for spares, reparables, and some "smart" munitions. Additional production capacity was not needed to meet replacement demands since sufficient capacity was available through existing contracts.

Fourth, the detailed production data and industrial capabilities information contained in DoD's formal industrial preparedness planning (IPP) system were of little value in specifically representing industry's possible responsiveness. The formal data collection system was in the midst of being revised, so data were not available on all normally industrially planned items or systems. Since the traditional IPP had focused on achieving mobilization rate production 7 months after the outbreak of a global conflict, the planning parameters were different.

Notwithstanding limitations in production data, industrial planners were important contributors throughout the crisis. Their knowledge of the respective industrial sectors was instrumental in assisting the various crisis management teams. As a specific example, industrial base planners at DLA were able to quickly select the most capable and responsive contractors for manufacturing such items as chemical protective clothing and other clothing and textile items. Similar assistance was provided at other commands.

Nonetheless, the focus of prior industrial base planning on supporting a long-war scenario and attendant Mobilization Day (M-day) planning revealed the need for improvement, restructuring, and integration of industrial base planning considerations by program, project, and item managers.

**3. The choice of items that were accelerated highlighted the need for increased planning for secondary items.**

The majority of items accelerated for ODS were secondary items, not major end items.

The Army's Industrial Preparedness Planning List (IPPL) identifies the critical items for which IPP will be done to ensure the base's ability to meet mobilization training and combat consumption requirements.

However, of the items accelerated for ODS, only about 25 percent had current production data available. Consequently, industrial base planner's were uncertain of the base's possible responsiveness. An exception was the Communications and Electronics Command (CECOM). Approximately 95 percent of 825 CECOM-managed items for which urgency buys were authorized were listed on the IPPL. Nonetheless, for the majority of commands, that was not the case.

For the future, industrial responsiveness to contingencies will again most likely require accelerated production of secondary items. Accordingly, the IPP community should focus increased attention on secondary items for crisis response. Because of reduced procurements, more production lines for major end items will be "cold" and therefore unable to respond to a crisis of little warning. Industrial planning for major end items will center more on meeting replenishment and reconstitution needs, not crisis response. Thus, the immediate emphasis should be on planning for secondary items, with a different degree of future planning for major end items out of production.

**4. Hoped for industrial base responsiveness cannot substitute for insufficient war reserve stocks.**

The industrial response to ODS benefited from the strategic situation. After initially deterring Iraq in early August 1990, the United States had the initiative. This provided industry with essentially 6 months (August 1990 through January 1991) to supply anticipated ground war needs.

Although before the crisis, U.S. forces were better stocked and equipped with modern equipment than prior to entering any previous conflict, stockage deficiencies existed in many areas (right up to the commencement of Operation Desert Storm). In fact, had the land war been longer, the battery and electronics industries might not have kept pace with the demands.

In the case of batteries, only three companies produce military lithium batteries. Procuring increased quantities of BA-5112 batteries meant curtailing production of BA-5590 and 5567 batteries. Had the land war lasted more than 30 days, the battery industry could not have met the demand. Such a condition results from sizing the industrial base to meet peacetime demands rather than projected wartime requirements. This problem is compounded by failure to provide adequate war reserve stocks.

Decreased tensions in other theaters permitted the Army to shift theater war reserves to support Operation Desert Shield. In all, stocks from 13 WRS sites were shipped to Saudi Arabia. Those shipments helped reduce demands upon the industrial base. However, industry, or in some cases foreign sources, were expected to fill the remaining shortages.

It was hoped that 1.2 million 25mm Armor Piercing Discarding Sabot (APDS) rounds manufactured in the Netherlands could be used in American weapons. However, because those cartridges had been manufactured with nonheated cartridge cases, they would not work in the U.S. M242 cannon. The lesson here is that we cannot assume foreign substitution without appropriate pretesting.

Government and industry's past mobilization-oriented planning (with its focus on achieving sustained production rates in the seventh month after mobilization) did not facilitate industry's response. However, the 6-month buildup did allow industry to fill many existing WRS shortages. Even with that luxury, however, the Army would have faced materiel shortages had the ground combat phase been much longer.

Accordingly, a key lesson relearned was that when reacting to a crisis with little or no warning, operations planners and field commanders cannot blindly assume that industrial capability can serve as a substitute for WRS.

5. **The focus of past industrial preparedness planning is not relevant to today's national military strategy, which emphasizes response to regional crises.**

Past industrial base planning assumed a long-war scenario. Both industry and Government planned as though the United States were going to fight World War II again. We planned to simultaneously fight the Soviet Union and other Warsaw Pact ground forces in central Europe, engage naval forces around the world, and meet other contingencies.

The industrial base was expected to meet those demands by achieving sustained mobilization rate production at the end of 6 months (M+6) following the onset of hostilities, with mobilization (M-day) and the conflict beginning almost simultaneously. Industry was to provide sufficient production (P) after 6 months to meet the wartime consumption demand (D) at that time. This was known as the D-to-P concept.

That planning assumed, among other things, that industrial preparedness measures (IPMs) had been identified to facilitate increased production. Some IPMs were developed on the assumption that preconflict funding would be provided in time to permit implementation on either M-day or when hostilities began; Congress would provide a "blank check" to fund the accelerated production. In addition, planners widely assumed that environmental and safety waivers would be provided automatically to facilitate expanded production. All of this was tantamount to assuming that the industrial base would be "turned on" as though it were a light switch and expecting results just as quickly.

Some believed this was the key lesson learned from World War II, when the "arsenal of democracy" supported the victorious Allies. Sometimes forgotten was that those production output levels took approximately 4 years to achieve.

In terms of strategic planning, the D-to-P concept also assumed that sufficient stocks would be in place to supply the forces through the first 6 months. In reality, our procurement strategies of the past decade did not adequately fund those stockage levels because the "big war" scenario was given a low probability of occurring.

The bottom line is that past industrial base planning did not affect industry's response to Operation Desert Shield. Industry did not mobilize; M-day planning was not implemented; IPMs were not funded; Congress did not give a "blank check" for

additional procurements; and no blanket environmental waivers were granted. Rather, because of the contained nature of the Persian Gulf conflict, the acceleration of production for selected items was a limited response under almost "business as usual" conditions. And under those conditions, industry responded extremely well with some exceptions.

Essentially, industry showed that it did not have to mobilize to meet crisis demands (as long as the force was reasonably stocked and equipped, the combat phase was short, and no other major immediate threat occurred). On the other hand, the specific companies accelerating production were responding as though they were mobilizing, e.g., they added shifts, opened new lines, and contracted with new suppliers. Generally, no regional contingency should require "mobilization" in the traditional sense.

Our strategy recognizes the possibility of reconstitution for responding to a possible future major threat – but that reconstitution would be expected to occur over a longer term, say, 2 or more years. The necessity for a quick, massive, general mobilization can be envisioned only as a failure in responding to early strategic warning.

The near-term effort should concentrate on the development of crisis response planning focused on industry's ability to quickly satisfy specific shortfalls.

## CONCLUSIONS

1. **Future industrial base planning and investment must reflect changed fiscal and strategic realities.**

The past 2 years' revolution in world affairs has radically redefined America's defense strategy. From a planning perspective, American industry now must be prepared to respond to at least three distinct requirements: participate in major regional contingencies that can occur with little or no warning; replenish depleted stocks reasonably quickly following a conflict; and reconstitute forces over a relatively long period of time (at least 2 to 3 years) to meet a major threat. The strategy and plan to assure that capability are still evolving. The difficulty of planning and programming for nonspecific threats is just beginning to emerge as a major national issue.

The IAMS considered two distinct strategic situations: two simultaneous MRCs with essentially no strategic warning and a general conflict in Europe preceded by 12 to 18 months of strategic warning during which time the U.S. industrial base could respond. This latter case represented a mobilization scenario for countering mobilization activities in the then-Soviet Union. With the abolishment of the Warsaw Pact and dissolution of the Soviet Union, the European general conflict scenario appears implausible, even in the longer term.

## CRISIS RESPONSE

For the near term, the national military strategy requires the ability to respond to crises with very little warning. Prolonged warning and buildup periods are not assured and, therefore, are not prudent planning assumptions. Response to such crises may be regarded as "come as you are". The immediate focus for industrial planning, then, should be on striving to achieve a balance between procuring the needed WRS for planning scenarios and investing in industrial responsiveness for critical items. That is, in some cases it may be cheaper to actually buy fewer end items (primarily secondary items) and invest in industrial surge capability. (This observation is the basis for development of the LMI PEACE model, described in Chapter 5.)

Planning for replenishment/regeneration and reconstitution, which is also necessary, requires a different orientation. Table I-2-1 presents a framework for considering the differences among these situations.

### Replenishment/Regeneration

In the past, most industrial planning concentrated on meeting immediate wartime needs. At the end of World War I and World War II, since we faced no imminent threat of renewed large-scale fighting, we demobilized both industry and the military rapidly. Even though large amounts of stocks existed at the end of World War II, 5 years later when Korea exploded, there were deficiencies, old equipment, and a very "cold" military industrial base. We could be in a similar situation – but today, consideration of possible industrial responsiveness is part of the national security strategy.

Future regional conflicts, while possibly of short duration, may not result in the minimal equipment losses of ODS. Reduced defense procurements will not guarantee

TABLE I-2-1

INDUSTRIAL BASE PLANNING CONSIDERATIONS POST-DESERT STORM, NEW WORLD ORDER

| Considerations / Situations | Crisis response | General conflict | Replenishment/ regeneration | Reconstitution |
|---|---|---|---|---|
| Warning | None – short | Moderate | TBD | Moderate – long |
| Conflict (duration) | Short | Short – moderate | Needs definition | Possibly long |
| Planning horizon | Near term | Moderate | Near – moderate | Long term |
| Readiness response | WRS | WRS and buildup | Replacement | WRS and much buildup |
| IBP focus | Secondary items | Secondary items limited MEIs | Secondary items; major end items | Major end items; secondary items |
| IBP response | "Come as you are" | Warm base/surge limited cold base starts | Warm base/expansion; cold base regeneration | Warm base/expansion; cold base regeneration |
| GMR | Minimal | Yes | Yes | Yes |
| Today's focus | Fund WRS; integrate IBP with item management | Fund WRS; consider IBP response; consider warm base requirements | Define requirements and response time; consider cold base | Identify targets; identify critical subtiers; focus production base analyses |
| Technology focus | Product development | Critical technologies; manufacturing processes | Critical technologies; manufacturing processes | Critical technologies; manufacturing processes |

*Note:* IBP = industrial base planning; MEI = major end item; GMR = graduated mobilization response.

that warm production lines will be available to replenish depleted stocks within a reasonable time. Thus, the ability to replenish consumed war supplies and equipment will be diminished.

The PEACE model, developed by LMI, could be used to analyze possible industrial contributions toward replenishment resulting from peacetime investment in industrial preparedness measures.

The Army's Logistics Evaluation Agency's (LEA's) sustainability analysis for IAMS contains data on selected munitions and major end items on which to base

possible replenishment demands. However, LEA did not evaluate secondary items, thus reinforcing the need for better data in that area.

The LEA results can serve as a starting point for analyzing the possible replenishment requirements for industry based upon the IAMS scenarios. Among the key variables to consider in that analysis is the currently forecasted procurement profiles for the selected items. Since the LEA analysis was done on selected items, that can only serve as a starting point.

Of particular consideration for replenishment planning are the available time between crises to replenish depleted stocks, the effect of trying to increase production from a cold base after possibly years of reduced procurements, and the impact of investing in industrial preparedness measures.

The current acquisition strategy of emphasizing development of the next generation of modern systems without entering full-scale production has significant implications for replenishment planning. Production of major end items, such as the Abrams tank, Bradley Fighting Vehicle, and Apache helicopter, may be terminated before development of follow-on systems is completed or production initiated. If a conflict results in serious attrition of such assets, the Army will be faced with a decision of whether to replace those major end items by reestablishing production facilities (easier if they have been laid away) or waiting to complete development of the new items and replace with new production. In either case, there is a risk of a significant period before the new items are available. This period will be shorter if development and prototype production (of sufficient numbers to test producibility) have been completed. Nonetheless, this risk must be considered in deciding to end production of the current systems.

### Reconstitution

Reconstitution planning, as an element of the national military strategy, is important even though the chance of a general conflict, long-warning scenario has decreased. Although reconstitution considerations closely approximate past mobilization planning scenarios (and therefore now runs the risk of being ignored), certain prudent actions should be taken with respect to reconstitution planning. Table I-2-1 identifies some of the different industrial base considerations in planning for reconstitution as distinct from planning for other contingencies.

At this point, it is difficult to foresee the actual threat that would require reconstitution of forces to the 28 division Army strength. The absence of a specific threat does not obviate the need to plan for the contingency; however, it does change the focus from crisis response planning, placing greater emphasis on the ability to regenerate additional equipment and supplies from a colder production base. However, in contrast to crisis response and replenishment planning, greater emphasis will be placed on producing major end items to fill the additional forces.

### Graduated Mobilization Response

The Graduated Mobilization Response (GMR) planning concept has been developed to provide a structure for organizing the Government's response to national military emergencies.[2] The possibility of a long strategic warning period places greater premium on developing and implementing the GMR concept.

The GMR's structure and planning principles apply across the entire spectrum of contingencies not only in planning for reconstitution but for crisis response and replenishment planning, as well. Through such planning, appropriate triggering mechanisms can be identified to facilitate industrial responsiveness. The key will be timely implementation of those GMR actions. (See Part IV for a complete description and possible applications of GMR.)

**2. While concern for the defense industrial base has been widely discussed within segments of the defense community, industrial base planning has not been adequately considered in the acquisition process.**

In 1980, the Defense Industrial Base Panel of the House Committee on Armed Services published a report entitled, *The Ailing Defense Industrial Base: Unready for Crisis,* commonly referred to as the Ichord Report. Since that time, concern for the health of the U.S. industrial base has increased. The DoD industrial base planning community and associations such as the American Defense Preparedness Association have been especially vocal in this regard. However, a certain unreality has permeated this concern, stemming from the widespread perception that the

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[2]Title 44, Code of Federal Regulations, Part 334, provides the bases for incorporating GMR planning in the Federal departments and agencies. GMR is a system for integrating emergency preparedness planning actions designed to respond to ambiguous and/or specific warnings. Those actions are designed to mitigate the impact of an event or crisis and reduce significantly the lead time associated with implementing them.

likelihood of needing to actually mobilize industry in the foreseeable future was nil. This perception was validated in successive DoD budgets and programs wherein little or no emphasis was given to sustainment issues (e.g., war reserves and the industrial base).

In particular, industrial preparedness measures were unfunded in the past because we perceived no need to ever mobilize the industrial base. Few industrial preparedness measures were associated with quick-response scenarios; rather, they were associated with achieving mobilization rate production. As a practical matter, that meant they did not interest acquisition managers who generally focused on the need to field the most items within budget. In addition, industrial preparedness planning was done by industrial planners (a somewhat isolated community) who were not directly involved in end-item procurement decisions.

For similar reasons, other industrial base planning considerations were not fully integrated into the acquisition community. Numerous studies have highlighted the need for considering industrial base issues in the acquisition process. However, it has not been until recently, especially with the publication of the revised weapon system acquisition policy directives (DoDDs 5000.1 and 5000.2) that the industrial base aspects have received appropriate official consideration in the acquisition process. Even here, however, the emphasis is on the planning associated with major end items and no concern is given to secondary items.

Notwithstanding these directives, the acquisition community is likely to continue to focus on cost, schedule, and performance while paying minimal attention to the industrial base. With fewer industrial specialists, more responsibility for considering industrial base issues will have to be borne by program/project/item managers.

## RECOMMENDATIONS

1. **The Army should refocus industrial base planning from M+6-month mobilization rates to crisis response/quick surge planning.**

The Army should emphasize possible industrial base contributions to the short-warning scenario. Had we not been graced with a 6-month buildup period for Operation Desert Shield or if Operation Desert Storm had lasted longer, industry would not have been able to respond as it did.

Simply shifting the focus of planning will not be sufficient to achieve the desired result of an industrial base better prepared to respond to crisis. Key to planning for industrial responsiveness is the availability of critical planning data that are timely and accurate concerning production capabilities, especially from a supply – rather than scenario-dependent perspective. Use of the incremental production schedules on the DD Form 2575-1 will be very helpful. Scenario-dependent information, e.g., warning times, force composition, attrition/consumption, etc., can be used for conducting sustainability and trade-off analyses between stocking war reserves and relying upon industrial responsiveness.

2. **The Army should emphasize industrial base planning for ammunition and secondary items.**

The Critical Items List (CIL) and the IPPL should be reviewed to ensure that they support the crisis response strategy. These lists should be expanded. With decreasing personnel involved in industrial base planning, acquisition managers will have to become more involved. The revised industrial base planning forms (DD Form 2575 series) should facilitate the data collection.

Several agencies are involved in identifying "critical" items for industrial base planning. However, in addition to the Service operations staffs and the Commanders-in-Chief of the combatant commands, program/project/item managers should be involved in identifying critical items by considering the current stockage position and the state of the industrial base relative to their particular items.

As the military adopts an adaptive planning philosophy for future operations and considering the general uncertainty regarding specific threats, identifying requirements will be even more difficult. Accordingly, planning for crisis response, replenishment, and reconstitution probably will be based more on available "supply" data from industry than on industrial data identified for meeting a specific

"demand", (i.e., scenario, requirements). DD Form 2575-1 provides industry with the opportunity to depict incremental production increases. That information should be the basis for improved IBP.

The use of the three-part DD Form 2575 has not been fully implemented, thus industry's response is not known. However, without some incentives, industry may be reluctant to provide such detailed data. The use of data item description (DIDs) requirements in the contracting process, while costly, would facilitate gathering IBP information.

**3. The Army should develop a stronger linkage between war reserve stockage policy and industrial responsiveness.**

Reducing to the base force will not necessarily result in an abundance of WRS materiel for future crises. Specific deficiencies that still exist may be compounded by declining procurement budgets, especially funding for secondary items. Although the basis for determining future stockage objectives has not yet been firmly established, having sufficient WRS to fight two major regional conflicts has been suggested as a possible goal. As noted above, constrained budgets may mean that even relatively modest WRS stockage objectives will not be attained.

In any crisis, we will need some war supplies that are not stocked. However, we can determine those deficiencies by analyzing procurement budgets. Industrial base planning to correct those shortfalls is an immediate priority. For responding to crises with short warning, the Army cannot depend upon restarting a "cold" production base to satisfy warfighting requirements. The Army's objective should be to fill its war reserve requirements and to use the "warm" production base for consumables and reparables to satisfy any shortfalls. Satisfying those shortfalls is the imperative for industrial base planning.

Funded WRS objectives should be determined during the program objective memorandum (POM) process considering realistic industrial surge capability. That is, the Army must seek opportunities to satisfy wartime requirements through a combination of investments in industrial surge capability and procurement of WRS. And it should seek to satisfy them at a cost lower than it would face if the WRS requirements alone were funded. To do that, managers must be apprised of the potential for cost-effective investments in surge capabilities. With such information, managers can balance WRS procurements with industrial surge investments,

particularly with regard to secondary items and ammunition. This procedure requires closer coordination between industrial planners and the acquisition community, especially for secondary items.

**4. The Army should determine the impact that various environmental conditions in the areas of possible regional contingencies may have on secondary item requirements.**

The absence of specific threats does not eliminate the need to quantify WRS objectives as much as possible. One of the criticisms arising from the ODS experience was that the various environmental aspects of fighting in that region (e.g., high temperatures and sand) had not adequately been considered in the estimation of requirements.

Industry met the specific climatic needs encountered in Saudi Arabia, Kuwait, and Iraq for such things as filters, truck tires, and shade screens. American ingenuity rose to the occasion, but ingenuity should not substitute for inadequate planning.

For the future, requirements determination will be complicated by the absence of specific threats. Our focus in planning for regional contingencies using adaptive planning techniques will require even greater emphasis on identifying the distinctive environmental characteristics and resulting impact upon military equipment and supplies.

**5. The Army should determine the requirements for the two most demanding operations plans or regional contingencies and use them as the objective for WRS procurements.**

For WRS procurements, we recommend identifying and using the requirements for the two most demanding operations plans or regional contingencies, especially for secondary items.

One benefit of buying WRS against the requirements for two major regional contingencies is that it ensures that, after fighting a single conflict, our stockage position would still be adequate for a second contingency, i.e., replenishment would not then be an emergency requirement.

In some cases, we can meet WRS requirements at lower cost by a combination of procuring complete items and investing in industrial preparedness measures to

provide a response capability. If we do not procure enough WRS for two contingencies, the assumptions concerning any warning time and our response to such warning will become more sensitive. The expected time between crises is also a key variable for determining the amount of investment necessary for increased production. However, these concerns would be significantly alleviated by adopting a policy of setting procurement objectives on the basis of the two most demanding operations plans.

With the great changes in the defense planning environment, we need to examine closely how requirements, especially for secondary items, are determined. Witness the experience of the Gulf War wherein the CINC established a "requirement" for 60 days of supply.

6. **The Army should conduct tradeoff analyses between procuring complete items and investing in industrial preparedness measures, especially long-lead-time components, raw materials, and test equipment.**

The response to Operation Desert Shield indicated that industry could produce additional quantities of certain items quickly, e.g., HETS tires, rations, and M1 Abrams tank V-pack filters. Because of changing strategic and fiscal realities, it is important that we identify the existence of possible tradeoffs between end-item procurements and investments in industrial responsiveness.

We should develop criteria for item managers to use in determining good candidates for investment in surge capability. These criteria could include, as a minimum, such factors as the number of current producers of the product, health of the supplier base, life-cycle status, degree of foreign sourcing, etc.

The surge benefits of funding industrial preparedness measures can be determined by using the tradeoff methodology of the Production Expansion/Acceleration Capability Enhancement (PEACE) model developed by LMI in conjunction with this study (see Chapter 5). Through this tool, acquisition managers can decide between procuring complete items and investing in industrial preparedness measures.

As a first step, the Army, in conjunction with DLA, should support an effort to identify selected secondary items for which the wartime requirements can be satisfied by a combination of WRS and industrial surge.

7. **The Army should make sure that Congress and others in the funding process understand the need to meet warfighting requirements by funding a combination of WRS and industrial preparedness measures.**

Throughout the past decade, the Army (and the other Services) had difficulty convincing Congress to adequately fund WRS. Much of that problem was self-inflicted since sustainability often received low funding priority during Service programming. Even when the *Defense Guidance* postulated the prospect of global war against the Soviet Union, the Services predicated their funding proposals on the premise that war would not occur during the 5 years covered by successive Five Year Defense Plans (FYDPs).

The current regional focus and adaptive planning process highlight the need for ready, sustainable forces. Accordingly, with the prospect of short-notice force employments possibly greater now than in the past, increased attention should be paid to ensuring the adequacy of WRS funding.

In the absence of specific threats, Congress may be reluctant to fund sufficient WRS for two possible contingencies. However, the instability of the current world situation may assist the Army in receiving favorable consideration by OSD and Congress. The primary argument would be that funding WRS based on the two most demanding regional conflicts would provide for the worst-case scenario of those two contingencies occurring simultaneously. In addition, such stockage levels would ease replenishment demands following an initial crisis.

In pursuing this proposal, the Army should be able to demonstrate that for selected items, the funding requirements represent providing needed wartime quantities through the least-cost peacetime investment of procured stocks and industrial responsiveness.

**8. The Army should consider adopting a two-tier approach to industrial base planning: one for meeting crisis response needs and the other for satisfying replenishment and reconstitution requirements.**

Although the Army must be prepared to respond to crises across the spectrum of contingencies, the near-term emphasis is on being able to respond to possible major regional contingencies with little warning. Yet, the Army must also plan for replenishing supplies attrited in such conflicts and for possible reconstitution requirements. However, the extent of planning, especially from an industrial base perspective, will differ for each of these situations, primarily because of the time available for responding.

To facilitate such an approach, industrial base planning for the items listed in the IPPL could be oriented in two directions: planning for items necessary to respond to crises – items for which there is "warm" production base, particularly secondary items that have an unfilled war reserve requirements: and planning for items necessary for replenishment or reconstitution for which the production base is "cold."

Such a distinction would focus industrial planning on the ability of industry to quickly support crises by a responsive base separate from the ability of industry to respond when more time is available.

The use of joint production base analyses (PBA) should be reinforced. The process is beginning but needs more complete implementation. Initial candidates should be those systems which are about to curtail production to determine the availability of the subtier, down to third and fourth level, to support future spares availability.

**9. The Army should analyze options concerning the operations of Government-operated manufacturing and repair facilities.**

The Government-operated manufacturing arsenals and repair depots are important segments of the Army's industrial base. While conducting this study, the possibility of over-facilitization of such facilities, especially in light of future reduced budgets, was identified as a possible problem.

The Army has addressed a similar situation in the ammunition production base in the Ammunition Base Planning and Restructuring Study of 1990. However, no

comparable comprehensive study appears to have been done for the manufacturing and repair segments.

As a means of retaining portions of its active ammunition production base, the Army encourages operating contractors in some of its Government-owned ammunition plants to obtain third-party sales. In some instances, this allows ammunition plants to be retained in an active status rather than being totally inactivated. A corollary situation may pertain to Government-owned and -operated manufacturing arsenals and repair depots.

Faced with steadily declining budgets and possibly decreased workloads at these facilities, a possible alternative for continued operation may be the use of these facilities for other than strictly military manufacture or repair. The modernization of these facilities by computer-aided design and manufacturing equipment and flexible manufacturing systems may make them available for dual-use (commercial and military) applications. Another alternative may be the conversion of these facilities to contractor operation, similar to that of many Army ammunition plants. This could be a means of retaining the facility if it results in reduced costs to the Government.

In the face of continued efforts to reduce the number of military facilities, some depot repair operations may be transferred to commercial industry. The reduction in Army facilities may have economic benefits and also serve to preserve some commercial industrial capabilities that might otherwise be lost as military spending declines. The possible transfer of repair operations to industry would have to be balanced against the loss of Army organic capabilities.

# CHAPTER 3

# THE INDUSTRIAL BASE RESPONSE FOR OPERATION DESERT SHIELD/DESERT STORM

## INTRODUCTION

At the outset of Operation Desert Shield/Desert Storm (ODS), the United States recognized that it was not to be engaged in a prolonged global war and that U.S. industrial mobilization, as a general notion, would not take place. Nonetheless, for the industrial areas affected by the operations, herculean efforts were often needed to produce the necessary materiel support for the war. The efforts of the thousands of military and civilian personnel who provided that support demonstrated diligence, creativity, and determination.

Operation Desert Storm was an unqualified military victory, and the U.S. industrial base made major technological, developmental, and production contributions. This success would not have been possible without industry's often proactive actions, including those of the R&D community, in anticipating and responding to Government requests for additional supplies and equipment. In large measure, this highly positive reaction was reflective of the generally positive public support for the U.S. role in this operation.

Such agencies as the Army Materiel Command (AMC), its major subordinate commands (MSCs), and the Defense Logistics Agency (DLA) have developed and submitted detailed after-action reports. This report highlights key observations that are generally indicative of industry's support for ODS and have implications for the future.

## BACKGROUND

A major caution should be stated at the outset. The industrial response to ODS, as noteworthy as it was, should only be taken in context. It was not an industrial mobilization. The many unique aspects, (e.g., 6-month buildup period, existence of a relatively warm production base, and focus on accelerated production of secondary items rather than major end items, were significant factors in industry's

responsiveness. The absence of such favorable factors in the future, because of reduced military production, would bring into serious question U.S. industry's ability to respond to crises when such conditions might not exist.

A key element in successfully facilitating increased production of critical items was the personal interactions between Army general officers and the chief executive officers (CEOs) of supporting producers. In November 1990, AMC hosted a meeting with CEOs of some of the principal companies supporting major Army aviation systems. This meeting was followed by selected plant visits by general officers to boost morale and reinforce the importance of the defense efforts. Similar direct general officer contacts were made by leaders of AMC and its MSCs. Often these contacts were simply telephone calls. However, the importance and influence associated with such contacts cannot be minimized. Many times, they were the key to obtaining needed support or eliminating production problems.

It should also be mentioned that prior to the outset of ODS, AMC and its MSCs were preparing to execute a significant reduction in force (RIF) affecting AMC headquarters and MSC personnel on 9 August 1990. Prompt personnel management action was taken to suspend the RIF execution notices and to revise schedules for future implementation.

## INDUSTRIAL PREPAREDNESS PLANNING

### General Observations

Industry's response to ODS highlighted several issues:

- The limitations with current industrial base planning (especially in light of a significantly changed strategic situation)
- The limitations of accelerating/surging production[1]
- The need for the Defense Production Act, or similar authority, for resolving priorities and allocation issues
- The availability of foreign-sourced components

[1]No distinction will be made between these two terms, which are often used interchangeably within this report. Surge is defined in the Draft DoD 4005.1-M, *Industrial Base Program (IBP) Procedures*, October 1991, as an increase in the production and repair of defense goods of limited duration that minimizes disruption of other production and repair activities. In the past, surge was often considered to be a doubling of production within 6 months.

- The lack of timely additional procurement funds
- The limitation of emergency procurement actions by peacetime reprogramming authority.

Questions regarding industry's ability to sustain committed forces for prolonged periods to repair or replace major end items were not answered by this experience. The relatively short duration of the war, especially the ground combat phase, resulted in the relatively minor demands for battle damage repair in the theater, low consumption of conventional ground-delivered munitions, and the lack of serious attrition of major end items.

Primarily because of the buildup time available before the initiation of combat, the emphasis on accelerating production and repair of secondary items rather than major end items, and the relative "warmth" of the production base, industry was able to respond. In the absence of such favorable conditions in the future, *the industrial base should not be expected to be capable of immediately eliminating stockage deficiencies, especially if the base is "cold."*

What should be clear is that in preparing for future major regional contingencies that may occur with little or no warning, assumed industrial responsiveness should not be considered as a substitute for the procurement of sufficient war reserve stocks. Rather, industry's responsive capabilities can, and should, be considered in determining appropriate stockage levels.

## Specific Observations

First, our response to the crisis did not result in industrial mobilization or require it. The entire industrial base was not stressed and, therefore, the industrial response is not a true indicator of industry's ability to respond to major conflicts that require additional major end items or weapon systems, replenishment of attrited items following a conflict, or additional forces during reconstitution in the face of a major threat.

Because of the complex and diverse industrial base supporting U.S. forces, sweeping generalities regarding industrial responsiveness cannot be made with any confidence. What is clear from the ODS experience, however, is that sizable segments of industry increased production and accelerated deliveries, including

items under repair. Among the conditions that favored such response were the following:

- Pre-existing contractual relationships and a proven record of performance with specific producers
- A pronounced sense of urgency and corresponding high degree of public support
- Personal involvement of general officers and CEOs
- A "warm" production base and concentration on producing secondary items (components) rather than major end items
- Identified and available additional producers (especially true for commercial-type items, e.g., rations, uniforms, and boots)
- Pre-identified and approved commercial substitutes for military items.

Notwithstanding severe shortages of particular items, such as chemical protective clothing and detection equipment, our forces were reasonably well stocked with modern major end items. Where certain deficiencies existed, some items could be obtained from nondeploying units to support deploying forces. In the absence of other threats, stocks pre-positioned in other theaters were also made available to supply the committed force.

Yet, in many instances, sufficient stocks of spare parts and consumbles, e.g., batteries, were not immediately available to fully support systems operating at increased levels. The severe climatic conditions of the Persian Gulf theater further exacerbated those shortages because of greater than anticipated usage rates. First, this meant that items with relatively low stockage levels faced rapid depletion and the accompanying rapid demand for replenishment.

Second, from a purely supply perspective, it meant that items with adequate peacetime inventory levels, e.g., batteries, filters, and other spare parts, were quickly depleted by large requisitions, either caused by increased consumption or the need to build an in-theater 60-day inventory. This immediate spike in demand created the need for expeditious action on the part of the procurement community. In some cases, item managers had been temporarily lulled into a false sense of security by presumably high stockage levels only to see them quickly eliminated by much greater than anticipated requisitions. Thus, items that seemed to have adequate

stockage levels one day very quickly made the intensely managed items list of the procuring activities the next day.

Third, the fact that Iraq was quickly deterred from attacking Saudi Arabia meant that the initiative for the remainder of the operation resided primarily with the United States and the coalition forces. Accordingly, given the timetable established by the National Command Authority, 6 months was available to industry to eliminate stockage shortfalls in order to fight the ground war.

Fourth, the relatively good inventory posture of major end items for the deployed forces (even considering the need for some cross-leveling of items between nondeployed and deploying forces) meant that increased production requirements centered on secondary items (consumables, reparables, and spare parts), selected munitions, and particular troop support items. With the exception of some troop support items, e.g., desert camouflage uniforms and boots, rations, and chemical protective clothing, that necessitated contracting for additional producers, the primary means of achieving increased deliveries was accelerating the production of items already under contract or in production. With very few exceptions, notably the Patriot Antitactical Missile Capability – Level 2 (PAC-2) version and the Army Tactical Missile System (ATACMS), major weapon systems were not accelerated.

Finally, it is important to note that no magic "mobilization switch" was turned on that provided unlimited funding authority or granted blanket environmental or Occupational Safety and Health Administration waivers to expedite increased production levels. However, innovative and expedient contracting mechanisms were used very successfully to facilitate obtaining contractor support.

## SUBJECT AREA COMMENTS

### Industrial Preparedness Planning

A major lesson relearned during ODS is that *industry's capabilities cannot be fully identified within any formal industrial base planning system.* At best, the data submitted in past years on such forms as the DD Form 1519 (Test) *Industrial Preparedness Program Production Capacity Survey*, April 1989, represented the best information available at a particular point in time and were useful only as a starting point. At that, the orientation of the data was not appropriate for responding to a regional crisis with little or no warning.

For the past several decades, industrial preparedness planning (IPP) for the items contained in the Department of the Army (DA) Critical Items List (CIL) had focused on developing plans to increase production 6 months following the initiation of a massive mobilization to counter a global threat. The goal was to increase production so that in the seventh month of mobilization production would be equal to the continued monthly demand of a prolonged (global) war. This planning focused more on major end items than consumables and, therefore, did not have a crisis response orientation that would have assisted responding to Operation Desert Shield. Notwithstanding the limitations of this planning system, some earlier efforts (e.g., providing long-lead-time components for the Tube-Launched, Optically Tracked. Wire Command-Link Guided Missile, Version 2 (TOW 2) were made to provide a surge (quick-response) capability.

For many items, industrial preparedness measures of long-lead-time components, additional test or manufacturing equipment, or facilities were identified to increase production to meet mobilization rates. Such IPMs were not funded primarily for three reasons. First, they were not oriented towards a crisis response situation. Second, the absence of a mobilization threat precluded the necessity for funding. Third, any funding recommendations developed by industrial base planners were given lower priority by the acquisition community, which was primarily concerned with meeting current cost and production schedules. What was often missing was a quantifiable linkage among funding IPMs, the impact on meeting stockage deficiencies, and the possible effect on warfighting capabilities.

In many cases, the industrial planning data[2] provided by industry could not be fully validated partly because of reduced staffing of industrial specialists at the procuring commands. In 1985, in part because of the low degree of confidence in the

[2]Industrial planning data, as reflected on DD Form 1519 (Test), consisted of item and prime contractor-producer identification; production planning schedules under various shift and mobilization conditions; minimum sustaining rate; IPMs, prioritized list of pacing factors, critical components by part number, nature of criticality, and supplier; critical labor skills; commercial substitutes; foreign-sourced items and related information; foreign-manufactured production equipment; and recommended reductions to military specifications for mobilization production. Additional information was provided on the production facility to include maximum production capabilities, time needed to achieve it, plant physical characteristics, and employment figures. The DD Form 2575 series requests similar information, with the most noteworthy change being the addition of requesting incremental production schedules with associated IPMs, cost, and emplacement time.

data reported by industry, the Undersecretary of the Army suspended the use of the DD Form 1519 collection process.

In 1989, a DD Form 1519 (Test) was developed by the Army and sent to contractors to collect IPP data. At the outset of ODS, current production data were available for approximately 25 percent of those items chosen to be accelerated, as reflected on available DD Forms 1519 (Test). Maximum production data were available but were stated in terms of what could be achieved in 6 months. Thus, for the most part, the data available through the formal IPP process was neither timely, relevant, nor useful for supporting ODS.

An integral part of the IPP process was the identification of IPMs that would facilitate increased production. However, even in that area, the past IPP system was oriented on achieving increased production rates 6 months after formal mobilization. Accordingly, most of the IPMs identified were associated with increased facilitization requirements. Very few were associated with the ability to accelerate production by stocking long-lead-time components. Not surprisingly, with only limited exceptions – notably, the TOW 2 missile and for some parts for the Avenger – IPMs had not been funded in the past and, therefore, were not available to facilitate increased production to meet ODS requirements.

Essentially, support for ODS was a "come-as-you-are" effort and *that meant that much of the detailed IPP of the past was not applicable.* That does not mean, however, that the past IPP failed to produce benefits. It simply means that the production schedules identified on the IPP Form [DD Form 1519 (Test) and its earlier versions] would not be the basis for increasing production.

Since then, OSD working with the Army, the Joint Staff, and the other Services, has developed a new industrial base planning data-collection method as part of revising the overall IPP process.

The DoD recognized the need for improvements and has included many changes in the development of the revised planning forms (DD Form 2575 series) authorized in April 1991 and the forthcoming guidance in such draft directives as the Department of Defense's *Industrial Base Program (IBP) Procedures*, DoD 4005.1-M, and the Army's revisions to Army Regulation (AR) 700-90, *Army Industrial Base Program.*

Of special interest is information provided on DD Form 2575-1, *Crisis Production Survey*. On that form, industry will provide incremental production-increase schedules (and associated IPMs). Caution is recommended, however, for the incremental production increases are predicated on the assumption that the identified IPMs for long-lead-time components or additional equipment have been funded and are available in the first month of the expected production increase. In terms of responding to no-notice, short-warning crises, such IPMs may not be available if not previously funded; the conditions should certainly be considered in analyzing industry's schedules. No-cost IPMs, such as relief from regulations or laws, may also be identified.

The problem of verifying industry's data will still vex the Army. The AMC's MSC, the Armament, Munitions, and Chemical Command (AMCCOM) – has the largest industrial base planning staff in the Army. Its Command Review of the Industrial Base (CRIB) and Industrial Engineering Activity's (IEA's) Review of Mobilization Production Schedule (ROMPS) efforts can only check obvious concerns on a highly selective basis. In fact, AMCCOM is AMC's only procuring activity with a formal CRIB process.

Even though considerable emphasis is placed upon the role of the Armed Services Production Planning Officer (ASPPO) in obtaining DD Forms 2575 information, ASPPO does not guarantee the accuracy of the information. However, the ASPPO's familiarity with the producers and their facilities should result in some degree of reasonableness of the data. However, the forms clearly state that providing the data does not bind either the Government or the firms "in any contractual relationship nor do they [those forms] constitute a planning agreement." AMC's recently instituted Production Planning Schedule (PPS)[3] system attempts to more firmly establish actual production planning agreements with producers.

Such planning will correlate more closely with the current national military strategy. That strategy emphasizes being prepared for major regional contingencies (with possibly very short warning) and attendant postcrisis replenishment requirements while still providing the means for indicating industry's ability to increase production to meet possible reconstitution needs. The future development of

[3]The PPS consists of three mechanisms for Government-industry agreement: a memorandum of understanding, a no-cost contract, and a cost contract. Of the three, the last provides the most assurance for the Army that the producer can meets its planned production targets.

the DoD Production Base (ProBase) information system may help provide more comprehensive industrial planning information.[4] However, the major problem remains not only the timely development of specific industrial base data but also the availability of data on the prospective force structures, asset availability, warfighting attrition/consumption, and scenario information.

Although the revised industrial base data-collection systems represent an improvement, none will be a real-time system. And, as was the case in responding to ODS, individuals in the production and procurement side rather than those in the industrial base planning community probably will be relied upon to have the best idea of how industry can respond because they are more involved with the producers on a routine basis.

None of the observations presented here is meant to denigrate the past efforts of the industrial base planning community. Past data-collection efforts were based on a strategic scenario that is no longer applicable and certainly did not facilitate the crisis response needed for ODS. Unfortunately, the prospective data-collection changes had not been implemented prior to ODS. On the positive side, largely because of the work done by DLAs industrial planners prior to the conflict, DLA was able to quickly identify and obtain additional producers for their items.

The changing environment means that a more integrated effort is needed between the production/procurement community and the industrial base planners. The need to consider industrial base ramifications more thoroughly throughout the acquisition process is reflected in DoDD 5000.1, *Defense Acquisition* and DoD Instruction (DoDI) 5000.2, *Defense Acquisition Management Policies and Procedures.* In some cases, as at AMC's Missile Command (MICOM), such actions are already underway. Some of MICOM's industrial specialists are fully integrated members of the program management staffs.

The Missile Command's integration of industrial base planners with the acquisition community represents a feasible arrangement at the "development" end of the acquisition process for major end items. Increased integration of the industrial

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[4]ProBase is intended to become the centralized depository of DD Forms 2575 information and serve as the industrial data exchange mechanism within DoD. In addition, a compendium of Service, DLA, and other data bases should also be available in ProBase to assist in industrial planning.

planners with those procuring consumables, e.g., Class IX spares and repair parts, also is needed.

### Crisis Management Policies and Procedures

In past mobilization exercises, DoD attempted to assess the adequacy of the industry-Government interface and the ability of Government to direct, control, and monitor industry's response. Those exercises included industrial response elements, but such efforts were usually restricted to modest response cells usually consisting of representatives from the industrial preparedness community that tested basic procedures. The experience gained from those exercises provided a very useful starting point for many of the efforts that occurred in response to ODS. However, for the most part, the actual procedures used in managing the crisis evolved within the context of the crisis.

At the outset of Operation Desert Shield, it became obvious that energizing small response cells would not be enough; greater participation would be necessary from all elements of the procurement and production community, the industrial base planners, and contract specialists. Representatives of these elements formed matrix management teams that identified and solved critical issues regarding obtaining the needed supplies.

Each of these representatives was tasked with obtaining appropriate information on potential industrial responsiveness. It became quickly apparent that those with the most current and valid information on the base's responsiveness were those actually involved in the daily management of the procurement process; the program/project/item managers were the key to the pulse of industry's capabilities.

In some of AMC's subordinate commands, the industrial planning community was left almost completely out of the crisis response process. In other commands, they became integral members of matrix teams that developed responses in conjunction with industry.

Thus, a key lesson learned is the need to integrate the daily peacetime efforts of the industrial base planning community with the procurement and production community. This integration has not always occurred in the past for several reasons. First, program/project/item managers are concerned with fielding the most systems, at least cost and on schedule. The industrial planners' emphasis, on the other hand,

has been to collect and analyze industrial mobilization data, including to the extent possible, the availability of substitute producers.

Another way of saying this is that the program managers are focused on solving current problems; the industrial base planners have been focused on planning for an indefinite future involving a worst-case scenario.

By 8 August 1990, the Emergency Operations Centers (EOCs) of AMC and its MSCs were fully operational. In many cases, however, no pre-established procedures were available for managing the details of even a limited industrial mobilization. AMC quickly established processes for surging production; accelerating research, development, test, and evaluation; identifying technical base issues; and dealing with new ideas from industry. AMC's Memorandum for the Record of 9 October 1990 was the initial documentation of those processes and was updated as a result of subsequent experiences.

### Local Command Management Operations

The establishment and operation of the Class IX Intensive Management Team (IMT) at the Tank-Automotive Command (TACOM) typified the organizational processes used at the field activities.

At the outset of Operation Desert Shield, a team of representatives from TACOM's functional directorates was formed to manage the effort of providing critical Class IX consumable items (spares, components, and repair parts) for major end items deployed to Southwest Asia. The team was chaired by the Materiel System Management Directorate and included representatives from Procurement and Production, Readiness, Product Assurance and Test, Maintenance, and Engineering directorates. A comparable team was established in January 1991 to manage Class IX reparables, but its activities were not as successful as the team managing consumable items.

The team's mission was to (1) identify critical items whose poor supply position could adversely affect TACOM-managed weapon systems, (2) expedite contract awards and deliveries, and (3) resolve problems that delayed receipt of critical assets. The Class IX IMT also coordinated with Army depots to ensure timely shipment of items to the theater.

Through its operations, the Class IX IMT

- Developed the Class IX Intensively Managed Items List that in the course of the operation, identified 152 critical consumable items that had the potential to adversely affect the readiness of TACOM-managed systems.
- Briefed the status of the most critical items to the command group at the daily EOC briefings, with special emphasis on identifying those issues requiring senior-level decisions or involvement for resolution.
- Processed a cumulative total of 702,000 requisitions for the 152 items, with an overall 85 percent fill rate. Of the 152 items, 109 were completely satisfied and requisitions for most of the remaining 43 items were partially filled.
- Coordinated with program managers and program executive officers to divert assets from weapon system production contracts. Of special note was the Abrams tank program manager's diversion of Government-furnished materiel scheduled for use in the production program to the theater for use as spare parts. (Such a supply source would not be available if or when such production lines are terminated.)
- Developed a standing operating procedure for use in future crises.

## Recommendations

As a result of this process and considering the experience other agencies, several recommendations were developed to assist in managing future crises:

- *Establish a Class IX CIL during peacetime.* The IMT was challenged at the outset by the fact that there was no listing of critical Class IX items by weapon system at the start of the crisis. Ideally, such a list would contain projected demand data for each item and account for the impact of peculiar environmental or climatic factors on demands. (This was a recurring problem with all commands because of the lack of prior experience in operating under the extreme heat and sand conditions of Saudi Arabia.) Part of the ability to respond to worldwide contingencies is to have anticipated demand data on possible deployment areas. An example of the extensiveness of the proposed critical Class IX items for TACOM-managed systems is shown in Table I-3-1.
- *Establish and fund war reserve stocks for the critical Class IX items.* Of special concern are those items influenced by theater-peculiar climatic or environmental conditions. Those items would be candidates for pre-positioning within the respective regions. The failure to adequately fund war reserve stocks has been a continuing problem, especially for secondary items. AMC estimates that only 15 percent of the CONUS-stock of Class IX

## TABLE I-3-1

## WEAPON SYSTEM CRITICAL COMPONENTS

| Combat[a] | Tactical[a] |
|---|---|
| 1. Engine<br>2. Transmission<br>3. Final drive<br>4. Suspension<br>a. Roadwheels<br>Wearplates<br>b. Track<br>(1) End connector kits<br>(2) Wedge kits<br>(3) Center guides<br>(4) Pads<br>c. Road arms<br>d. Torsion bars<br>e. Sprockets<br>f. Hub caps<br>g. Brake components<br>h. Shock absorbers<br>5. Filters<br>a. Oil<br>b. Air<br>c. Fuel<br>6. Electrical components<br>a. Starter<br>b. Generator (primary)<br>c. Regulator<br>d. Alternator<br>e. Generator (auxiliary)<br>f. Wiring harnesses<br>7. Batteries<br>8. Fuel pump<br>9. Radiator<br>10. Kits<br>a. Repair<br>b. Semi-annual<br>c. Annual<br>11. Seals<br>a. Preformed packing<br>b. V-pack<br>c. Plenum<br>d. Exhaust<br>12. Driver's instruction panel<br>13. Tarps/canvas products<br>14. Power distribution box<br>15. Hull network box<br>16. Master panels | 1. Engine<br>a. Turbo chargers<br>2. Transmission<br>3. Shafts<br>a. Propeller<br>b. Drive<br>c. Half<br>4. Suspension<br>a. Rim, wheel<br>b. Tire<br>c. Shocks<br>d. Brakes/hydrovacs<br>e. Axels<br>f. Steering gears<br>5. Filters<br>a. Oil<br>b. Air<br>c. Fuel<br>6. Electrical components<br>a. Starter<br>b. Generator<br>c. Regulator<br>d. Alternator<br>e. Protective control box<br>f. Wiring harnesses<br>7. Batteries<br>8. Pumps<br>a. Fuel<br>b. Rotary<br>9. Radiator<br>10. Kits<br>a. Cyl sleeve<br>b. Piston ring<br>c. Poppet valves<br>11. Seals<br>a. Preformed packing<br>b. Gaskets<br>c. O-ring<br>12. Tarps/canvas products<br>13. Seats<br>14. Side racks |

[a] Combat vehicles are such systems as tanks, howitzers, or Bradley Fighting Vehicles. Tactical vehicles are trucks, High Mobility Multipurpose Wheeled Vehicle (HMMWV), Heavy Expanded Transporter System (HETS), etc.

war reserves for a global war scenario was funded and filled prior to the crisis. If no buildup period occurred, if the ground combat phase lasted longer, or if the U.S. forces were not able to shift resources in the absence of other threats, the Army's sustainment posture for ODS would have been much more precarious.

- *Use requirements-type contracts.*[5] For items with high crisis demands but relatively low peacetime demands, requirements contracts would reduce administrative lead times in responding to future crises and would provide addition procurement flexibility. The surge clause, approved December 1991, contained in the *DoD FAR (Federal Acquisition Regulation) Supplement (DFARS)*, Section 252.217-7001, may assist in that regard.

- *Develop personnel inventory list reflecting theater expertise.* Those personnel, either military or civilian, within the commands with specific area expertise should be identified and made available as crises develop.

- *Develop crisis-management standard operating procedures.* While general practices have evolved as a result of previous exercises, the detailed procedures developed while responding to this prolonged crisis should be the basis for detailed standing operating procedures to be used during future exercises and crises.

- *Monitor Class IX items closer during peacetime.* Class IX items should be monitored more closely in peacetime on the basis of such criteria as possible readiness impacts on mission essentiality caused by low stockage levels, projected inventory balances, unique technical production problems, and supply availability issues.

- *Use the provisions of Section 6.302-2 of the FAR as necessary to have less than "full and open" competition.* In the face of an "unusual and compelling urgency," the Government is permitted to limit the number of sources from which it solicits bids or proposals. Contracts awarded under this authority require written justifications and approvals. However, it may be advantageous to use this mechanism during crises as a way of obtaining materiel from proven sources more expediently.

- *Increase the use of unpriced basic order agreements or blanket purchase agreements.* These mechanisms, especially when contracting for commercial spare or repair parts, could be renewed annually to identify contractors who could quickly respond. Such vehicles would reduce administrative lead times by 1 or 2 weeks in responding to such crises, exceeding other expedient contracting mechanisms.

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[5]Requirements contracts are those that usually bind the Government to buy a minimum quantity while binding contractors to possibly provide a pre-established maximum quantity.

- *Establish prioritization on orders to industry issued by MSCs.* In the case of TACOM, many orders were filled by single-source spare parts suppliers who provided many items for TACOM. With no priorities given by the national inventory control point or TACOM, it was often left to the suppliers to set the priorities for their efforts. That responsibility is the Government's. (This issue should not be confused with using the Defense Production Act to set priorities for the production and delivery of "rated" orders ahead of "nonrated" defense work or commercial business.)

Comments from other agencies included the lack of automated links to secondary item data bases for use in determining requirements and identifying asset postures to match against the requirements.

Tank-Automotive Command's experiences in managing the Class IX issue were typical of those encountered by the other procuring activities. A similar procedure at the Communications-Electronic Command (CECOM) was used daily to identify and monitor the current 10 most critical systems. By the end of the crisis, more than 90 separate items had been on that list at one time or another.

At CECOM, item managers were instrumental in recommending cross-leveling actions to accommodate shortfalls in deploying units. Essentially, items were transferred from Korean-based units and CONUS-based nondeploying units to support the deployed forces. (Such a procedure may not be workable when confronted with multiple threats in different theaters.)

## COMMAND INFORMATION AND GUIDANCE INTERACTIONS

In identifying the procedural aspects of this operation, it became obvious that the procuring activities were often looking for guidance to be provided from higher headquarters and were often frustrated. Too often it appears that a hierarchical or sequential process is presumed to exist whereas in reality, an intensely interactive process is necessary among all commands and activities involved.

Also brought out were the competing demands for similar information requested by different sections within senior headquarters. To gain some control over this situation, AMC's MSCs required that such requests be channeled through their EOCs and that the responses be routed accordingly.

While similar information was requested, it was often done at different times. Thus, it was not unusual for similar requests to have responses with slightly different

data. Time was then spent on trying to reconcile differences, which detracted from more important matters by the operating-level personnel. This situation appeared to be especially irksome when the operating agencies were trying to respond to similar requests from both the industrial base planning community and the procurement field.

We recommend that such information requests, to the extent possible, be coordinated at the senior headquarters prior to being requested in order to minimize duplicative and nonproductive information gathering.

## ACCELERATED PRODUCTION PROCEDURES

To support ODS materiel requirements, the AMC shipped over 900,000 tons of equipment, supplies, and ammunition worth more than $12.8 billion. Through February 1991, AMC processed over 3.4 million requisitions and awarded over 4,000 contracts involving 1,500 contractors with a total value of nearly $4 billion. DLA responded to more than 2.2 million requisitions valued at over $3.4 billion, excluding bulk fuel.

Following the President's 5 August 1990 decision to deploy U.S. forces, the magnitude of the Army's participation in Operation Desert Shield evolved during the rest of August. The uncertainties regarding the eventual magnitude of the Army's response for the crisis, especially until Phase II was announced on 8 November 1990, set the initial response tone. While some managers in MSCs expected the "mobilization switch" to be turned on from a procurement management perspective, a proactive information-gathering process was initiated at AMC headquarters, while an organized decision-making process was developed.

The first 2 weeks after the President's decision saw an intensive information-gathering effort to assess equipment and supply shortages and to estimate production increases possible from the industrial base. Table I-3-2 presents a representative listing of nearly 100 items or systems (less ammunition) for which initial production or development status information was requested. More items were considered as the crisis developed.

The information that was accumulated generally indicated whether the item was currently under contract and/or in production; the name of the producers and their capabilities for surge; the current monthly production schedule if it was in

## TABLE I-3-2

## OPERATION DESERT SHIELD
### Production information items

| |
|---|
| **Tactical and support vehicles** |
| Heavy Expanded Mobility Tactical Truck (HEMTT) |
| M936A2 wrecker |
| Trailer water tank 400 gallon[a] |
| Semitrailer 5,000 gallon[a] |
| Petroleum, oil, and lubricants (POL) tanker for use as water tanker |
| Family of Medium Tactical Vehicles (FMTV) |
| M1000 semitrailer |
| Palletized Loading System (PLS) |
| M9392A 5-ton trucks |
| Heavy Equipment Transporter (HET) |
| **Other support equipment** |
| Water chillers |
| 3K onion tanks |
| Laundry units |
| Bath units |
| Water quality test sets |
| 3,000-gallon per hour (GPH) (accelerated out of R&D) Reverse Osmosis Water Purification Unit (ROWPU)[a] |
| 600-GPH ROWPU[a] |
| Water distribution sets |
| M9 Armored Combat Earthmover (ACE) |
| Desert clothing items |
| TEMPER tents[a] |
| Flameless ration heaters[a] |
| Ballistic-Laser Protective Spectacles (BLPS)[a] |
| Location of water |
| Desert camouflage net[a] |
| Desert camouflage helmet covers |
| M85 laundry, trailer mounted |
| Portable maintenance hanger (aviation/vehicle clamshelter)[a] |
| Water bladder |
| Aviator visor[a] |
| Handheld mine detector |
| Pipe and coupling unit (SWAPDOP) |
| Sun, wind, and dust goggles (app. for acceleration) |
| Pallatibility of T-Rations |
| Bodybags |
| Floodlight set, trailer mounted[a] |
| M702 6,000 Btu and M894 18,000 Btu air conditioner[a] |
| Solar Shade System[a] |
| Sleep Restraint System (SRS) |
| Hypochlorination unit[a] |
| Multipurpose equipment shelter[a] |
| Countermine |
| Ultralightweight camouflage Net System (ULCANS) |
| Refuel assembly [refuel on the move (ROM)] |
| **Chemical items** |
| XM93 Nuclear, Biological, and Chemical (Fox) Reconnaissance System (NBCRS)[a] |
| M43A1 mask (M43 mask only surge approved) |
| M40/42 mask (M40 accelerated out of R&D) |
| M8A1 alarm (surge approved assembly)[a] |
| Chemical overgarments sets |

[a] Items for which initial accelerated production was approved.

## TABLE I-3-2

## OPERATION DESERT SHIELD (Continued)
## (Production information items)

| |
|---|
| **Chemical items (continued)** |
| M17A2 protective masks (approved overhaul) |
| M13A2 filter sets |
| M10A1 filter sets |
| M258A1 kit |
| M6A2 hood |
| Chemical Biological Protection Shelter (CBPS)[a] |
| M9 detector kit |
| Mobile chemical lab |
| M20 simplified collective protection equipment |
| M28 simplified collective protection equipment |
| XM21 Remote Sensing Alarm (RSCAAL) |
| Individual chemical agent detector[a] |
| Microclimatic cooling vest (for BDU) |
| NBC protective cover |
| Biological detector |
| M43E1 protective mask |
| Laser Protective Outserts (LPO) for chem. prot. mask |
| Chemical/biological protective rigid wall shelter |
| **Missiles** |
| TOW 2A |
| TOW 2B |
| STINGER |
| Hellfire |
| Patriot (PAC-2)[a] |
| Multiple Launch Rocket System (MLRS) |
| TOW launcher |
| M551 Tank Thermal Sight (TTS) Retrofit |
| CHAPARRAL Missile Rosette Scan Seeker (RSS) |
| **Communications/electronics** |
| Global Position System (GPS)[a] |
| GUARDRAIL Remote Relay System (GRRS) |
| **Special operation forces equipment** |
| Desert mobility vehicle[a] |
| AN/TSQ-171 transportable video transmitter, 5KW |
| MSQ-85B Mobile Audio Visual System (MAVS) |
| **Research, development, test, and evaluation items** |
| Large caliber warhead/missile |
| XM951 leaflet artillery round |
| Army Tactical Missile System (ATACMS)a |
| Manportable Laser Assault Weapon (MLAW) |
| Thermal tarps |
| Individual Soldier-Operated Personal Acoustic Detector System (ISOPADS) |
| Unmanned aerial vehicle/moving target indicator |
| Full width mine rake for CEV |
| XM41 Protective Mask Fit Validation System |
| AN/PVS-4 brackets for mounting on AT-4 |
| Flame Launcher and Rocket (FLAR) |

[a] Items for which initial accelerated production was approved.

production; the maximum monthly production rate (surge schedule) through December 1991; the unit cost and the additional cost to surge; the current inventory levels and general locations of the inventory (CONUS, theater reserve, etc.); and general comments. That information might include recommendations for surging production, requests for waiving first article test requirements (if a new item), and difficulties expected by producers.

The information was then updated periodically and new items added. As indicated in Table I-3-2, few of the major end items listed were accelerated. Significantly, though, AMC made a concerted effort to obtain this information in early August without waiting for requirements to be generated. Accordingly, those proactive efforts positioned AMC to respond to later requirements as they were identified.

Figures I-3-1 through I-3-3 (provided by AMC) depict the formal production surge procedures that evolved at AMC headquarters.

The process officially began with the identification of shortages, needs, or requirements from a variety of sources. The Army component of U.S. Central Command (ARCENT), the Office of the Deputy Chief of Staff for Operations (ODCSOPS), AMC's MSCs, program managers, the Army laboratories, AMC's Logistics Assistance Office, and those involved with foreign military sales (FMS) all made inputs at various times on different items. The items contained on the Commander-in-Chief's CIL also were initially considered as possible candidates for accelerated production.

After an extensive screening process at AMC involving the appropriate coordinating staffs, candidate items for acceleration were presented to a General Officer Surge Committee. If that group recommended approval, the item was forwarded for formal DA approval by DCSOPS, the Deputy Chief of Staff for Logistics (DCSLOG), and the Assistant Secretary of the Army for Research, Development, and Acquisition (ASARDA), as appropriate, based on the nature of the item. Formal approval/disapproval was provided by DCSOPS. If approved, execution messages were sent to the appropriate commands outlining the quantity and funding being provided, as necessary, to increase the production.

This process was used to approve 59 equipment items and 34 different munitions for accelerated production to support ODS. Those numbers do not include

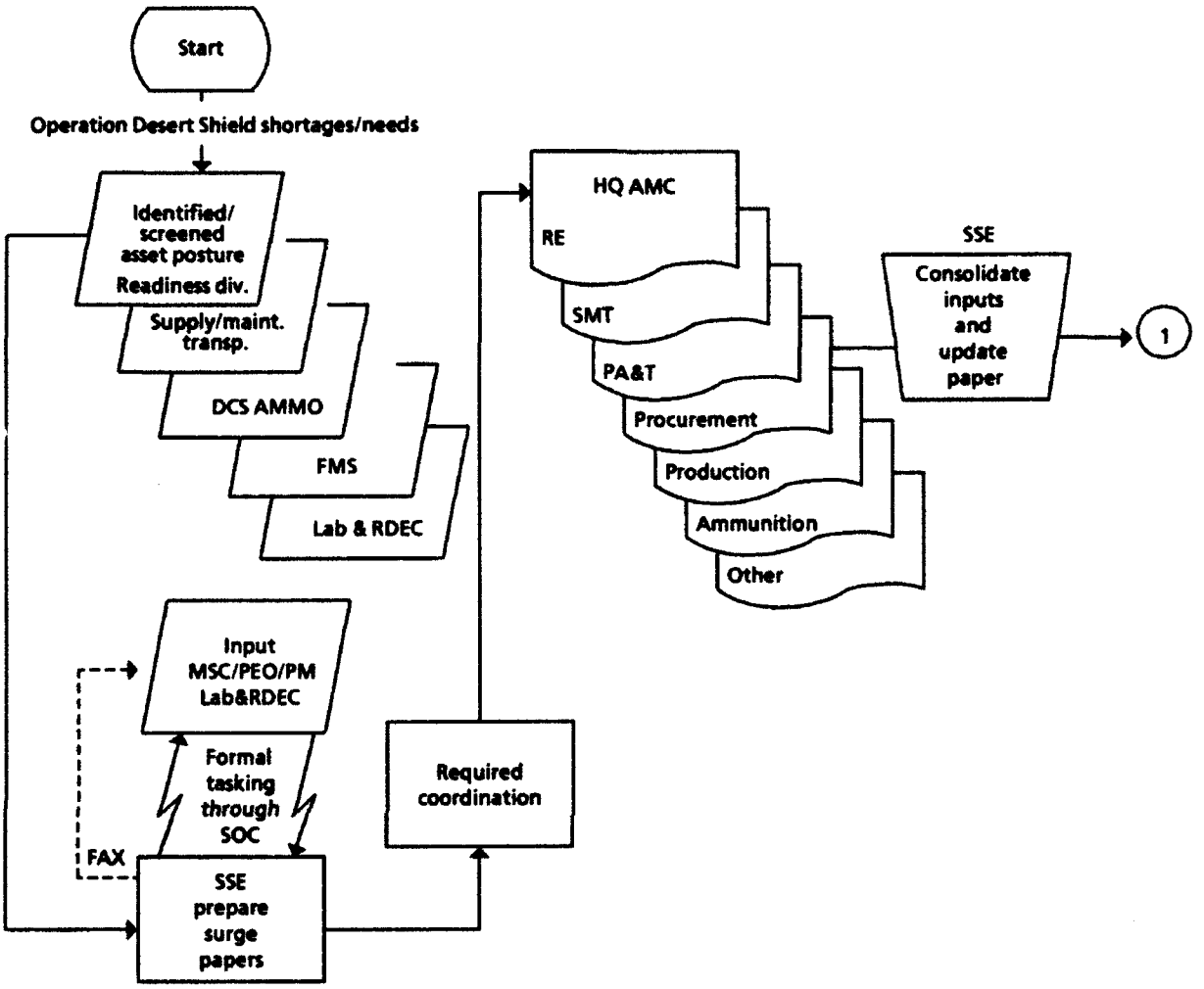


**FIG. I-3-1. HEADQUARTERS AMC PRODUCTION SURGE PROCEDURE**

the majority of secondary items accelerated within Class II personal support items, Class IV construction materiel, Class VIII medical supplies, and Class IX spares and reparables.

The President's 8 November 1990 authorization of Phase II of the operation resulted in a change in the industrial tempo as well. As the nature of the U.S. response changed and the Army's force contribution dramatically increased, the tempo of the implementing accelerated production also changed. During this second phase, especially as the stated United Nations deadline of 15 January 1991 approached, the identification of production-related problems also increased. This increase was reflected in both additional Special Priorities and Assistance Cases

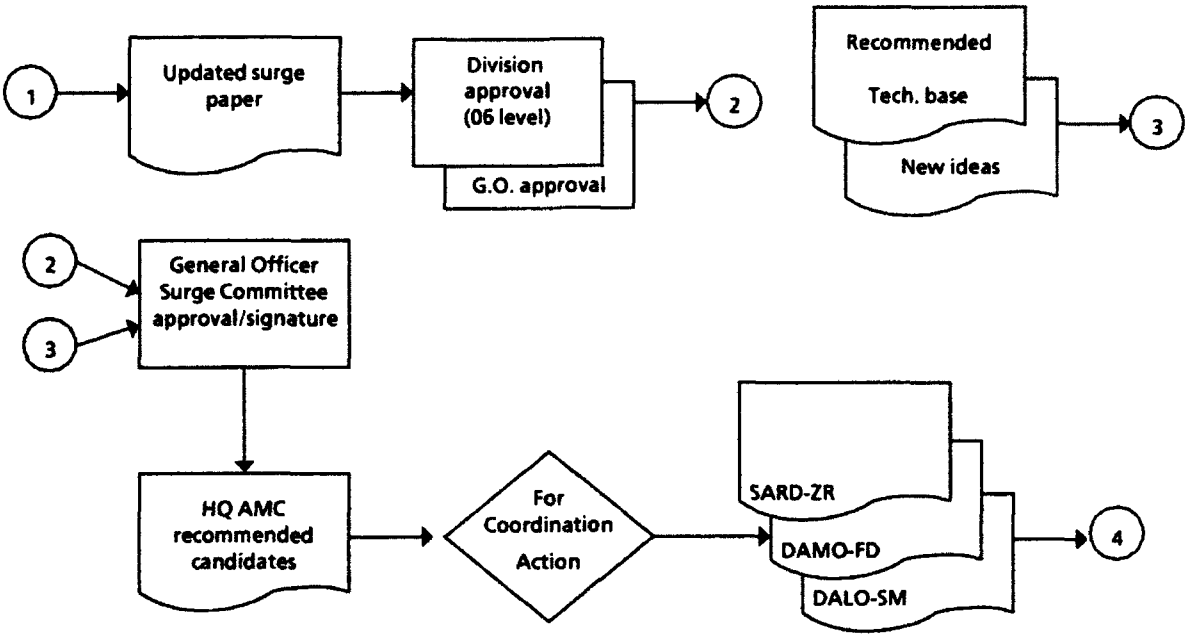


FIG. I-3-2. HEADQUARTERS AMC PRODUCTION SURGE PROCEDURE

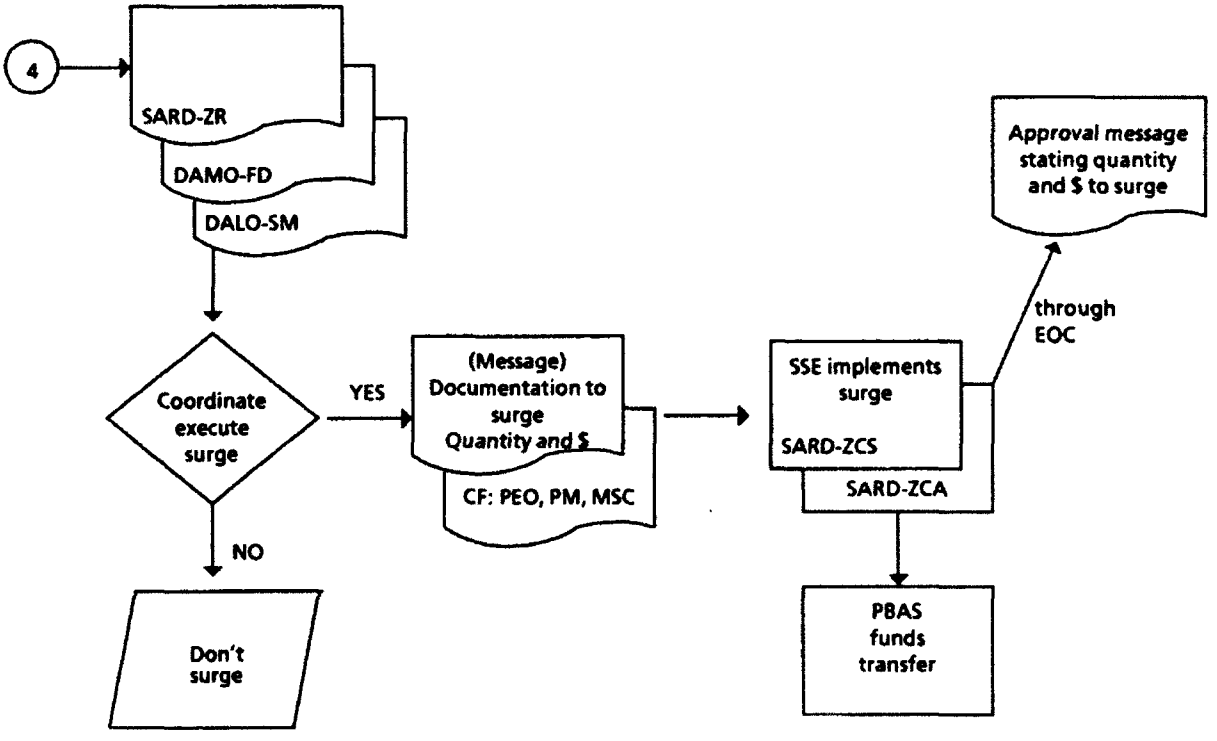


FIG. I-3-3. HEADQUARTERS AMC PRODUCTION SURGE PROCEDURE

handled by AMC and the issuance of Defense Production Act (DPA) Title I, *Priorities and Allocations*, directives by the Department of Commerce (DoC).

## ITEM ACCELERATIONS: WHAT WORKED, WHY IT WORKED, AND WHAT PROBLEMS AROSE

In January 1991, AMC's IEA was tasked to conduct an integrated production surge study to identify problems the industrial base might have in sustaining the production of critical items supporting ODS. The detailed study included an analysis of items for which breaks in production might occur as a result of accelerating production to meet ODS requirements. In addition, the study analyzed production capabilities to sustain a prolonged, 12-month ODS conflict. Accordingly, while that analysis indicates problem areas in sustaining a prolonged conflict, some of the shortfalls identified affected short-term producibility for ODS.

The following comments reflect selected highlights identified in the IEA study as well as information derived from reviewing AMC's MSC after-action reports, and interviews. What follows are examples and highlights from which generalized lessons can be derived.

### Tank-Automotive Command

#### *M1 Tank V-Pack Filters*

At the outset of ODS, no production contract for M1 Tank V-pack filters was in effect for TACOM. Donaldson Company, Inc., was the previous producer but had lost the most recent competitive bid contract to another firm that had not at that time passed the first article test. Donaldson was in the process of terminating production and in the beginning of August was only producing 50 filters a week. Upon request, it immediately began to increase production, added a second line, and was able to increase production to 2,200 filters a week, with a goal of achieving 2,750 a week.

Donaldson was a long-time supplier, and an excellent previous relationship existed between it and the Army. While expeditious contracting would soon provide the necessary documentation, Donaldson was willing to proceed on an informal basis until it was in place. Filters are an essential item, and the key machine in the production process had enough capacity to satisfy the demands of a second production

line. Additionally, Donaldson had sufficiently skilled personnel to operate a second line while integrating new employees.

This example provides the following lessons:

- Prior existing relationships facilitate informal requests for increased production.
- Available excess capacity of critical equipment facilitates production when adding additional lines.
- Simplicity of an item lends itself to accelerated production.
- In managing consumable items, contracts should not be awarded solely on price competition; they should include a "best value" consideration of accelerated production capabilities.

### *M747 Heavy Equipment Transporter System Tires*

At the beginning of the crisis, Firestone was the only approved producer for the HETS tires. Its production capacity was extremely low since only one mold existed for the approved tire. Firestone agreed to obtain an additional mold to double its capacity, and TACOM initiated action to qualify additional sources. Goodyear discovered two molds that could be used for the HETS tire production, and at approximately the same time, the contracting officer found that the tire procured for the HEMTT ammunition trailer from General Tire was originally procured for the M747.

ARCENT notified TACOM that at least 3,000 tires were needed to satisfy its requirements. The option with Firestone was immediately exercised, Goodyear was approved as a second source, and the General Tire product was approved for emergency use. In addition, General Tire also recommended a nearly identical tire as a complement to the Firestone and Goodyear tires. That tire was also approved, and some stocks were immediately delivered from General Tire's inventories. In addition, TACOM tested and obtained approval for a Michelin radial replacement tire for the M747, which had been using belted bias tires rather than radial tires to resolve a problem encountered in mounting the radial tires. The Government furnished wheels for mounting. As a result of these actions, 4,000 tires were available for shipment within 2 weeks.

This example provides the following lessons:

- Simple but critical factors such as the tire mold may restrict production capabilities.
- Again, because of the relatively simple nature of the product, tires, and the availability of suppliers, e.g., Firestone, Goodyear, General Tire, and Michelin, additional sources may be readily available.
- Intensive activity by item managers and contract specialists can locate and gain approval of additional suppliers.
- Expeditious testing of proposed substitute products may result in the approval and use of qualified substitutes even while needing to still overcome resistance to acceptance of substitutes within certain elements.

### *Bradley Fighting Vehicles*

An urgent issue was the desire to convert the basic Bradley Fighting Vehicle (BFV) to the A2 configuration. The FMC Corporation was able to convert 700 of the basic models to A2 because (1) they had excess BFVs on site at their production facility (as a result of delayed shipments to Europe) and (2) the modification materiel had already been stocked. Accordingly, FMC was able to modify the BFVs with 600 of the 700 A2 models shipped to Saudi Arabia arrived before the start of the ground war.

### *Heavy Equipment Transporter System Commercial Substitute*

For the past decade, TACOM's IPP branch had been working with industry and other TACOM elements to identify commercial substitutions through the Commercial Replacement Item Substitute Planning (CRISP) program. To support ODS, TACOM was tasked with identifying commercial substitutes for vehicles to transport major weapon systems. A substitute was especially needed for the HETS for transporting the M1A1 Abrams tank.

A task team with representatives from Procurement and Production, Engineering, Maintenance, and the R&D center was formed to identify viable commercial substitutes and their limitations for use in lieu of the TACOM vehicles. The team found appropriate substitutes. In addition to the HETS deployed from U.S. military assets and those provided by Host Nation Support (including Egypt, Germany, Czechoslovakia) and the Italian military, the task team obtained 48 vehicles commercially and TACOM leased 134 from commercial trucking

companies. Nonetheless, attempting to identify and catalog large numbers of substitutes, together with the high degree of matrix coordination necessary to obtain approval, is a daunting challenge in the midst of a crisis.

This example provides the following lesson: The CRISP program should be expanded and better coordinated as an ongoing peacetime activity to reduce the additional workload, especially matrix team coordination and approval, during a crisis.

#### *Other TACOM Items of Interest*

The TACOM producers expedited deliveries on such items as diesel engines, pivot arms and sprockets for tracked vehicles, and 400-gallon water trailers. Companies prestocked forgings at their own initiative in resolving problems.

This example provides the following lessons:

- What emerges repeatedly is that in support of a popular cause, regular suppliers or producers exercised both initiative and dedication to achieve increased production levels. A great deal of this increase is attributable to the good relationships existing between the Government and suppliers prior to the crisis.
- We do not know whether other producers would be able to initiate production to Government specification if not actively doing so. Speculation is that such production would be difficult to achieve.

### Armament, Munitions, and Chemical Command

#### *Chemical Items*

To meet ODS requirements, AMCCOM surged production at the gas mask rebuild facilities at Pine Bluff Arsenal, Ark. Partially as a result of that action, AMCCOM supplied 314,500 M17 protective masks, 27,500 M25A1 tank crewman masks, nearly 4,000 M24 aviation masks, 600 M43 aviation masks for use in Apache helicopters, and 4,500 chemical agent alarms.

Considerable development work had been done in recent years on the chemical items. Accordingly, development of several of these was almost complete. Thus, this was a transition period for many of the chemical detection/prevention items; older items were no longer being produced, and newer items were not yet in full production.

The M17 was a basic protective mask, but it was in the process of being phased out in favor of the M40/M42 series. Since sufficient stocks of the new mask had not yet been produced, war reserves of the M17 were distributed in addition to those made available by surging the rebuild facilities at Pine Bluff Arsenal. Fielding of the M40/42 was accelerated; however, the two contractors producing the mask had experienced a 12-month delay because tooling drawings were not available.

New production of the chemical agent monitor had failed the first article test three times, and the problem was finally resolved during ODS; however, production was insufficient to support all requirements.

One major concern about the production of chemical masks was the availability of Whetlerite carbon, the key component of the filters for several series of the chemical protective masks. Whetlerite carbon is also used by the Air Force, Navy, and several allies, and its sole worldwide producer is Calgon, with a maximum surge rate of 300,000 pounds per month. The Defense Production Act was used to allocate the production among the Services and our allies. Nonetheless, had the war been longer or the enemy had used chemical weapons, a serious concern existed regarding the availability of sufficient carbon for Army use.

Seven of the 17 Priority 1 chemical items were still in development when the crisis began. Of particular concern was the availability of the Nuclear, Biological, and Chemical (Fox) Reconnaissance System (NBCRS). Eventually, this shortfall was alleviated by Germany's providing the units directly to American forces, including training and maintenance support packages necessary to fully field the system.

As a result of analyzing the chemical items industrial base, it was recommended that a Review of Mobilization Production Schedules (ROMPS) be conducted with the manufacturers of the M40/M42 masks.

### *Ammunition*

To meet ODS requirements, production of numerous ammunition items was accelerated. While there were challenges associated with accelerating production, most of the problems become more evident and pronounced when faced with

sustaining a prolonged conflict.[6] The IEA study estimated that more than a year would have been needed to meet requirements on 24 percent of studied items had Operation Desert Storm been a prolonged war. For ODS, none of the inactive Army Ammunition Plants were activated. The environmental restrictions on "Red Water"[7] production remain a major problem that still must be resolved.

While many of the munitions could be effectively accelerated, the specific items listed below had problems:

- *M830 120mm HEAT tank round.* Acceleration was hampered by problems with the M764 fuze. Visit by a general officer assisted in resolving problem.
- *M829A1 120mm armor piercing tank round.* Constrained by penetrator production and extrusion of propellent.
- *M825A1 155mm smoke round.* Was not in production because the burster was being redesigned. Previous stocks were scrapped. Deliveries of new bursters were not expected until June 1991.
- *M791 and M919 armor-piercing 25mm ammunition.* Shortfall of tungsten penetrators. Contracts were awarded to two additional domestic producers. Acquisition of additional penetrators from off-shore producers was considered but not implemented since it was considered faster and cheaper to facilitize domestic sources than using the foreign sources.

The Netherlands had 1.2 million rounds of 25mm armor-piercing ammunition available. However, that ammunition had been manufactured with nonheated cartridge cases and, therefore, would not work in the U.S. M242 cannon. The lesson learned is that we cannot rely upon foreign substitutes without ensuring compatibility with U.S. weapon systems.

### *Weapons – M37 Recoil Mechanism*

During the initial ODS deployment, the M37 recoil mechanisms for the M102 howitzer experienced a high failure rate. Spare recoil mechanisms were shipped from CONUS stocks, which left only a few remaining in CONUS. Letterkenny Army Depot, Pa., began to rehabilitate 55 recoil systems to replace the spares, and Rock Island Arsenal, Ill., was also scheduled to rebuild 30 of the mechanisms. While we

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[6]We do not address in this report the plausibility of a "prolonged" war given the present political-military environment in the world.

[7]Red Water is the waste water generated during the purification process in the manufacture of TNT.

have the capability to repair the mechanisms, fortunately, enough spares were available at the outset of the crisis. The short ground war precluded placing additional demands upon a system that would have been difficult to quickly replace.

#### *Weapons – M1A1 Gunner's Sight*

Existing stocks were not sufficient to provide the necessary spares. General Dynamics, after being notified of the situation, began to increase gunner's sight production on its own initiative. In addition, the Abrams tank program manager authorized diversion of sights on hand for production for use as spares in the theater. The combination of both producer initiative and existence of the tank production base resulted in a satisfactory solution.

#### *Munitions – General Bomb, GBU-28*

One of the real success stories concerning munitions produced for ODS was the development of the General Bomb, GBU-28, the "bunker buster." The requirement for a munition to burrow through 100 feet of ground and then penetrate 22 feet of concrete was identified to the Watervliet Arsenal, N.Y., on 25 January 1991. Using M201 8-inch howitzer tubes, the GBU-28 was developed, produced, shipped, and tested on 17 February 1991. A total of 32 were dcelivered. Two GBU-28s were dropped on an Iraqi bunker on 27 February 1991.

### Troop Support Command

#### *Overview*

The Troop Support Command (TROSCOM) is responsible for a vast array of items, including physical security equipment, fixed and floating bridges, watercraft, soldier support items, including laundry units, rations, uniforms, and support equipment such as air conditioners. Many of those items are procured by DLA, and the industrial base issues for many of those items are presented earlier in this report.

#### *Particular ODS Interests*

The TROSCOM was particularly successful in the development and fielding of several significant hot environment items. Production of the desert camouflage screen system was accelerated, and 70,000 systems were shipped through January 1991 with an additional 4,000 systems being produced each week. The ultra-

lightweight camouflage systems, the five-soldier tank crew tent and the tank turret camouflage were also developed and provided in the theater.

Production was accelerated for three versions of Reverse Osmosis Water Purification Units (ROWPUs). Because of accelerated production of the 600-gallon-per-hour (GPH) version, 170 units were provided in theater. The 3,000-GPH version still needed first article test at the beginning of the crisis. The 150,000-gallon-per-day unit went through accelerated depot rebuilding and, as a result, 25 units were provided in theater. Collapsible fabric tanks were produced for water storage. The significant point here is that environmental and climatic conditions of likely deployment areas must be considered in stocking various troop support items.

Some items had component problems. The rotor and shaft gasifier and the rotor assembly gasifier are critical components for the 150-kW gas turbine generator set, which is used to support the Patriot missile system. General officer involvement was necessary to accelerate delivery schedules of the component parts.

Of special note was the development of the mine-clearing rake, which went from concept to fielding in less than 4 months. That type of innovation is able to solve many of the less complicated problems that arise at the outset of a crisis. Such performance demonstrates the value of a strong R&D capability.

A common issue raised was the need for the better identification of requirements. The requirements data used for past IPPs were not valid, and past peacetime demand rates were also invalid because of the low usage of many of these troop support items. Unfortunately, these secondary items are not usually identified in the warfighting models. As stated earlier, one of the key lessons learned from ODS is the need for increased planning attention for the less highly visible items, especially consumables and Class IX spares and repair parts.

### Aviation Systems Command

The experiences of the Aviation Systems Command (AVSCOM) were similar to those of the other MSCs. Production of major end items, e.g., helicopters, was not accelerated. The emphasis for acceleration was on subassemblies rather than major components. As with the other commands, AVSCOM's requirements had been underfunded and, while sufficient spare parts were stocked for peacetime operations,

the additional demand caused by the increased operating tempo and peculiar environmental impacts considerably stressed the spare parts situation.

The primary response for ODS was to accelerate the delivery on subassembly contracts, surge over 500 existing repair and overhaul programs, establish new programs as needed, and initiate new procurements. Of the nearly 2,000 items accelerated from subtier vendors, approximately 63 percent were successfully accelerated, partly because of vertical integration techniques. In some cases, 9-month lead times were reduced to 3 months, and those companies that were exceptionally aggressive in taking proactive actions reduced lead times dramatically.

By 8 November 1990, 97 percent of the 18,000 ODS requisitions had been filled, including all those needed to ensure aircraft could fly. The addition of another 800 aircraft to the theater after the President's 8 November 1990 decision to increase the force resulted in another round of procurement actions to support those aircraft. The goal was a 60-day supply[8] of battlefield spares. By the end of the war, estimates indicated that 90 percent of the Army's critical aviation spares had been positioned in Southwest Asia. A curtailed flying-hour program outside of the ODS theater was used to reduce spares demand.

Like the other MSCs, AVSCOM developed its list of aviation intensively managed items, which focused command attention on the critical items. Some of the items for which production was successfully accelerated were several items of aircraft survivability equipment. Accelerated deliveries included 1,000 radar warning receivers, 400 radar jammers, and 300 infrared jammers. The initial production of the latter items was accelerated by 7 months.

The impact of the heat and sand on aircraft systems generated innovative techniques. Rotor blade edges were taped to eliminate pitting from the sand. The manufacture of 30 rotor-analysis diagnostic systems was accelerated, and the blades were in Southwest Asia by mid-December. These systems were used to balance rotors after blade taping or change out.

The funding situation was perceived as critical at AVSCOM. The lack of additional funding at the outset of ODS meant that the spares provided would have been insufficient had the war gone beyond 30 days.

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[8]In retrospect, a very conservative requirement.

Nonetheless, AVSCOM had some very real successes in supporting ODS. It was a major user of the Desert Express airlift to get critical spare parts into the theater. Between 20 October 1990 and 21 May 1991, more than half a million pounds of Army aviation items were airlifted. In addition, as with other commands, Contract Field Service Representatives were present in theater to assist the maintenance and repair of aircraft as part of the Theater Aviation Maintenance Program – Southwest Asia.

The bottom line appears to be that as with many of the other commands, AVSCOM was especially concerned about its spares situation and the ability of the industrial base to respond. Since IPP had not focused on that area, the expected responsiveness of the base was unknown. Again, innovative and proactive actions by industry were sufficient to meet the ODS needs, but it appears that for some items, e.g., T-700 engine, auxiliary power units, tail and main rotors for the UH-60 Blackhawk helicopter, and T-55 engine for the CH-47 Chinook, the margin was very close. Had the war lasted much longer, the impression is that the aviation community would have had serious problems.

## Communications-Electronics Command

### *Overview and Crisis Management Procedures*

The CECOM exercises life-cycle integrated management for communication and electronic materiel and systems. Beginning 7 August 1991, the Emergency Operation Center (EOC) was activated on a 24-hour basis and served as the central point of contact for processing of industrial base information.

Similar to the operations at TACOM and AVSCOM, CECOM established a logistics support (matrix) team consisting of industrial base, production engineering, procurement, legal, and quality assurance representatives. The status of the 10 current critical systems was routinely briefed. This list ended up including more than 90 different items/systems during ODS. To receive information on the ability of the industrial base to support the critical items, the materiel management representatives would query the industrial base specialists. Item managers reviewed the unit asset posture of deploying forces, began ordering to backfill shortages, and cross-leveled between units, especially those from Korea and CONUS that did not deploy.

### *Industrial Preparedness Planning*

Unfortunately, a great disparity exists in the depth of detail provided by the prime contractors on their subtier vendors. An exception was the data on the Single Channel Ground and Airborne Radio System (SINCGARS) radios. Adequate detail was available because it had been required as a data item description (DID) in the contract. However, there is no uniform policy on including such industrial base support as a DID in procurement contracts. As do other commands, CECOM does IPP for approximately 20 percent of the items it manages. That percentage is consistent with the concept of concentrating on critical items, but during a crisis, the actual items deemed critical will inevitably differ from those planned. In addition, since IPP is based upon items being listed on the IPPL, failure to appear on the IPPL, as in the case of lithium batteries, creates a planning void. Nonetheless, CECOM reported that 95 percent of the ODS items were on the IPPL. A possible solution is to require some data as a DID, although that approach may be somewhat costly. The IPP data collection on the DD Form 2575 series could then supplement the DID.

## Particular ODS Concerns

### *War Reserve Shortages*

As with most of the other commands, CECOM suffered from underfunded war reserves prior to ODS; that underfunding meant that some critical assets such as batteries and wire were minimally stocked. To meet the immediate ODS requirements, critical assets were shipped without ASL/PLL bench stocks and Class IX repair parts. This served to deplete whatever assets were available. In addition, the War Reserve Automated Process (WRAP) calculations were not adequate.

### *Accelerations*

CECOM accelerated 825 items by urgency procurements by awarding new contracts, modifying existing contracts, or accelerating production under current contracts.

### *Batteries*

The total war-reserve-funded program for batteries was $6 million against a requirement of approximately $86 million to meet ODS line needs until accelerated

production can provide minimum support. Usage in the theater was in excess of industry's ability to produce. After 6 months of surge production, the industry could barely meet ODS requirements. If the war had been longer, the industry could not have supplied the demand.

The highly competitive nature of the CECOM-managed items means that CECOM is in the somewhat difficult position of trying to achieve peacetime economies and efficiencies while attempting to have some surge capacity within industry. Accordingly, the industry was sized to meet peacetime demands and did not have the additional capacity to adequately accelerate. CECOM estimates that to meet an extended wartime demand would require a 1,600 percent increase over the current peacetime capacity.

Batteries are a relatively simple item to produce. However, only three producers make lithium batteries and efforts to surge production resulted in a zero-sum predicament: to meet the demand for BA-5112, production of BA-5598s and 5576s would have to be reduced. No well-defined requirements determination process existed. Accordingly, CECOM assigned priorities among the batteries using its own best judgement.

Mercury batteries for identification, friend or foe (radar) systems were in low-rate production in the United States. Only one source was available and, because of the nature of the product, environmental protection concerns were associated with increased production. Alternate sources were China and Japan for the mercury batteries.

### *Radios*

Accelerated deliveries of radios were possible. The supply of PRC-112 survival radios was inadequate to meet ODS requirements. The producer was able to increase production during the first 2 months of its contract, but its monthly production rate was constrained by a 42-hour burn-in requirement in the specifications. It may be possible in the future to develop reduced specifications for crisis response needs.

For the SINCGARS, the producer could have gone to full-rate production and delivered an additional 2,800 sets in FY91 from January through September 1991 and 2,300 additional sets above the FY92 contracted deliveries, if the funds for the

FY92 surge were provided simultaneously with the additional FY91 funds requested in January 1991 to allow ordering of long-lead-time components.

For the AN/PRC-77 family of radios, the producer could have gone to full-rate production in 9 months by the end of FY91 and produced an additional 1,500 radios. The contract for continued surge in FY92 would have to be awarded in January 1991. Another contractor could have produced the AN/PRC-1077 as a substitute for the AN/PRC-77. As with the other firms, to get the additional production in FY91 and FY92 required simultaneous contract award in January 1991.

The significance of that information is that production increases are possible, including even some commercial substitution, but they require time and, in some cases, extend the time to procure long-lead-time components.

#### *Contractor Support*

The nature of the fielding of new communications and electronics equipment is such that extended contractor support is necessary after fielding the systems. Therefore, a large number of contractor personnel were in Southwest Asia (SWA) supporting the recently fielded systems. Up to 100 contractors representing 23 companies operated the CECOM Special Repair Activity (SRA). Contractor personnel representing the other MSCs worked at similar SRAs established to support the systems of the other MSCs.

The large number of contractor personnel in SWA supporting all the MSCs highlighted numerous issues about their full integration into theater operations. Beginning with the appropriate contract language, the Army must address the identification, indoctrination, transportation, housing, provisioning of support and maintenance facilities, in-theater transportation of contractor personnel, and the establishment of appropriate policies to account for their expected presence.

### Missile Command

#### *Overview*

Because of the Patriot missile's success in ODS, MICOM's ODS support was very important. Also interesting was the accelerated production of the Army Tactical Missile System (ATACMS), which was still in low-rate initial production when accelerated.

### *Industrial Preparedness Planning*

As at most MSCs, the IPP community at MICOM voiced frustration concerning the general status of IPP. However, MICOM used an innovative approach to improve IPP.

While the basic organizational relationships between the IPP staff at MICOM is similar to that at other MSCs, MICOM has industrial specialists working directly for program managers (PMs) as part of the program management teams of several of the major projects. In this manner, industrial base considerations are an integral part of routine program management and not outside the procurement and production community as is so often the case. Unfortunately, because of the increased demands placed upon the industrial base staff during ODS, these project-associated representatives had to be returned to the staff, thus depriving the PMs of their IPP expertise and assistance during a critical period.

The key point, though, is that having industrial base representation on the project management teams reinforces the need to hold the PM responsible for industrial base planning; that planning is not an adjunct staff responsibility.

Not all MICOM systems are managed by PMs. The MICOM Logistics Center manages Class IX spares and repair parts, secondary items, and modification items. No IPP is done for those items. The Logistics Center uses failure rate analysis for determining requirements. Contracting is done competitively, primarily with Section 8(a) (minority-owned) firms.

At the beginning of Operation Desert Shield, some repair parts were procured under normal procedures, with no priority set for shortening delivery times. In some cases, the lead time for the parts was 2 years. The war's short duration did not strain portions of the industrial base, and needed parts were obtained by stripping depots, using war reserve stocks, and rebuilding failed assemblies.

It was interesting how often in interviews the use of war reserve stocks was mentioned in an almost negative manner, as though they should have been saved for the "big war." That inference was perceived on several occasions at various commands.

As confirmed at the other commands, MICOM emphasized the inapplicability of the DD Form 1519 (Test) data for use in accelerating production for ODS. In

addition, MICOM indicated that some of its major prime contractors refused to do IPP without funding.

### *Surge Funding*

The MICOM was the recipient of the only approved separately identified surge funding over the past several years; funds had been provided for long-lead-time components for the TOW 2 missile. However, production of those components was in its final stages, and those long-lead-time items, as part of the rolling inventory, were in the process of being depleted. No surge production of TOW 2 missiles was needed to meet ODS requirements. Surge funding had also been provided for Multiple Launch Rocket System (MLRS) components, but evidently it had been diverted for use in procuring additional firing units. Capacity is available to support surging MLRS, but the availability of long-lead-time components will be a constraint. In FY91, surge funds were also provided to support the Avenger antiair system.

### *Avenger*

The Avenger production did not receive the publicity of ATACMS and Patriot. However, the Defense Priorities and Allocation System (DPAS) was used to obtain electronic relays and launchers for the Avenger since one company was making similar parts for the Air Force, Navy, and Army. The DPAS worked, and the Avenger received priority.

### *Patriot*

The Patriot (PAC-2) (Scudbuster), its producers, and the Army received accolades for successfully producing, deploying, and employing the PAC-2. Raytheon, in recognition of the need for an antitactical missile, had initiated development and production of the PAC-2 missile prior to the outbreak of ODS. Accordingly, the ability to produce the revised version was nearly complete prior to the crisis, with many of the subtier vendors already accelerating production. Nonetheless, considerable effort was involved in completing and increasing production to meet the specific and additional demands of ODS.

The Patriot missile was the subject of more Special Priorities Assistance cases at AMC than any other system. Components requiring attention – sometimes requiring Defense Production Act directives to be issued by DoC – included the

shipping containers, fuze, warhead, gyro, processing box, transistor, mixer, and assorted valves.

Completion of the missile involved using the two certified Certified Round Assembly Facilities [Martin-Marietta in Florida and Messerschmitt-Blochau-Blohm (MBB) in Schroebenhausen, Germany]. In addition, standard Patriot missiles could be converted to the PAC-2 version at the Red River Army Depot Tx. Subcontractors for the warheads included MBB, Chamberlain in Iowa, and Hi-Tech in East Camden, N. J.

Initial surge involved shipping empty warheads to Germany to be filled with explosives, returning them by military air, and then trucking them to Orlando. Other components, such as the explosive train assembly, could be moved by commercial air, except no commercial missions could be flown into or out of Germany carrying explosives. The completed missiles were then trucked to the Cape Canaveral Air Force System for military flights to SWA.

After the Hi-Tech plant was brought on line, initial empty shells were shipped back from MBB to Dover, Del., trucked to Iowa for modification, flown to Hi-Tech to be filled with explosives, and provided to Martin-Marietta for final assembly into finished missiles.

### *Army Tactical Missile System*

The first delivery of ATACMS from low-rate initial production (LRIP) was on 30 March 1990, with an initial production rate of four a month. On 29 August 1990, the Army ordered the acceleration of ATACMS while still in the LRIP Phase I. At the end of January 1991, LRIP Phase II was also accelerated, compressing the scheduled 12-month production run to 7 months, resulting in missile deliveries 4 months ahead of schedule. Funding for the accelerated production was advanced from later scheduled procurements.

A major problem in accelerating the production was the availability of the M74 grenades provided by AMCCOM. ATACMS shares requirements for those grenades with the MLRS, which was also in production. The DPAS was required to obtain electrical filters and capacitors because of their use in other computer systems.

The normal lead time for major ATACMS components is 17 months. In consideration of that, preproduction contracts are awarded for the long-lead-time

components. To partially compensate for that and to take advantage of the available capacity to expand production, the ATACMS PM requested $20 million for long-lead-time rolling inventory items.

### *Other Items*

To facilitate ODS production needs, MICOM's Product Assurance Directorate expedited 48 technical data package reviews, processed 50 requests for waivers, provided 200 first article test or quality verification waivers, and then expedited 38 first article tests and 145 quality verification tests.

The Battery Coolant Unit Production for the Stinger missile was ordered accelerated in August 1990, with accelerated deliveries beginning in October. The scheduled rate of 900 a month was more than doubled to 2,000 a month in January 1991.

Such production increases are possible primarily because of the existence of a warm production base. Once the scheduled productions are ended, such "ramp-up" capabilities are unlikely to exist. This certainly argues for fostering foreign military sales to maintain production capabilities, consistent with concerns regarding weapon system proliferation.

## Depot System Command

### *Overview*

The Depot System Command (DESCOM) does not usually receive as much publicity as the other AMC MSCs, yet it played a vital role in supporting ODS. As a major maintenance and repair organization, DESCOM is an important, although often forgotten, key component of the defense industrial base. Certainly, its future is as critical a concern as the other elements of the industrial base.

In supporting ODS, DESCOM provided nearly 520,000 tons of supplies to U.S. and allied forces and its Army Support Group repaired over 10,000 items. Over 400 DESCOM employees were sent as materiel fielding teams to help inspect, repair, and hand off various types of equipment to deploying forces.

### *Industrial Base Issues*

The following DESCOM industrial base issues were noted during ODS.

***Environmental Concerns.*** One of the recurring concerns is the relationship between defense production and environmental concerns. In attempting to meet desert pattern-painting requirements, the Letterkenny Army Depot (LEAD) in Chambersburg, Pa., received two violation notices from Pennsylvania's Department of Environmental Resources. The notices regarded volatile chemical compound (paint) emissions. Pennsylvania's emission standards are among the strictest in the nation. After discussing the urgency of the situation, Pennsylvania agreed not to enforce the environmental regulations with the understanding that LEAD develop a plan to avoid or minimize future problems.

The lesson learned is that the Army must establish and maintain continuous relationships with state and local environmental agencies. No standing or automatic provisions are available for waiving state or local environmental restrictions. The development of working relationships with the environmental agencies will assist the military in meeting crisis needs. Proactive approaches by the military may help preclude formal action by such agencies although state concerns must be recognized and dealt with. This situation is neither unique to Pennsylvania nor to the Army.

***Expanded Maintenance Production.*** To meet the increased demands of ODS, DESCOM's maintenance depots surged production. One-thousand temporary employees were hired, and overtime usage increased from 7 percent to 20 percent.

The following are examples of unprogrammed work spanning the spectrum of DESCOM's maintenance effort in support of ODS:

- *Letterkenny Army Depot.* Repaired 80 M37 recoil mechanisms, manufactured 59 newly developed mine rakes for the M1 tank and assembled 800 replacement tracks for M1A1 tanks within 2 weeks.
- *Anniston Army Depot.* Retrofitted 70 M551A1 Sheridan Airborn Assault Reconnaissance Vehicles with thermal imaging systems to provide advance night vision capabilities, set up a new repair line, and produced 3,500 Shillelagh missiles.
- *Corpus Christi Army Depot.* Expanded production of the AH-1F helicopter from 5 to 30 and fabricated 214 spreader bars for all models of the CH-47 helicopter.

- *Sacramento Army Depot.* Increased fabrication of cable assemblies from 1,500 to 5,000, expanded the overhaul of VRC-12 radios from 350 to 1,350, and increased other communication repair and overhauls correspondingly.

- *Tobyhanna Army Depot.* Increased the repair and overhaul of several radio series and communication shelters.

- *Red River Army Depot.* Modified 1,000 field packs for SINCGARS radios within 48 hours, applied corrosion-prevention chemical to 700 Hawk missiles, and accelerated the production of 1,600 roadwheels for the M9 Armored Combat Earthmover.

- *Tooele Army Depot.* Fabricated 200 M60 machine gun mounting kits and increased the overhaul of Patriot power generation units from 40 to 60 – a very critical accomplishment.

This list gives an indication of the breath and depth of organic maintenance and repair capability resident within the Army depots. Of concern for the future is the balancing of the operation of these depots against possible competing demands to retain a commercial base for some of this work.

## Development Items

### *Overview*

With the prospect of a declining production base for the future, the performance of the R&D community in ODS can give some indication of the possible responsiveness of that segment of the industrial base.

### *Particular Accomplishments in Support of Operation Desert Shield*

The quick development of both hardware and software products for deployment to SWA contributed significantly to the success of the mission. Many of the R&D accomplishments are included in the various after-action reports. The following are a few examples:

- *Light Applique System Technique (LAST).* Armor upgrade progressed from the research program to delivery to the Army in 90 days.

- *Marking round for friendly troop locations.* Nine days to conceive, fabricate, test the prototype, produce and package the system. Used existing contract to produce using the M687 binary round.

- *Laser protection for Apache helicopter crews.* None existed prior to ODS. Used sole-source R&D contract, quickly prepared Technical Data Package, and delivered system.

- *Antifratricide identification systems.* Identified need, developed systems for protecting friendly forces, and applied them to vehicles in theater. Instrumental in minimizing casualties from friendly fire.

- *Clamshell shelters.* Provided as nondevelopment item (NDI). Sole-source commercial source. Previously unavailable, provided protection from heat and sun, especially for maintenance efforts.

- *M951 leaflet artillery round.* Provided as means of enticing Iraqi soldiers to surrender.

- *GBU-28 bomb.* Development assigned to Watervliet Arsenal on 25 January 1991. Used 8-inch M201 howitzer tubes as primary component. Shipment of first two for test on 17 February. Total of 32 delivered to theater. Used on 27 February against Iraqi bunkers.

- *Night vision sight bracket.* Quickly developed, fabricated, and applied.

- *Mine rake.* Developed, tested, and produced land mine rakes for mounting on Abrams tank. Systems applied in theater and effectively used during assault phase for clearing land mines.

- *Global position system.* Good example of using commercial source as military expedient. Successful because Iraq did not have capability to intercept satellite transmissions.

- *Personnel locator system.* 500 AN/PRC-112 systems provided to be carried by airmen during missions.

- *TACFIRE/BCS/MLRS support.* Reprogrammed software to correct operational anomalies of operating in SWA.

- *Communications capability enhancement support.* Provided connectivity between commercial FAX machines and tactical communications network in both secure and nonsecure modes.

- *Mobile assault command post (ACP).* Developed, fabricated, tested, and shipped a mobile ACP that provides FAX, teletype, VHF, UHF, and crytographic capability in one heavy air-drop HMMWV platform.

- *QUICKFIX AN/ALQ-151.* Reprogrammed software to correct errors in target fixes caused by interoperability problems with Trailblazer system.

- *Space blankets.* Developed and ordered tan-colored aluminized mylar shields to drop temperatures by 25 degrees to protect communications shelters.
- *High-gain antennas for AN/PSC-3 radios.* To overcome attentuation of radio signals caused by environmental conditions in SWA, developed and tested lightweight, high-gain antennas with twice the gain of original antennas.
- *Fiber-optic cable for Patriot system.* Developed fiber-optic cable to provide reliable remote control of Patriot systems from engagement control centers.
- *Pallet identification.* Developed microcomputer-based scanning device to identify and locate pallets using bar code technology.

These few examples span the spectrum of contributions made by commericial suppliers as NDI or developed inhouse by the MSCs and Laboratories. It indicates the scope of innovation possible during a crisis. In part, it represents a return on past R&D investments. It also represents the ability of the technology and industrial base to improvise to meet the challenges of specific crises.

## Defense Logistics Agency Performance

### *Overview*

The performance of DLA, its support centers, and supporting contractors provided a good indication of the crisis-response ability of industry over a broad spectrum of issues. Of particular interest was DLA's response in the areas of subsistence, clothing, construction/barrier, medical, and weapon system support. Its after-action report contains details on the performance of its support centers and producers. In this subsection, we present selected highlights from those reports, indicating both the degree of success in specific areas and the corresponding concerns.

Table I-3-3, provides examples of critical troop support items accelerated for production to support ODS requirements. The table indicates the pre-ODS production rates, the rates achieved by February 1991, the initial production lead times, and the success in obtaining additional producers.

In contrast to the AMC experience in which existing producers increased their production primarily by accelerating deliveries, DLA sought and obtained additional producers to meet ODS-critical – but not highly technical – requirements. As the table indicates, DLA attained substantial production increases between August 1990

**TABLE I-3-3**

**EXAMPLES OF CRITICAL TROOP SUPPORT ITEMS IN SUPPORT OF ODS**

| Item | Production rate | | Initial production lead time | Remarks |
|---|---|---|---|---|
| | August 1990 | February 1991 | | |
| Chemical protective suits | 33K/month | 150K/month | 120 days | From 4 to 7 contractors |
| Chemical protective gloves | 111K/month | 133K/month | 30 days (from current producers) | Maintenance of 2 unique and dedicated contractors at Min. sustaining rates |
| Combat boots, desert | 0 | 160K/month | 60 days | From 0 to 4 contractors |
| Desert BDUs (coat and trouser sets) | 0 | 376K/month | 90 – 120 days<br>60 days to produce GFM<br>30 days to produce suits | From 0 to 16 contractors |
| Nerve agent antidote autoinjectors | 60K/month | 717K/month | 60 days | Surged production of 2 critical contractors |
| Meals, ready to eat (MREs) | 3M MREs/month | 14.4M MREs/month | 60 days | 3 dedicated assembly contractors attempted to produce 28.8 MREs per month |
| Tray packs | 1.3M MREs/month | 4.7M meals/month | 60 days | From 3 to 5 contractors |
| Meals, ordered ready to eat (MOREs) | 0 | 9.8M meals (Dec 90 surge), 4.5M meals/month sustaining rate | | Used to supplement tray-poack meals as an off-the-shelf item |

*Source:* DLA.

*Notes:* K = thousands, M = millions. These examples illustrate cases where DLA has, in most cases, utilized the industrial base to the maximum extent possible in order to get the largest and fastest output achievable. The companies involved generally constitute a specialized segment of industry dedicated to production of Defense requirements.

and February 1991, especially with the use of additional producers. The unique 6-month buildup period of Operation Desert Shield provided the time for DLA to identify and contract with additional producers, for industry to respond, and even for DLA to identify substitutes to meet ODS requirements.

Although earlier planning was based primarily on the NATO scenario, insofar as possible, available war reserve stocks were used as intended – to provide time for industry to ramp-up production. That procedure was followed especially for subsistence items. However, in other areas, e.g., construction/barrier materiel, sandbags, desert camouflage battle dress uniforms (BDUs), and chemical protective suits, such adequate war reserve stocks were not available.

Thus, a major lesson relearned is the need to provide adequate war reserve stocks to meet contingency requirements, especially when extended buildup periods are not expected or available.

Based upon these selected examples, replenishment or reconstitution requirements can apparently be satisfied in many areas supported by DLA. Nonetheless, we should recognize the peculiar circumstances surrounding the reduction of such items as atropine injectors for nerve agent. As noted in Table I-3-3, current producers were used to increase injector production. Ending production of those items because of an extremely low peacetime demand would result in the loss of any emergency production capability. Thus, the Army should support DLA's identification of selected critical items for continued peacetime production to ensure a crisis production capability.

### *Subsistence*

DLA initially provided three types of meals: A- and B-rations (fresh and easily reconstituted food products); Tray packs (T-rations), a hot meal composed of thermostabilized, prepared foods; and meals, ready to eat (MREs), a complete combat meal in a pouch. To meet shortfalls in the supply of T-rations, DLA purchased off-the-shelf packaged commercial food and reconfigured it as meals, ordered ready to eat (MOREs). In addition, DLA invested in production equipment for the contractors to use to increase the total production capacity for MREs and T-rations.

Mobilization versions of certain subsistence items, such as pouched bread, were created for ODS. Normally, pouched bread is sealed in a laminated container to provide a long shelf life. However, large quantities of the laminated material were not available for ODS. Since consumption would occur shortly after production, approval was given to use a cellophane wrap package.

Operation Desert Sheild was the first test of the unitized B-rations, which had not been stocked prior to ODS. During the early phase of ODS, the defense depots at Memphis and the Western Region were tasked with assembling the B-rations. From an initial requirement of producing 70,000 meals per day at Memphis, the depot was assembling more than 516,000 meals each day bv the end of February. Personnel productivity increased from 286 to 619 meals per day. The depots hired an additional

846 temporary personnel to support this project at Memphis and 250 at the Western Region.

Prior to ODS, DLA procured fewer than 3 million MREs and approximately 1 million T-rations each month. The ODS requirement was 37.4 million meals a month, based upon the deployed troop strength and preferred feeding plan. In order to meet that tremendous increase, DLA planned to acquire plant equipment and furnish it as Government Furnished Property (GFP) to the MRE and T-ration producers. As shown in Table I-3-3, additional T-ration producers were obtained and the productive capacity of the three dedicated assembly contractors improved. The shortfall in desired rations was partially offset by the use of the B-rations and shipments from existing war reserves, both from CONUS and European stocks.

Use of the war reserve stocks (their intended purposes) gave industry time to respond. In addition, the innovative development of the MORE concept assisted in reducing the shortfall as well as providing a more varied menu to the troops. Compounding this entire issue was the attempt to attain the stated theater reserve of 60 days prior to 15 January 1991. The use of the MORE concept was instrumental in achieving the desired ration level. Nonetheless, it is important to closely integrate stockage objectives with industrial capacity and delivery capabilities to provide sufficient stocks without placing unnecessary demand upon industry or logistics managers.

### *Clothing and Textiles (C&T)*

During ODS, the Defense Personnel Support Center (DPSC) received 230,000 requisitions valued at over $1.1 billion. The off-line processing effort exceeded by a factor of 43 the normal processing activity! Existing peacetime production lines were converted to the items needed to support ODS. Among the items needed were chemical protective suits, desert camouflage suits, body armor, protective gloves, parkas, tents, small arms cases, kevlar helmets, sunglasses, and protective goggles. Because many of these items required new patterns, designs, or fabric changes, they resulted in adding essentially new items to the supply system.

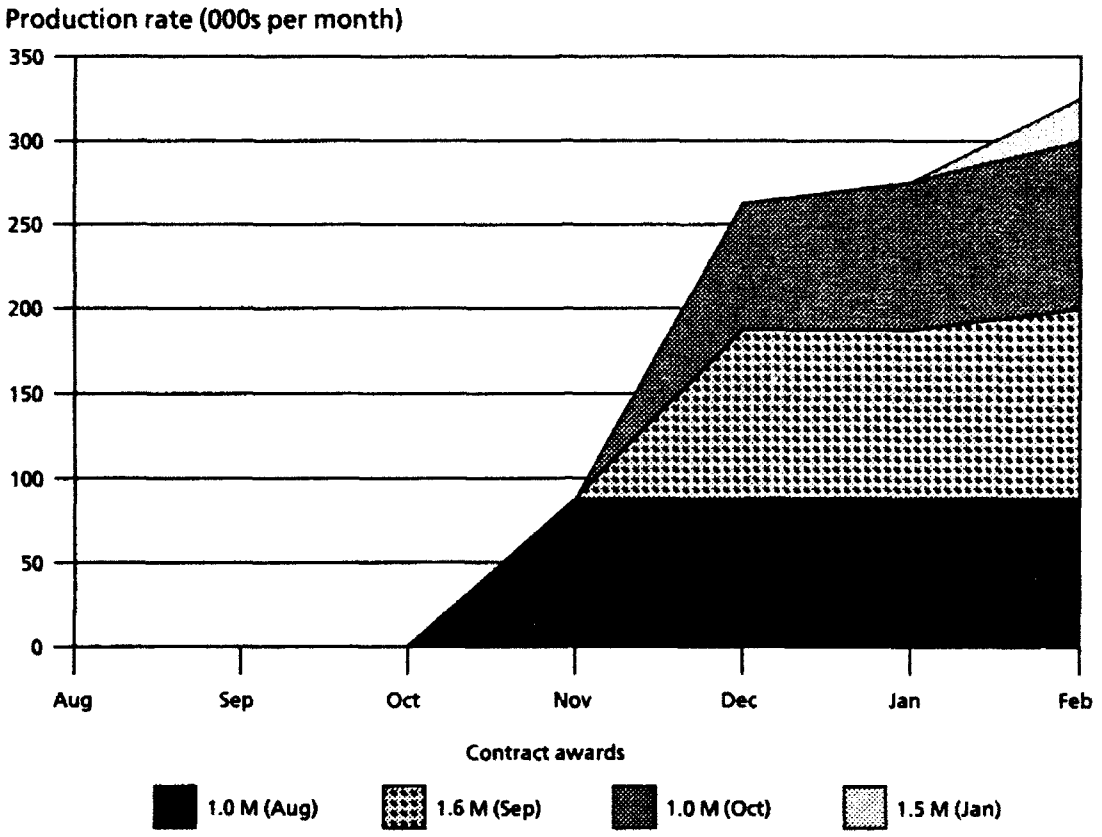
Through expeditious contracting procedures and close personal coordination between the laboratories, manufacturers, trade associations, and distribution activities, tremendous results were achieved. Contracts for the chemical protective suits were awarded in just 6 days. "Tiger teams" were formed and dispatched to

assist manufacturers doing business with the Government for the first time. These teams consisted of contracting, manufacturing, and supply representatives and experts from Natick Laboratories and Aberdeen Proving Ground. This type of effort was instrumental in reducing the contracting lead time from the normal 9 to 12 months to 10 to 14 days. Some of the highlights by particular product are given in the following subsections.

***Desert Battle Dress Uniforms (BDUs).*** Because preparing for a desert war had been a relatively lower priority prior to ODS, only 300,000 sets of desert uniform items were in stock. To meet ODS requirements, previous producers of camouflage garments were given immediate orders to produce their maximum capacity of BDUs, with contracts awarded in less than 14 days instead of the usual 9 to 12 months. Current producers of the woodland camouflage were converted to producing the desert pattern. DPSC was able to place 3.2 million sets on order within 90 days. Figure I-3-4 shows the monthly production rates achieved with the corresponding contracted quantities. Of the initial 2.6 million sets placed on order in August and September, 500,000 had been delivered by early February. The delivery could have been accelerated had the camouflage fabric been available. The desert camouflage material took 40 to 60 days to produce at the mills. Production of the uniforms then took an additional 30 days. To complicate matters, the original six-color desert pattern was replaced with a three-color pattern to better conform with the desert region. In addition to the BDUs, helmet covers, hats, field jackets, and chemical protective suits were all required in the new pattern.

***Camouflage Items.*** Similar procedures, problems, and successes were associated with the other camouflage items. DPSC had not bought the desert hat since 1986. Former producers were immediately placed under contract with, and maximum flexibility was allowed for, increasing quantities. Of the 1.2 million hats ordered, 200,000 were delivered by early February.

The desert field jacket was a new item. To meet the initial requirement, options were exercised on existing woodland contracts. Within 24 days after the Army provided specification data, contracts were awarded for the production of 400,000 desert jackets. Desert tan boots were another entirely new item. The Vietnam-type hot-weather boot was inadequate for the Saudi desert, requiring several design changes. The four military boot manufacturers were placed on alert, and, within 2 weeks of final Army approval, contracts were awarded for




*Source:* DLA.

**FIG. I-3-4. PRODUCTION INCREASES FOR DESERT BDUs**

500,000 boots, with deliveries beginning 30 days after the order rather than the usual 165 days. The final version, known as the "Schwarzkopf boot," was approved in December. By early February, more than 100,000 boots had been delivered.

While commercial sources provided considerable support for these items, DPSC's clothing factory was also a major producer of camouflage items. At the outset of the crisis, 800,000 yards of desert camouflage material was in stock; and, from that material, DPSC immediately began to produce desert camouflage clothing and continued to do so throughout the crisis.

***Chemical Protective Ensemble.*** In preparation for a possible chemical attack, one of DLA's immediate priorities was to provide chemical protective ensembles. These ensembles consisted of the chemical protective suits, gloves, overboots, and headcovers, as well as nerve agent antidotes.

The DLA industrial preparedness planning staff had recognized the critical nature of these items, their relatively low peacetime procurements, and the difficulties in producing them. Because of their prior work, potential alternative producers had already been identified. Accordingly, as noted on Table I-3-3, to meet the crisis demands, the production base was expanded from four contractors (some of whom had problems producing the items) to seven contractors for the suits. Exceptions to the Competition in Contracting Act (CICA) were granted to obtain the additional producers because of the situation's urgent nature. As a result, the contracting process that would have normally taken 6 months was done in 2 weeks.

The exacting standards of the chemical protective overgarment make it especially difficult to manufacture. It presents an excellent example of the need for concurrent engineering during the design phase to adequately address the producibility questions. What is needed is a fully integrated product development approach that includes participation of all involved parties: TRADOC, AMC, TROSCOM, Natick Laboratory, DLA, DPSC, and manufacturers' representatives. In this manner, the full benefits of concurrent engineering will result in a product that meets the original need and, at the same time, is economical and efficiently producible.

### *Medical Support*

Medical support to ODS involved more than 210,000 requisitions worth in excess of $557 million. DLA was quickly able to outfit the two medical ships, *Comfort* and *Mercy*, and build and ship 35 deployable medical systems, of which 29 came out of DLA storage. Since not all the supplies were immediately available, a "ship short" program was developed to identify shortages and correct the shortfalls as medical supplies became available. In addition to these efforts, DLA outfitted 3,600 major nonhospital medical assemblies such as battalion aid stations and chemical decontamination kits.

Prior to ODS, DLA was concerned with the dwindling industrial base of medical items because peacetime demands were insufficient to sustain the base. Of special concern were production and storage nerve agent antidotes/atropine injectors. Only two sources were available for those items and that base was being maintained by service contracts. The service contracts maintained the prime contractors and subtier vendors' abilities to produce the item but do not require actual production.

This mechanism is a lower cost solution than procuring items for which there is no peacetime requirement.

In this manner, DLA was able to retain the nerve agent antidote base. Had that base been allowed to disappear, it would have taken 2 years and $40 million to restore. Essentially, $4 million a year is needed to maintain the service contracts. Because of that capability, the producers were able to surge production to meet ODS requirements.

### *Other Defense Logistics Agency-Managed Items*

In addition to the items listed above, DLA also provided very low-tech troop support items such as sandbags, concertina wire, fence posts, and human remains pouches. For all these items, assorted supply problems were encountered but the following paragraph highlights the sandbag problem.

The demand for sandbags far exceeded DLA assets. European war reserve stocks were also used. However, the major problem was that the stocked bags were olive drab for use in the European theater, whereas ODS required tan bags that were not in the inventory. At the outset of ODS, DLA had only one approved source for either fabric and that source could not meet the ODS demand. In cooperation with Natick Laboratory, over 50 alternate materials and over 80 companies capable of sewing sandbags were evaluated. The Defense General Supply Center contracted with a Canadian firm to supply over half of the fabric for the required 50 million tan sandbags. In addition, 13 letter contract awards were made using the Paperless Ordering Procurement System, which accelerated the contract award process.

### *Defense National Stockpile Center*

Defense production in support of ODS was not constrained by a lack of industrial raw materials. Therefore, no materials were ordered released from DLA's National Defense Stockpile of strategic and critical materials. However, orders for jewel bearings from the DLA-owned, contractor-operated jewel bearing plant, the sole producer of jewel bearings in North America, increased by 150 percent during ODS. In some instances, deliveries were diverted directly to defense contractors. The jewel bearings are used in precision systems in most major weapons systems, including all U.S. fixed-wing and rotary-wing aircraft, the Abrams tank, and the Hellfire and Patriot missile systems.

### *Defense Logistics Agency Summary*

To meet the ODS troop support needs, DLA and its support centers and contract management commands increased production and accelerated deliveries over the broad spectrum of troop support and weapon system support items. Additional producers were established and expeditious contracting methods used; increased production resulted. DLA's efforts resulted from prior industrial preparedness planning. While significant production increases were achieved, production lead times must be accounted for in determining war reserve stockage levels. The link between the two was clearly demonstrated by the DLA performance, including the benefits and sometimes the necessity of maintaining a warm production base.

The DLA currently manages approximately 3,000,000 items, which is expected to increase to almost 4,000,000 with the transfer of additional item management responsibilities. Of the current items, approximately 250,000 have identified War Reserve Materiel requirements. Using item selection criteria, approximately 10,000 items are identified for IBP. For DLA's support centers, planning ^ · even that number is a difficult task. A relatively few critical "warstoppers", e.g., nerve agent atropine injectors, are identified for intensive planning.

## USE OF THE DEFENSE PRODUCTION ACT AND THE DEFENSE PRIORITIES AND ALLOCATIONS SYSTEM

### Overview

The Defense Production Act is the primary authority used to support the prioritization and allocation of resources (products, materials, and services) considered vital to the national defense. Title I, *Priorities and Allocations*, was used extensively in support of ODS. In addition to providing the authority to prioritize and allocate resources in support of U.S. forces, the Act also supports procurements for allies.

The DPAS is the mechanism by which timely delivery of industrial resources to meet defense requirements can be assured. DoC administers DPAS.

As it pertains to industry, the basic DPAS requirements are as follows:

- *Mandatory acceptance.* Priority-rated contracts and orders must be accepted by the contractor and vendor base.

- *Preferential scheduling.* Production of items must be scheduled to meet delivery requirements.
- *Mandatory extension.* Priority ratings must be included on contractor orders to its vendor base and so throughout the chain of supply.

Of particular benefit to industry are the Act's provisions for explicit indemnification protection and injunctive relief against claims arising from displacement of commercial orders by priority-rated defense orders.

Under DPAS, two priority ratings are available – DX or DO. The DX-rated orders have precedence over DO ratings. However, no DX ratings were used to support ODS requirements. Throughout the crisis as the need arose, DO-rated orders for ODS materiel were given priority above non-ODS DX orders.

The Defense Production Act expired on 20 October 1990 during the midst of the buildup for ODS. Accordingly, no legal basis existed for prioritizing defense contracts until Executive Order 12742 was issued on 8 January 1991. That Executive Order authorized the use of Section 18 of the Selective Service Act (SSA) to set priorities for defense items and materials. Although the SSA provisions are not as complete as those of the Defense Productio Act, it did satisfy the immediate need of providing a legal basis for prioritizing defense requirements.

Between 20 October 1990 and 8 January 1991, both DoD and DoC acted as though the Act was still in effect. Because of the public support for the defense effort, neither industry nor commercial claimants challenged the lack of legal authority. That is partially explained by the fact that it was believed that a future reenactment of the Act would be made retroactive to 20 October 1990. And, as a matter of fact, in August 1991, the President signed legislation reenacting the Defense Production Act for the period 20 October 1990 through 30 September 1991.

### Specific DPA/DPAS Use in Support of Operation Desert Shield

From August 1990 through February 1991, 135 special priorities assistance cases were received by DoC, of which 44 were for allied requirements. Figure I-3-5 depicts the cumulative growth of cases during that period. Of the 135 cases, 82 were processed between 8 January and 1 March 1991, with 67 occurring after 17 January. We believe this is significant for it shows the increased awareness by the Services of

production priorities problems as the period for potential combat neared. It may also reflect a lack of knowledge of possible production problems earlier in the crisis.

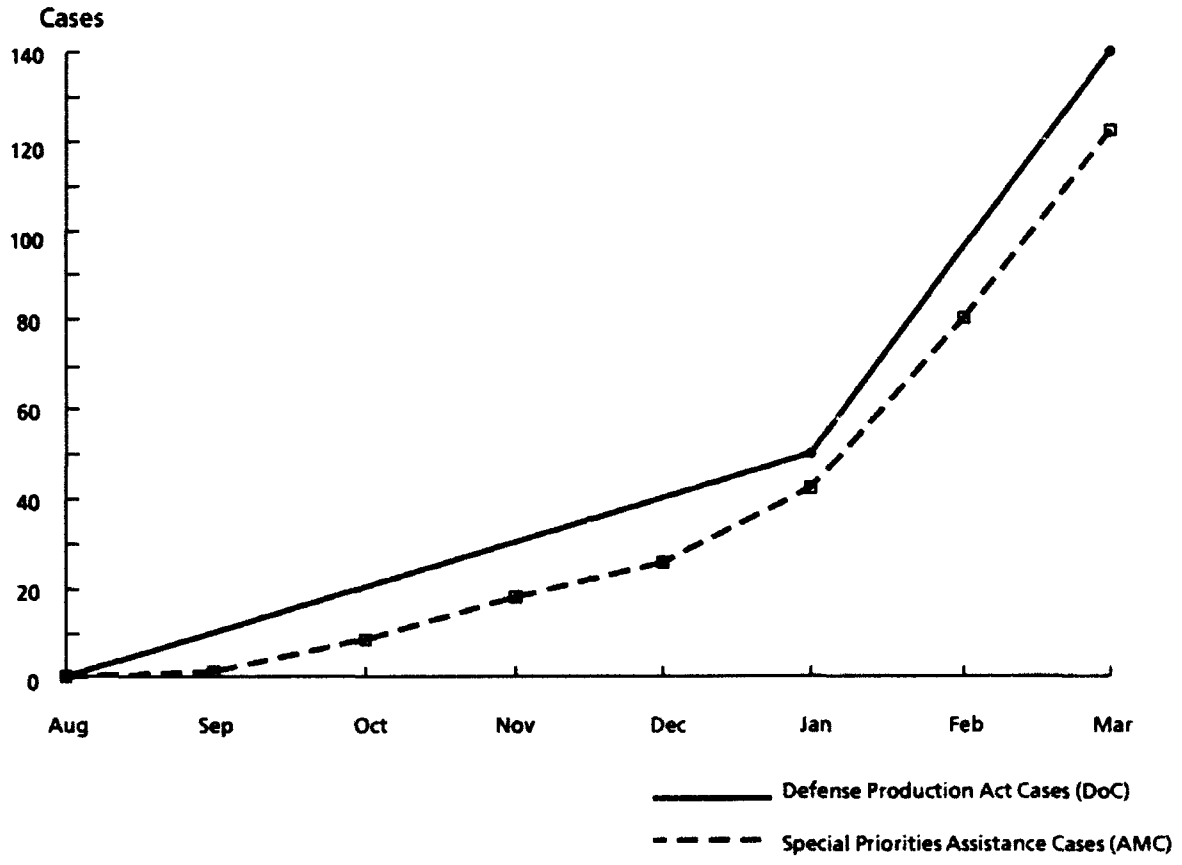



**FIG. I-3-5. DEFENSE PRODUCTION ACT SPECIAL PRIORITIES ASSISTANCE CASES**

Of the 135 cases, 118 were priorities and allocation cases for accelerating production or shipment of items or allocation of production among competing requirements, both military and commercial. Seventeen rating authorization cases were also handled, of which 14 were for allied requirements. Rating authorization for an item makes the item eligible for DPAS considerations, e.g., accelerated production or delivery order commercial items.

As shown on Figure I-3-5, AMC processed a total of 122 special priorities assistance cases. Most of AMC's cases did not require DoC action. Most of the AMC cases were resolved by inter-Service coordination and AMC management action.

A trend line similar to DoC's depicts the special priorities assistance cases handled by AMC as the Army DPA office of primary responsibility. Table I-3-4 lists the major Army items and components addressed in the special priorities assistance cases.

**TABLE I-3-4**

**SYSTEMS/COMPONENTS FOR WHICH SPECIAL PRIORITIES ASSISTANCE REQUESTED**

| | | |
|---|---|---|
| Patriot | UH-60 | Desert boots |
| Containers | Test set | HET tires |
| Fuze | Engine bearings | M1A1 tank |
| Warhead | Insulation blanket | Carrier assembly |
| Tape | APU support | Couplings |
| Gyro | Shaft support | 120mm tank round |
| Detector | Computer | Propellant |
| Radar absorbing sheets | Crystal oscillator | Fuze |
| Processing box | Tempest lap-top Computers | AH-16 |
| Transistors | Expansion unit | Spare parts |
| Mixer | SATCOM | Charcoal carbon |
| Valve | Satellite uplink | M291 decon units |
| ATACMS | Spectroanalyzer | AH-64 |
| Electrical filter | Waveguide switch | Transducer |
| M109 Ground Position | AN/PRC 112 radios | Servo cylinder |
| Systems | Medical items | Stabilizer |
| Trim packs | Water still/vaccine | Shelter assemblies |
| Antennas | Lab door | Entrenching tool |
| Surface mount indicators | Patient wraps | |
| OH-58 | Glassware washer | |
| Signal converter | Plumbing/fittings | |
| "Falkland netting" | | |
| Keyboard parts | | |

Listed below are some of the Army systems for which DoC action was necessary, the identified problems, and corrective action.

- Fuzes for M1A1 120mm tank round
  - *Problem*: Prime needed components from six vendors
  - *Action*: Vendors ordered to accelerate deliveries.
- Propellent for Army M1A1 tank 120mm projectile
  - *Problem*: Primes competing for propellent from producer

- *Action*: Producer directed to allocate propellent between primes to best meet Army needs.

- Water distribution and disposal system for Army field hospitals
  - *Problem*: Plumbing fittings and hoses urgently needed
  - *Action*: Accelerated production directive issued; delivery reduced from 16 weeks to 8 weeks.

- Tempested lap-top computers
  - *Problem*: Prime had large backlog of undelivered orders operating at maximum capacity
  - *Action*: Desert Shield orders to be given priority.

- M109A ground position locator
  - *Problem*: Competing requirements from all Services and U.K.
  - Action: Allocation of production to satisfy needs.

- Radar absorber sheets for Patriot PAC-2 missile
  - *Problem*: Competing demands for material
  - *Action*: PAC2 requirements given priority.

- "Falkland Netting" for OH-58D helicopter
  - *Problem*: Radar-absorbing material had competing demands
  - *Action*: Producer given priority; reduced lead time from 7 weeks to 2 days.

Shortly after the crisis began, a joint ad hoc working group, cochaired by OSD and the Joint Staff, was formed to identify industrial base issues, share information, and discuss mutual problems. Participation included representatives from OSD, the Joint Staff, each of the Services, both Service and Secretarial staff levels, and the major procuring activities such as AMC, DLA, and the Naval Supply Systems Command. One of the primary benefits was the sharing of problems, especially those that might impact on other Services and agencies. Through this means, informal coordination resolved many issues rather than requiring formal resolution.

While not an initial participant at the outset, the DoC DPAS point-of-contact (POC) became a regular participant, which also facilitated his ability to anticipate

problems and be more responsive to Service requirements. The informal coordination among OSD, the Service DPAS POCs, and DoC was instrumental in effectively using the DPAS.

Analysis of the special priorities assistance cases indicated that approximately 75 percent did not require formal DoC action. In addition, based in part on the information exchanged at the meetings, additional problems were resolved at the MSCs without even formally involving AMC.

However, a repeated comment, especially from MSCs (and recognized at AMC) was the need for additional training at MSCs on the use of DPAS. Although the system is used periodically during peacetime, usually members of the industrial base community are most familiar with its applications. Program, project, and item managers should be more aware of its usefulness for resolving problems and the ease with which it can be applied.

### Foreign Sourcing

The increased globalization of defense procurements will continue to impact U.S. procurement strategies. On the one hand there is the desire to retain domestic capabilities. On the other, is the opportunity for shared production with allies, to the mutual benefit of both, including some sharing of technology. The current Administration is determined to retain the technological advantage evident during ODS. However, there will be increased pressure to share technology among allies.

The foreign sourcing issue was highlighted in specific instances in responding to ODS requirements. Because of the general climate of allied cooperation, it did not pose serious problems. Yet, from a planning perspective, it is unknown completely to what extent the U.S. depends upon foreign sources. Often program, project, and items managers are not aware of the amount of foreign-source material contained in their products. However, it became obvious in supporting ODS that especially in the area of electronic components, much of the material is obtained from foreign sources with no readily available domestic source. Studies on specific systems have identified such areas, but there is no general data base with such information. In fact, the prime contractors are not aware of the total extent of the problem for their particular systems. Increased efforts are required to identify the magnitude and criticality of such foreign support.

In those cases where the bases for foreign sourcing are strictly economic, the question then centers on the time needed to procure substitutes domestically if needed. The danger arises from foreign sole-sourcing because of the uniqueness of the item or capability. We cannot return to a "fortress America" concept given the global economic realities, but we must be aware of the specific impact on critical items.

In supporting ODS requirements, 5 Japanese and 2 United Kingdom producers were identified as major electronic component subcontractors. Army systems involved included the AN/PRC-112 radio, Tempest lap-top computers, and the Global Position System.

While DPAS identified the requirements, those foreign subcontractors are not required to follow DPAS proscriptions. Nonetheless, all seven producers were very cooperative and provided the necessary components. The extremely high degree of international cooperation for ODS was reflected in the cooperation of these suppliers.

The increasing globalization of national defense issues and the reliance of the United States on foreign suppliers highlights the need for development of an integrated defense supply process with reciprocal arrangements such as an "international DPAS." Canada, the United Kingdom, Germany, and France are currently considering priorities systems to support future emergency production requirements using the DPAS as a model. The DoC is working in its role as the U.S. representative to NATOs Industrial Planning Committee to support development of such mechanisms.

## FUNDING CONSIDERATIONS

As would be expected, funding considerations were a key factor in the Army's ability to meet immediate ODS requirements. With the beginning of the crisis occurring within 60 days of the end of the fiscal year, minimum discretionary funds remained within the Operation and Maintenance, Army (OMA) appropriation.

To provide emergency relief for the OMA appropriation, the Secretary of Defense, on 24 August 1990, authorized use of the Feed and Forage Act. This provided the fiscal authority for units to requisition materiel normally funded by the OMA appropriation.

However, acquisitions requiring Procurement, Army appropriated funds, received no emergency funding relief analogous to the Feed and Forage Act. Even though the procurement appropriation has a 3-year obligation authority, pressures remain to obligate a substantial percentage of the procurement funds during the first year. Nonetheless, even with funds available within the appropriation totals, procurements are controlled by line item with limited reprogramming permitted within DoD. Congressional approval is required for reprogramming actions totaling in excess of $10 million.

The basic procurement financial decisions were to initially operate within the available procurement funds, use Service-level reprogramming authorities, request congressional reprogramming only as absolutely necessary, and be prepared to develop supplemental funding requests, as necessary.

Several reasons apparently favored such a direction. First, the strength of public and congressional support was uncertain at the outset of the crisis. There appeared to be a conscious effort by Army leadership to cautiously approach increased funding requirements. During August and September, it appeared that DoD would take a hesitant approach towards requesting additional funds in anticipation of having increased both funds and flexibility at the start of FY91.

From a practical perspective, as it pertained to decisions concerning the procurement appropriation, efforts were made to identify available procurement funds, realign funds where flexibility permitted, and reprogram within authorized limits. Data regarding additional procurements for ODS were developed to provide justification for subsequent supplemental funding requests, which were subsequently submitted and approved for both FY90 and FY91.

In addition, the Administration policy of seeking funding support from the allies resulted in the establishment of the Defense Cooperation Account by Public Law 101-403 on 1 October 1990. This account would be the mechanism by which allied financial contributions would be accounted for and later distributed to finance incremental costs associated with U.S. support during ODS. In addition, the Persian Gulf Conflict Supplemental Authorization and Personnel Benefits Act, Public Law 102-25, required monthly reports on both allied contributions and incremental U.S. costs to support ODS.

Accordingly, the Army estimated incremental FY90 procurement costs of $49 million to support ODS and $2.3 billion for FY91 through May 1991. Incremental operating support costs, which included purchases of spare parts, stock fund purchases, and increased maintenance costs were $896 million for FY90 and $6.6 billion for FY91.

In essence, the strict accounting requirements established by Congress served to cause the Army and the other Services to ensure that a disciplined approach would take place regarding the need for additional funding. The Army, as with all Services, did not want to leave itself open to later criticism for unnecessary expenditures.

No "blank check" was offered for Operation Desert Storm. Based upon comments in some after-action reports, some MSC commanders believe relaxation of sound funding constraints and delegation of certain authorities could improve funding availability to support increased requirements during a crisis. Thus, there may be a case to be made for the Services to have at least increased flexibility regarding reprogramming limits during an emergency. In those few instances when reprogramming actions to support ODS requiring congressional approval were submitted, such approval was quickly granted. In part, this may have occurred because Congress was aware of the efforts by the Services to make a realistic appraisal of the support needs for Operation Desert Shield. However, comments at both AMC and its MSCs reflected some frustration with the funding situation and after ODS.

# CHAPTER 4

# RECENT CONGRESSIONAL CONCERNS REGARDING THE ARMY'S INDUSTRIAL BASE

## INTRODUCTION

In 1980, the Defense Industrial Base Panel of the House Committee on Armed Services published a report entitled, *The Ailing Defense Industrial Base: Unready for Crisis*, commonly referred to as the Ichord Report. Since then, Congress has demonstrated considerable interest in the efforts of the Department of Defense in maintaining, preserving, and strengthening the defense industrial base.

A review of congressional hearings and reports indicates several recurring general concerns about the health of both the defense technology and production bases and specific items of concern for the Army.

## RECURRING ISSUES

Over the past decade, congressional concerns have covered a broad spectrum of issues:

- Adequacy of the mobilization base
- Possible decline of the defense technology base
- Lack of adequate and reliable data on the industrial base
- Loss of competitive technological advantages
- Delays in proceeding from development to production
- Fluctuating procurement funding profiles and impact upon industry
- Decline in the number of scientists, engineers, and technical personnel needed to meet future defense industrial base needs
- Funding profiles for R&D
- Incentives for industry to modernize manufacturing processes to meet defense production requirements

- Development of the National Critical Technclogies Plan to focus DoD efforts
- Identification of production surge requirements and methods of funding
- Lack of action plans for improving the industrial base
- Integration of industrial base considerations within the acquisition process
- Defense trade policy and technology transfer
- Capability of the industrial base to reconstitute forces
- Continued need for the Defense Production Act.

The above list does not exhaust the variety of issues addressed by witnesses in specific hearings before congressional committees dealing with the industrial base and in hearings on the President's budget before which DoD witnesses appear. These hearings on the budget review the various appropriations, and questions about different aspects of the industrial base are addressed at each budget review hearing. Review of these hearings[1] forms the bases for the following comments on congressional interest in the Army's industrial base.

One of the primary concerns in recent years has been the strength of the technology base. To partially allay that concern, DoD developed the National Critical Technologies Plan to address the most serious technology issues. In a general sense, all 21 of the identified technologies in the plan have industrial base ramifications. However, the flexible manufacturing technology has the most direct relationship. By including that area in the plan, DoD should be able to focus more attention on product data definition for automated manufacturing, computer-aided design (CAD) and computer-aided manufacturing (CAM), and automated data bases and data base management.

Congress has also been concerned about the funding of the DoD R&D effort. Congress believed that DoD funding requests for basic and applied research should be increased and that incentives should be provided for encouraging industry's Independent Research and Development (IR&D) efforts. In that regard, the

[1]The primary hearings reviewed were those conducted by the House and Senate Armed Services Committees and the House and Senate Appropriations Committees (and their respective subcommittees) on the Army's FY89 through FY92/93 Presidential budget requests for the Army Procurement and Research, Development, Test and Evaluation appropriations. Individual citations from specific hearings are not provided. Rather, the issue discussions represent a synthesis of the material addressed in those hearings.

Conference Report on the National Defense Authorization Act for Fiscal Years 1992 and 1993 recommended full recovery of industry IR&D costs.

The need for a national framework for developing production technologies has also been one of Congress' recent concerns. It saw no linkage among the Services Industrial Modernization Incentive Program (IMIP); the Manufacturing Technology (MANTECH) program; and the Defense Production Act, Title III program.

Congress has provided recent funding support for these programs and in various reports has voiced disappointment in the apparent lack of adequate funding for these programs by the Services. Recent changes in the structure of the MANTECH program resulted partially from specific congressional interest.

To further support these programs, Congress has funded the National Center for Manufacturing Sciences and continues to support the consortium of U.S. electronics firms, SEMATECH, to aid the semiconductor industry.

## CONGRESSIONAL INTEREST IN ARMY INDUSTRIAL BASE ISSUES

### Overview

We were asked to identify the major Army industrial base issues raised during congressional hearings for FY89 through FY91. Because of the rapidly changing strategic situation, revised national military strategy, and the significant budget reductions expected for FY92 and FY93 (as reflected in Tables I-4-1 and I-4-2), we also examined the major issues raised during the budget hearings conducted in 1991 for those fiscal years.

As indicated in the tables, Army procurement is expected to decline by 50 percent from FY89 through FY93 (even more if expressed in constant dollars). Since 1985, procurement has actually decreased by almost 65 percent. As of 1991, five of the Army's major weapon systems are on the verge of going out of production – Abrams tank, Bradley Fighting Vehicle, Apache and Blackhawk helicopters, and Patriot missile system. At congressional hearings, Army witnesses acknowledged that throughout the 1985 – 1991 period, affordability was the main reason for program cancellations although reduced force structure and the resulting decreased requirements were cited as additional factors in the later years.

TABLE I-4-1

ARMY RESEARCH, DEVELOPMENT, AND ACQUISITION
BUDGET SUMMARY

($ billions)

| Appropriation | FY89[a] | FY90[b] | FY91[b] | FY92[b] | FY93[b] |
|---|---|---|---|---|---|
| Aircraft Procurement, Army | 2.9 | 3.7 | 1.0 | 1.7 | 1.2 |
| Missile Procurement, Army | 2.6 | 2.3 | 2.2 | 1.1 | 1.3 |
| Procurement Weapons and Tracked Combat Vehicles, Army | 2.7 | 2.4 | 1.9 | 0.8 | 0.6 |
| Procurement Ammunition, Army | 2.0 | 1.9 | 1.3 | 1.2 | 1.2 |
| Other Procurement, Army | 4.7 | 3.6 | 2.5 | 3.2 | 3.3 |
| Subtotal | 14.7 | 13.9 | 9.0 | 8.1 | 7.6 |
| Research, Development, Test, and Evaluation | 5.2 | 5.3 | 5.4 | 6.2 | 5.9 |
| Total | 19.9 | 19.2 | 14.4 | 14.3 | 13.5 |

*Note:* Columns may not total exactly because of rounding.

[a] FY91 Army RDT&E and Procurement Appropriation Request statement.

[b] FY92/FY93 Army RDT&E and Procurement Appropriation Request statement.

In the ensuing years, as production for major programs was ending, Congress became more concerned about the ability and availability of the U.S. industrial base to modernize the future force or meet possible mobilization/reconstitution needs. (Reconstitution was first formally incorporated into U.S. defense strategy in August 1990.)

## General Congressional Industrial Base Concerns

Our review indicated that during its authorization and appropriation hearings Congress remained primarily concerned with programmatic rather than production base issues: revisions to acquisition strategies; the cause of increasing unit costs between fiscal years; adherence (or lack thereof) to prior congressional direction; program status in the research, development, and acquisition cycle; and the Army's ability to procure at economic production rates with reducing resources.

TABLE I-4-2

ARMY RESEARCH, DEVELOPMENT, AND ACQUISITION
CHANGES IN APPROPRIATION/BUDGETED AMOUNTS
FROM FISCAL YEAR 1989

(Approximate percent changes)

| Appropriation | FY90 | FY91 | FY92 | FY93 |
|---|---|---|---|---|
| Aircraft Procurement, Army | +30 | −70 | −40 | −60 |
| Missile Procurement, Army | −10 | −15 | −60 | −50 |
| Procurement Weapons and Tracked Combat Vehicles, Army | −10 | −30 | −70 | −80 |
| Procurement Ammunition, Army | −5 | −35 | −40 | −40 |
| Other Procurement, Army | −25 | −50 | −30 | −30 |
| Total Procurement, Army | −5 | −40 | −45 | −50 |
| Research, Development, Test, and Evaluation | — | +5 | +20 | +15 |

*Note:* FY90/91 percentages based upon appropriated amounts; FY92/93 based upon budget estimates submitted in 1991.

Often, industrial base considerations were not directly addressed; the most notable exception being the concern for the closure of the Detroit Arsenal Tank Plant and Army ammunition plants. Their status was addressed repeatedly in succeeding years. However, in each succeeding year, as the impact of the declining procurement budgets became more pronounced, concern for the production base has increased.

Over the past 4 years, as procurement budgets have dramatically decreased, Congress has become increasingly concerned with a broad range of issues in both the commercial and Government-owned production sectors. Those issues included, but were not restricted to the following:

- Overall health of the technology and production base
- Use of multiyear contracting
- Self-facilitization
- Foreign sourcing and ownership

- Use of dual-use technologies and commercial specifications
- Data base available for keeping abreast of industrial base conditions
- Impact of reduced procurements upon both the Government-owned and commercial sectors.

Throughout our review, it was clear that the Army was attempting to balance the need to maintain near-term readiness (and maintain an adequate production base) while preserving the ability to develop the next generation of equipment and weapon systems within constrained and declining resources. The nearly zero-sum aspects of the budgetary process were evident. In addition, it was increasingly evident that in a period of declining resources the Army could not maintain the same type and size industrial base developed during the Reagan buildup years.

Some in Congress were concerned that reducing procurements would cause one or more of the following problems:

- Military capability would be ruined; i.e, the United States would fight a war in 10 years with the same equipment and technology it used in Operation Desert Storm while the adversary would have equipment with improved technology.
- Significant industrial base impacts would occur; e.g., absence of a tank upgrade program would mean that the supporting industrial base, including the Department of Energy special armor facility, would disappear and not be available at the turn of the century to support the Armored Systems Modernization (ASM) program.
- Inconsistent procurement funding profiles would reflect a lack of commitment on the part of the Army.
- The Army would be unable to recapture the industrial base for such programs as the Light Helicopter (LH) and ASM when needed in the future.

The following subsections address these concerns.

### *Maintenance of Technology and Production Base*

Much of the Army's success in Operation Desert Storm was attributed to its technological superiority over Iraq's forces. However, for the past 4 years, the Army has been repeatedly questioned on its ability to maintain both technological superiority and an adequate production base, especially for ammunition, heavy-tracked vehicles, and helicopters. As seen in the following paragraphs, the Army's

response to these concerns was to cite its efforts to maintain technological superiority.

***Technology Base Investment Strategy***. When questioned by Congress on the issue of balancing investment in the technology base and production base, Army witnesses clearly stated that the Army had decided to invest in the technology base at the possible expense of the production base. In order to maintain the technological edge, the Army intends to devote adequate R&D resources, as indicated in Table I-4-1, while recognizing the risk caused by allowing portions of the industrial base to atrophy.

To counter the concern that the programmed growth in the budget did not strengthen the technology base, the Army indicated that the technology base portion of the budget was to be built with 2 percent real growth each year over the program objective memorandum (POM)-92/97 period.

In the face of declining available financial resources, the Army's research, development, test, and evaluation (RDT&E) investment strategy is to protect the technology base while accepting some near-term risk in the procurement accounts in order to focus on future system developments. Partially to finance technology development, in FY91, $4 billion in spending was avoided by ending production of the M1A1 tank, the Apache helicopter, and Mobile Subscriber Equipment (MSE), and termination of the Army Helicopter Improvement Program (AHIP).

The Army's strategy is to place emphasis on delivering the right technology in time to develop the right weapon system for the Army of the future. Accordingly, the Army's top priority R&D projects are the LH and ASM programs. Congressional hearing witnesses testified that as systems mature, prototypes will be produced to prove-out the technology and producibility. Transition from development to production will be in consonance with changes in the threat.

***Technology Base Master Plan***. The first Army Technology Base Master Plan was developed in 1989, focusing on 13 key emerging technologies expected to benefit the Army in the future. Twenty-five percent of the Army's FY91 technology base budget was directed toward these key emerging technologies.

The plan defines the Army's strategy for sustaining basic and applied research, advancing critical DoD technologies, and supporting a robust advanced technology

demonstration program so the Army can properly evaluate and select from among competing technologies and advanced concepts in a timely manner. The plan is a means for the Army to communicate its development intentions and technology needs to industry.

Of particular interest to the industrial base community is the inclusion of manufacturing process technology and the development of flexible manufacturing systems.

***Continued Commercial R&D.*** The Army shares congressional concern about the possible erosion of commercial technology investment as procurements decline. The declining procurement budgets threaten continued corporate sponsorship of defense-related R&D since companies expect to recoup R&D investments by winning production contracts. If potential production contracts are not available for companies to recoup their investment, additional incentives, such as more funded R&D, may be necessary for companies to continue that investment.

Except for IR&D, commercial R&D has little visibility within DoD. One way to keep a viable IR&D program is to allow companies to recover increased amounts, which Congress has authorized.

## MULTIYEAR CONTRACTING

Congress was concerned that approximately 30 percent of the Army's procurement budget (FY90) would be spent in multiyear procurements. Congress thought that type of contracting reduced the Army's flexibility in future budgets and also made the Army susceptible to considerable termination costs if programs were canceled later. The Army believed that the benefits, e.g., cost savings and program stability for the contractor, outweighed the possible disadvantages. Some of the disadvantages could possibly be ameliorated by using yearly production quantity options. However, the congressional cost savings criteria for multiyear contracts, i.e, 10 percent less than current contracts and 12 percent less than annual contracts, may preclude use of such options.

For ammunition production, the concerns were reversed. Congress thought that after initial production, multiyear contracting would benefit the Army. For ammunition production, however, the Army believed the flexibility of balancing

production workloads among critical mobilization base producers should not be sacrificed by using multiyear procurements.

In the particular case of 120mm mortar ammunition, Congress was concerned that procurements beyond FY90 would be sufficient for only one producer, which might favor a multiyear contract. The Army believed there might be additional procurements in FY93, which could justify having two producers, with potential cost savings from competing the contract, which might exceed those possible in an early multiyear contract.

## IMPACT OF REDUCED PROCUREMENTS ON INDUSTRIAL BASE

### Ammunition

Congress was especially concerned about the downsizing of the ammunition base resulting from the reduced funding profiles. Of the ammunition industrial base issues, the proposed deactivation and layaway of the Mississippi Army Ammunition Plant (MSAAP) received the greatest attention.

#### *General Structure of Program*

In the past, from the Army's perspective, ammunition procurement was a relatively easy task – produce quality ammunition as quickly, safely, and economically as possible. As indicated in Tables I-4-1 and I-4-2, the ammunition procurement account declined dramatically during this period. Essentially, the appropriation finances two activities: procurement of ammunition and maintenance of the production base. As stated throughout this period by Army witnesses, the priorities for funding were to achieve near-term readiness, including training, to provide ammunition for modern systems and war reserves; and to modernize the Government-owned active ammunition production base. Included in the funding requests were the initial layaway costs for deactivating several facilities.

The FY89 program was requested at essentially the same level as the FY88 program with the exclusion of the FY88 funding of the research and development explosive (RDX) facility. However, the FY90 program would represent another reduction, and major reductions would be expected beginning in FY91. As a result of these reductions, major changes occurred in the ammunition program and the supporting production base, which seriously concerned Congress.

During the hearings on the FY89 and FY90 appropriations, members questioned whether the procurement reductions were based upon a reduction in the threat. At that time, the Army indicated that the primary reason for the reductions was constrained funding availability. As the threat of global conflict subsided, especially during 1991, the Army could justify the reductions in part because of the changing strategic environment as well as the constrained resources.

Congress focused on:

- The impact of reduced procurements upon Government and commercial ammunition production
  - Erosion of war reserves
  - Plant closures
  - Competition with the commercial sector
  - Ability of the reduced base to meet surge and mobilization requirements
  - Maintenance of second sources
- Ammunition production base policy, including the following:
  - "Workloading" of Government plants at the expense of commercial operations
  - Self-facilitization of the commercial sector
  - Off-shore procurements
- Status of special facilities.

### *Erosion of War Reserves*

One of the immediate impacts of the reduced funding levels was the necessity to provide for near-term readiness (training) by reducing existing war reserve stocks. In FY90, the Army drew down $396 million in war reserve ammunition to satisfy training requirements and was expected to draw down almost $475 million in FY91.

Congress was concerned about these drawdowns and the production base's replacement ability during an emergency, especially in the face of forecasted ammunition plant deactivations. The Army testified that the reductions were relatively insignificant since they were primarily older munitions that could be quickly replaced if needed.

To retain the war reserve stocks would require an additional $300 million per year. More important, however, the older war reserves were being replaced by more modern munitions, such as the M864 155mm Baseburner projectile and the Volcano multiple delivery mine system. Such new munitions were having production problems in FY89; thus, additional funding would not immediately increase stocks.

However, in FY89 significant shortfalls existed, and the Army had stocked only 65 percent of the sustainability requirements for preferred munitions. Indicative of the Army's attention to the war reserve issue was the fact that by FY91 the request for modern munition war reserves was $669 million, more than half of the appropriation for ammunition end items.

### *Plant Closures*

The ammunition issue of major concern to the members of Congress was the expected decrease in the ammunition production base caused by the declining budgets. The Army believed that its current production base was out of balance with modern needs since many of the Government-owned plants used older manufacturing techniques that were incompatible with the new technologies needed for producing modern munitions.

The Army's goal was a smaller, active "core" ammunition production base capable of producing a greater variety of ammunition and a laid-away, inactive base that could be activated to meet mobilization/reconstitution needs.

The Army indicated that in FY89 it would procure the last of the M483 155mm Improved Conventional Munition projectiles because that ammunition was being replaced by a round with greater range, the M864 155mm Baseburner projectile. As a result, the MSAAP would be closed following completion of that procurement. Layaway costs of $39 million were identified but would actually be requested in subsequent budgets.

In addition, during the FY90/FY91 hearings, the Army indicated that additional plants would be closed because of the declining procurements. In FY91, the budgeted buy of the M864 155mm artillery projectile would be insufficient to keep open both the Scranton and Louisiana Army ammunition plants (AAPs). At that point, constrained funds and the need to fund other priority systems drove the Army's decision.

In FY89, the Army estimated that during the next 5 years more than half of the work force at 14 Government-owned ammunition plants (between 6,000 to 7,000 employees) would be laid off.

### *Army Ammunition Plant Closure Schedule*

Congress was continually concerned about the schedule of plant closures. At the FY92 hearings, the Army presented its summary recommendations from its Ammunition Production Base Planning and Restructuring Study:

- Downsize the active Government-owned, Government-operated (GOGO) and Government-owned, Contractor-operated (GOCO) base
- Workload only for minimal essential Government-owned base, with increased layaway and consolidation of AAPs.
- Maintain only the most essential mobilization base
- Rely on the commercial sector for metal parts.

As a result of that study, the Army indicated that in restructuring the ammunition base, active plants would be reduced from 16 to 8; inactive plants would increase from 8 to 13; and the number of plants scheduled to be excessed was doubled to 6. Plant closures were expected to follow this schedule:

- FY91: MSAAP
- By FY93: Indiana, Louisiana, Scranton, and Kansas AAPs, with Kansas possibly being leased for third-party sales.
- By FY94: Longhorn and Sunflower AAPs.

### *Commercial Sector Concerns*

In addition, reductions in the commercial active production base, which has over 200 contractors, would be necessary because of the lack of work. The Army did not know if any commercially owned facilities would be laid away.

Possible commercial reductions might be partially offset by the increasing shifting of procurements to the commercial sector for modern munitions, which already accounted for 60 percent of ammunition procurements. For modern munitions, the Army was doing system contracting in which the prime contractors were free to select the subcontractors.

The shift to commercial contractors is caused partially by increased use of electronics that are traditionally supplied by the commercial sector rather than the Government-owned base. Government plant closures would probably occur even if the procurement appropriation was increased to $2 billion because of the shift in procuring modern munitions.

### *Deactivation Considerations*

Some members of Congress wondered if any consideration had been given to balancing the commercial production base on a geographic basis. The Army responded that it was defining criteria to identify critical producers but that geographic balance was not an important criterion.

Congress was interested in knowing the extent to which the closure of Government plants was influenced by procuring munitions using modern technologies. The Army indicated for modern munitions such as the sense and destroy armor (SADARM) round, the metal parts came from the commercial base, and if the round was to use a liquid propellant, that would probably also come from the commercial base.

Since the Army appeared to be using more modern technologies, Congress questioned the future applicability of the relatively old technology laid away base. The Army indicated that area needed more analysis.

The Army did not want Congress to establish production floors by ammunition plant as a means of keeping plants open. Such floors would considerably limit Army management flexibility.

To analyze the situation, Congress repeatedly asked for data that compare the trade-off between layaway costs and the funds needed for additional production to keep plants producing at the minimum economic sustaining rate. In response to inquiries at the FY90 hearings, the Army indicated that $141 million would be needed to prevent the closure of MSAAP. However, even if that funding were provided, production gaps would occur because of the nonavailability of long-lead-time components and raw materials.

To prevent the closure of either Scranton or Kansas AAP, an additional $300 million would be required in FY90 to keep both active through 1992. Only

similar increases in FY91 and the following years would permit both to remain active.

### *Facility Reactivation*

Congress was concerned with the reactivation times of the laid-away facilities. The Army stated that if the production equipment were properly maintained, plants could begin partial operations within 4 months and could achieve full production within 9 months. However, because of the age of the equipment, frequency of maintenance, and complexity of the production process, more realistic response times were 5 to 9 months for partial start-up, with 12 to 15 months for full production.

### *Funding Considerations*

Initial layaway costs were funded out of the production base support portion of the ammunition procurement appropriation. However, prior to FY91, the maintenance of inactive plants was funded by the operations and maintenance (O&M) appropriation. Because of decrements absorbed by that appropriation over the years, only fire and security protection were being provided for many inactive plants. That meant that maintenance of the facilities was not being properly funded or performed, thereby degrading reactivation capability.

Beginning with FY91, the appropriation was changed permitting the Army to fund maintenance of inactive plants from the ammunition procurement appropriation. That change provided the ammunition manager with the funds and responsibility for improved management and maintenance of the inactive plants.

### *Loss of Skilled Work Force*

Laying away of ammunition plants also meant the potential loss of skilled workers. To ameliorate that situation somewhat, workers with critical skills workers were often selected to be members of the caretaker force responsible for maintaining the facility and equipment.

### *Mississippi Army Ammunition Plant*

In the FY89 hearings, the Army indicated that MSAAP would close in 1991 following production of the FY89 procurement. At that time, the issue did not receive

a great deal of formal attention. However, during the FY90 hearings, it was the subject of intense discussion.

Congress wanted to know why the Army's most modern, computerized ammunition plant, in which the Army had invested more than $700 million up to 1989, would be deactivated after operating for only 7 years.

Unfortunately (from the congressional perspective at plant closure time), the MSAAP had been designed and equipped as a continuous production facility for only one round, the M483 155mm Improved Conventional Munition projectile. For that very reason, MSAAP very efficiently and economically produced that projectile. However, those same characteristics were the cause of its closure.

The Army estimates indicated that 2 years and $28 million would be needed to convert MSAAP for manufacturing the M864; the Army considered both that time and that cost to be prohibitive. Accordingly, the Army planned to deactivate it, layaway and maintain the facility and equipment, and retain the facility and production capability in the mobilization base. If the plant were converted to other use, it would no longer have the capability to produce the M483 if needed to meet mobilization requirements.

#### *Technological Perishability*

Congress was concerned that if MSAAP were laid away, highly sophisticated electronics and production equipment would possibly deteriorate or become obsolete in the rapidly changing electronics world. In addition, technical support, including spare parts, may also evaporate. The Army recognized those concerns but was convinced that it could allay them.

### Ammunition Production Base Policy

The Ammunition Production Base Policy Report was submitted to Congress in 1988. It established the basic frame of reference for the use and management of the DoD ammunition production base.

### Self-Facilitization

Congress wanted to know the Army's policy on self-facilitization. Self-facilitization is the process by which commercial contractors rather than the Government invest in production equipment, especially in contractor-owned,

contractor operated (COCO) plants, with the contractors recouping their investment over the life of the contract. For the ammunition base, the policy is that contractors are expected to provide equipment, except that for producing lethal munitions and equipment at the load-assemble-pack (LAP) facilities. In 1989, the Army indicated that the policy may be extended to GOCOs if conditions are advantageous for it, e.g., third-party or facility contract situations, and if there is no mobilization requirement.

When the Government facilitizes, it does so to meet peacetime demands on a 1-8-5 basis (1 shift working 8 hours a day for 5 days a week), which provides a built-in surge or mobilization capability to be able to go to 3-8-5 or 3-8-7 if necessary. The Army is concerned that industry, on the other hand, can choose to meet peacetime demands by using multiple shifts, thus limiting its surge capability. This impact on mobilization can be minimized by the Government either sharing the added cost of building a facility to a 1-8-5 standard or entering into a Production Planning Schedule (PPS) contract that commits the contractor to retain established capacity.

### Workloading and Competition

Throughout the years, Congress expressed interest in the process by which the Army specifically assigns work (workloading) to particular ammunition plants when similar facilities are available at more than one type (GOGO, GOCO, or COCO) of facility. Congress was especially concerned that the commercial sector was being deprived of work directly assigned to either GOGO or GOCO plants. Congress was concerned how competition was maximized, given workloading and the desire to maintain a warm production base.

The Army reviews prospective procurements for possible allocation to Government-owned plants. Some procurements are directed to the Government base when specific expertise must be retained, it is the only source, or the required delivery time is limited. Workloads may also be assigned to retain the Government base at a minimum capacity to retain an active mobilization capability. The remainder is reserved for the commercial sector and may be fully competed, restricted to the United States and Canada, restricted to the mobilization base (firms who have signed planned production agreements), set aside for small business, or procured sole-source.

The Army indicated that competition was used to the maximum extent between U.S. and Canadian producers except when the situation warranted special restrictions, such as keeping critical Government and commercial activities in business; keeping unique production capabilities, tooling, or equipment in use; or avoiding interruption of delivery of critical items. In these cases, procurements could be directed to the Government base (workloaded).

The Army normally doesn't compete work between the GOGOs or GOCOs for production of lethal munitions, i.e., propellants, explosives, or lethal chemicals. Instead, these items are directly workloaded. Because commercial plants are available to produce metal parts, they are normally competed and GOCO facilities are included in the competition. In addition, the Army may split a buy between the commercial and Government base in order to maintain a larger industrial base.

The usual practice is to compete quantities above the current 1-8-5 production rate in order to expand the production base. In FY91, competitive awards accounted for approximately 60 percent of ammunition procurements.

Congress wondered whether contractor-owned plants could be workloaded. However, the Competition in Contracting Act (CICA) allows little flexibility in sole-sourcing commercial producers. Sole-source contracting could occur only if the situation were urgent or a unique capability existed. The Army had not workloaded a commercial facility in the 10 years prior to 1990.

### Workloading to Avoid Plant Closure

To help alleviate potential deactivations associated with the M864 artillery round, Congress provided an additional $300 million in FY89. As a result, additional work would be available for the Scranton and Louisiana AAPs for manufacturing the round while the Kansas and Milan AAPs could be used for LAP operations. However, the funds were sufficient to provide enough workload to justify only one metal parts facility and one LAP facility. The facilities would have to compete for the workload, with the loser probably being deactivated.

### Government Plants as Additional Producers

During the FY90/91 hearings, Congress was interested in why GOCOs were allowed to compete for the second-source award of the M864 155mm Baseburner

projectile on the basis of out-of-pocket costs when the stated policy was to rely on private industry.

The Army indicated that the Arsenal Statute established the criteria by which GOCOs could compete in this manner to avoid having idle Government facilities if it is possible to use them at a lower cost than to procure the item from private industry.

Beginning in the FY89 hearings, Congress indicated concern about the intended use of the Riverbank AAP. At the time, the Army indicated that it did not intend to reactivate the entire plant but would open parts of it for use by Norris Industries if that company successfully won contracts. The arrangement would be similar to a leasing arrangement, but the Army would not workload the plant in the future if it opened.

During the FY90/91 hearings, Congress was concerned that the Riverbank AAP was being activated to compete against the commercial sector for a contract in which several producers were already operating. The Army responded that it decided to expand the production base to five producers, which included the contractor at Riverbank. Riverbank received a quantity to produce, although at a higher cost, which indicated that at times a premium had to be paid for a larger production base.

### Competitive Sources in the Changing Environment

During the FY90 hearings, Congress raised a question about the economic health of one of the commercial ammunition firms. The Army indicated that it did not monitor the commercial operations as closely as it did Government-owned operations but was generally concerned about the contractors from an industrial base perspective. The COCOs compete on a cost basis, with no real set-asides (workloading) by the Government although some restricted competitions do occur.

Congress expressed concern over an apparent lack of competition for producing the M762 electronic fuze. The Army countered by explaining that it was pursuing an acquisition strategy that would increase the industrial base for the fuzes. Since the Army received 11 bids to produce the fuzes, the base appears adequate.

At the same time, Congress questioned whether the Army had assisted the decline of the industrial base for components for mechanical fuzes by a lack of procurements. The Army indicated that less reliance was placed on that segment

since greater emphasis was being placed on the emerging technology of the electronic fuze.

The Army intended to assure the availability of electronic components in a rapidly changing environment by using updated technical data packages, which should keep the manufacturing base current. Competition would be restricted to the United States and Canada to avoid an off-shore dependency problem.

Congress was also interested in whether the Army intended to continue dual-sourcing in a period of declining budgets. The Army indicated that while dual-sourcing provided the opportunity to surge production more quickly if needed, it would probably use more single-source contracts in the future for more economic procurements.

### *Maintenance of the Mobilization Base*

Congress was interested in the means by which the ammunition mobilization base is maintained. The Army maintains that base through a variety of actions. Active ammunition plants are deactivated when production requirements are insufficient to support economical unit production. Existing facilities are retained in inactive status if they satisfy legitimate mobilization requirements, as contained in either the Department of Army Critical Items List (DA CIL) or the Industrial Preparedness Planning List (IPPL). Plants are declared excess when they no longer satisfy a peacetime or mobilization requirement, cannot be economically converted, or are no longer cost-effective to retain. Commercial producers with inactive facilities are considered part of the mobilization base upon agreeing to maintain their inactive facilities for possible mobilization.

Using the M577 mechanical fuze as an example, Congress questioned whether the Army needed to maintain an active base for the fuze. The Army planned to maintain the M577 lines in layaway to support possible mobilization requirements until the production capability for the M762 electronic fuze was sufficient to satisfy those requirements.

### *Off-Shore Procurements*

Congress was concerned about off-shore procurements of critical ammunition items. The Army indicated that the policy was that procurements were directed first to U.S. and Canadian producers. (Canada and the United States comprise the

North American defense industrial base. Canadian firms may participate in the U.S. planned producers program and are considered part of the U.S. mobilization base.) Foreign source selection is not permitted for critical items or their critical components unless agreements are contained in a memorandum of understanding, licensing agreements, or under full-and-open competition. If foreign companies win an award, they are encouraged to build facilities in either the United States or Canada. Approximately 2 percent of munitions are procured off-shore.

### *Third-Party or Foreign Military Sales*

The Army's efforts to encourage third-party or foreign military sales (FMS) were also an area of congressional interest. In the ammunition area, Congress saw the use of a third-party sales or FMS as an opportunity for keeping open ammunition plants that were scheduled to close.

The Army indicated that it encouraged third-party sales as a means of keeping production lines open. However, the Commander, U.S. Army Armament, Munitions, and Chemical Command retains approval authority for third-party work so that it does not interfere with the facility's mobilization capability. In 1989, at the Kansas AAP, over 400 employees were used solely in support of third-party work. Through "facility contracting," essentially a leasing arrangement between the contractor and the Government, the contractor operates and maintains facilities that would otherwise by inactivated, thereby reducing the need for layaway maintenance funds. In order to make the contractors more competitive, the Army was working on a mechanism by which the Government could reduce the overhead burden on the contractor within the facility contract mechanism.

For MSAAP, it was suggested that the contractor aggressively pursue third-party sales to remain open since there was no possibility of transferring work to MSAAP from other plants.

## Loss of Critical Skills

Because of the expected loss of over 6,000 employees which was caused by ammunition plant layoffs, Congress was concerned with the Army's ability to retain a cadre of critically skilled personnel. The Army acknowledged that critical skills would be lost even though work skills had been consolidated among the remaining employees. One way to compensate would be to attempt to have work that had been

previously done in the commercial sector performed by GOGOs/GOCOs, but that would create opposition from the commercial sector. At the Longhorn AAP, infrared flare expertise had been retained by workloading two models of flares. For those plants being deactivated, attempts would be made to retain skilled personnel as part of the caretaker force.

### RDX/HMX Facilities

One of the items of interest to Congress during each year's hearings was the status of the special production facilities for RDX at the Louisiana AAP and the high melt explosive (HMX) facility at the Longhorn AAP. Congress appropriated $335 million for the RDX facility in FY88; $388 million would be required for the HMX facility.

The facilities were originally justified on the basis of satisfying explosive mobilization requirements. Construction of the HMX pilot plant was scheduled to be completed in March 1989. After prove-out of the pilot plant, the full-scale plant was scheduled to be constructed between 1991 and 1994 with prove-out scheduled in 1997. In 1988, the Army estimated that the plant would operate at only half-capacity when completed.

The original request for proposals (RFP) for the RDX facility was issued in November 1988, but the bids were unacceptable. The award was rescheduled for September 1990. It appeared that the $335 million originally appropriated would only provide for the manufacture of the Composition A5 explosive and not for multiproduct production. In any case, when built, the facility would be excess to peacetime needs, be immediately placed in a lay-away status, and be maintained as part of the mobilization base.

By April 1990, facing constrained financial resources, a diminishing threat, and reduced requirements, the Army concluded that spending $300 million to increase RDX capacity by 15 percent made no sense when sufficient peacetime capacity already existed. A similar rationale existed about the HMX facility. Accordingly, the Army sought and received approval to cancel both projects.

## ARMORED VEHICLE PRODUCTION

In addition to the ammunition program, the other area to receive major congressional interest regarding the effect of the Army's declining procurement

program on the industrial base was production of armored vehicles: the Abrams tank and its modifications; the Bradley Fighting Vehicle; and the ASM program, especially the development and eventual production of the Block III tank.

In 1988, the Army was in the midst of a multiyear procurement of the M1A1 tank. During the FY89 hearings, the Army mentioned that within the next few years it might have to close one of its tank plants. Since then, no single industrial base issue has received more congressional attention than the potential closure of the tank plants. Consideration of the issue included discussions in the following areas:

- Schedule of the tank modernization program including production of the M1A2 tank and follow-on Block III tank
- Effect of closures upon the tank modernization program
- Trade-offs between layaway costs and continued minimum production
- Reactivation time, costs, and possible loss of skilled personnel
- Relationship of FMS program to continued tank production.

## Tank Plant Closure

As indicated, the first indication of the possible closure of a tank plant was made during the FY89 hearings. At that time, the Army indicated that it did not have definite plans to close a plant, but with the forecasted reduced procurements, it would be difficult to maintain both the Detroit Arsenal Tank Plant (DATP) and the Lima Army Tank Plant (LATP).

### *Tank Production Schedule*

In FY89, both tank plants were producing a total of 69 tanks a month. If the remaining multiyear contract option of 229 tanks was approved, both plants could operate through September 1991 producing 60 tanks a month. If the FY89 budget request for 545 tanks was approved, the Army could reduce the production rate to 48 tanks a month (576 a year) and keep both plants operational. The minimum sustaining rate if only the LATP operated was 43 tanks a month (516 a year).

The Army indicated that the projected outyear resources did not appear sufficient to continue producing the Abrams tank at the annual minimum sustaining rate of 576. Consequently, DATP was the closure candidate.

At the FY90 hearings, the Army indicated that it did not plan to interrupt total tank production. Its plans were to continue production of the M1A1 tank until January 1993, produce the M1A2 tank between 1992 and 1998, and enter low-rate initial production of the Block III tank in FY97, with full rate production in FY98. The rationale for beginning production of the Block III tank in 1997 was to have an advanced tank in the inventory by the time the Future Soviet Tank (FST) III was fielded, which was expected to be around the end of the decade.

Because of declining financial resources and the rapidly diminishing Soviet threat, these plans were considerably altered during the ensuing years.

During 1989 and 1990, the Army thought that only one tank plant would be closed. By the time of the hearings on the FY92/93 budget in 1991, the Army indicated that what had been a "small gap" of 3 to 4 years between the end of M1A2 and beginning of Block III tank production now could be as long as 10 or 11 years. Foreign military sales and tanks already on order would carry some production out to possibly FY95, and with possibly additional FMS, production could be extended until 1997. However, introduction of the Block III had slipped from FY97 to FY03. For that reason, maintaining a tank upgrade program was important, but that was not affordable within available resources. A prolonged lapse in tank production seemed inevitable.

Congress questioned whether a trickle rate production of 10 tanks a month would be prudent to avoid total closedown of the tank production facilities. The Army's response was that that approach would not be affordable because of the extremely high unit costs.

In an environment of greatly constrained resources, if faced with the choice of upgrading M1A1s, producing M1A2 tanks, or continuing to develop the Block III tank, the Army would devote resources to the Block III. That approach is consistent with the basic policy of favoring continued development of the technology base, possibly at the expense of the current production base.

### *Deterrent Value*

In addition to the other industrial base issues involved, in 1988 the Army believed that keeping both tank plants in operation was important for other reasons. It felt that closure of either plant might be perceived by the Soviets as an erosion in

the U.S. conventional deterrent capability, which could be inappropriately interpreted during the ongoing deliberations on the reduction of strategic weapons.

### *Tank Plant Closure Costs*

During the FY90 hearings, the Army indicated that to close DATP, it had budgeted $31 million initially and $41 million in FY91. To keep both plants open and producing at the 576 minimum sustaining rate (MSR) would require an additional $94.4 million in FY90 and $139 million in FY91. Total additional procurement costs over the next 5 years to keep both plants open would be approximately $730 million, which did not include additional O&M costs associated with fielding the additional tanks. This funding would support production of both M1A1 and M1A2 tanks at both facilities at 48 tanks a month, well below the economic sustaining rate of 60 tanks per month. The Army would hope that the addition of FMS tank sales would permit economic production.

Initial layaway costs for DATP would be approximately $88 million; costs for LATP would be $223 million. In addition, the Army would fund the layaway costs of $158 million for other General Dynamics Land Systems facilities; $221 million for Allison Transmission Division; $63 million at the Stratford Army Engine Plant; $138 million for the Department of Energy special armor facility; and $5.2 million for Government-furnished equipment contractors. A total of approximately $896 million would be required to complete the layaway if and when both tank plants were to close. After initial deactivation, the annual layaway costs are estimated to be $800,000 for the DATP and $1.4 million for the LATP.

### *Closure Decision*

By the FY90 hearings, Congress was especially concerned about the continued viability of the two tank plants. The FY90 budget requested funds for only 603 tanks, which included 155 for the Marine Corps. Some concern was expressed for the possible effect of the Marine Corps canceling its buy, but even if it did not cancel, one plant would have to be closed. To keep both plants open for only 603 tanks would cost an additional $300,000 per tank.

During the FY90 hearings, much of the congressional interest centered on the economic aspects of the reduced procurements and the additional costs associated with keeping both plants open. However, the more traditional industrial base

aspects, e.g., reactivation time and alternate plans for producing items manufactured at the DATP, were also discussed.

In FY90 hearings, the Army indicated that OSD decided to close one of the tank plants for long-term economic reasons. Given the expected reduced procurements of the future for affordability reasons, the more economical approach was to layaway the DATP rather than produce lower quantities uneconomically at two plants.

For FY91, layaway costs at the DATP were budgeted at $111.6 million for restoration of physical facilities, rehabilitation, and layaway of equipment. Procurement funds would also be required to cover personal terminations, inventory carryover, relocation of plant records, plant inventory, a production continuity clause in the contract, and initial procurement of long-lead components for possible follow-on production.

***Reactivation and Its Costs***

Based upon the original analysis, it would take 15 to 18 months and $40 million to reactivate the DATP after it closed. This estimate would change during the years. In addition to the estimated costs, the Army also recognized the difficulty of redeveloping a trained work force, e.g., heavy armor welders who take more than a year to train and subtier vendors to support tank production once it had been interrupted. At the LATP, 675 welders are used to construct 60 tanks per month. Some robotics were also used, but if the line were scheduled to shut down, the Army would not invest more in robotic welders.

In 1990, the Army estimated that if the tank engine, suspension, transmission, and electronics lines were shut down, production could not possibly be started in less than 2 years. The 1,500-horsepower engine has only one producer and it has no commercial application; if tank production ends, the engine portion of the subtier disappears.

The Army performed a detailed analysis of the entire tank production base closure issue; that analysis was completed in 1991. It indicated that the costs to reopen the tank plants if both were closed would be between $740 million and $1.4 billion, depending on whether the M1A2 or the Block III tanks were to be produced. It could take 2 1/2 to 3 years to reopen the plants and begin production under mobilization conditions and between 5 and 6 years during peacetime.

Conditions that could affect the reactivation period include the quantities and types of long-lead components stockpiled prior to deactivation, availability of trained work force, and ability of the armor industry to reconstruct the vendor base.

### *Alternate Production of Items Manufactured at DATP*

Several major tank subassemblies – 34 items – were manufactured exclusively at the DATP. If it were closed, alternate production of those items would be necessary. One alternative would be to move the production lines for those items to the LATP. The major items included gun mount and kit, commander's hatch assembly, hubs and sprockets, driver's latch assembly, turret platform assembly, gun rotor assembly, commander's independent thermal viewer assembly for M1A2, gunner's primary sight housing, gun trunnion, weapon cradle, and weapon mount.

### *Meeting Surge and Mobilization Requirements*

Beginning in the FY90 hearings, Congress addressed the issue of the impact of closing the DATP on meeting surge and mobilization requirements. The Army stated that it could meet its peacetime requirements and provide a limited surge capability by building tanks only at the LATP.

## M1A2 Production

The Army's original plan was to produce approximately 3,000 M1A2 tanks. However, by March 1990, the prospect of decreasing forces in Europe, the possibility of a changing threat situation, and the continuing constrained U.S. fiscal environment resulted in a changed procurement strategy in 1990. Instead of producing 3,000 tanks to meet an acquisition objective, only 62 tanks would be produced to prove out the tank's producibility and provide enough for initial operational testing. After that, the production line could be laid away for later production or used for FMS. Many members of Congress thought this a proper way to proceed although considerable discussion on the recoupment of R&D costs occurred because so few were to be produced. Nonetheless, this program would serve as a possible prototype for future major weapon system acquisitions for DoD.

Because of the conditions in the Soviet Union, it appeared that the FST II, which the M1A2 tank was developed to overmatch, and which was scheduled to be

produced in mid-decade, may be postponed. As a result, the M1A1 is still considered superior to the currently fielded Soviet systems.

### Impact of Not Producing the M1A2

Congress had two significant concerns about failure to produce the M1A2 tank. Without upgrading to the M1A2, impacts on the industrial base included the loss of industrial momentum in what had traditionally been a bulwark of military production; the loss of technical expertise, including a considerably skilled work force; and conceivably the laying away of plants that would take considerable resources to reactivate for either production of the next tank, the Block III, or for meeting mobilization/reconstitution requirements. Of more importance in the near term, failure to produce the M1A2 may also foreclose the opportunity for significant FMS, especially because of increasing the cost to potential FMS customers.

If the M1A2 were produced, the ballistic steel welding, optics, and night vision industries; nuclear, biological, and chemical component industry; and the Department of Energy's special armor facility would be protected. However, the large aluminum castings and forgings sector would not be protected.

#### *Foreign Military Sales Considerations*

During the FY90 hearings and in subsequent years, the importance of FMS to the tank program was highlighted. While there were sizable potential tank FMS, several considerations were involved. In 1989, for example, the Egyptian coproduction arrangement on the M1A1 tank was set. After producing the first 15 tanks, the United States would produce 10 tank "kits" per month until 1996 for assembly in Egypt. However, few other prospective FMS deals were firm.

By the time of the FY91 hearings, the United States was negotiating with Saudi Arabia for the potential sale of 300 M1A2 tanks with deliveries beginning in the second quarter of FY93. However, of special concern was the possible impact on the sale if the United States was not producing the modernized M1A2 for its own use. A logistics support base was not being developed. The agreement with Saudi Arabia has a clause that allows Saudi Arabia to reconsider the M1A2 tank purchases if the United States does not produce them for itself. The Saudis then might consider buying M1A1s; if that were the case, it would continue to help the production base but not enhance its experience with the M1A2.

It was questionable that a foreign government would be willing to buy the M1A2 tank at $4 million per tank, an almost one-third cost increase over the original cost cap for U.S. procurement of the tank. At that price, the United States may not be economically competitive, even though it has the best tank in the world. To approach a competitive price for the M1A2, the United States would have to produce 38 M1A2s per month for itself, which did not appear likely at that time.

Other countries – the United Kingdom, Pakistan, Sweden, Kuwait, Canada, and the United Arab Emirates – expressed interest in buying the M1A2. However, from previous experience, the Army believed that FMS could not be totally relied upon in making production base decisions.

### Response to Congressional Assistance

In order to alleviate some of the problems confronting the tank production base, Congress appropriated additional funds in FY91 and FY92 for upgrades to the M1A1 tank and for production of the M1A2. During the FY92/93 budget hearings, Congress asked why the Army ignored the congressional direction to execute those programs. In response, the Army indicated that OSD had withheld the $64 million provided in FY91 and put those funds on the rescission list. The Army had identified funds for a modest tank upgrade program as a Major Budget Issue, but it was denied by OSD.

## AIRCRAFT PROCUREMENT

In 1990, the Army centered its aviation program on the LH and the Apache Longbow. Production of the AH-64A Apache and OH-58D Kiowa Warrior would be completed in 1990. The Army was willing to accept termination of some procurements to protect the long-term payoffs expected from the RDT&E investments in LH and the Longbow.

During the FY91 hearings, Congress was not too concerned about a possible break in production of the Apache because FMS, coupled with the application of the Longbow Fire-and-Forget missile, would keep the production line open until 1997, which would be only a few months until beginning production of the LH. By the FY92 hearings, Congress was more concerned about the status of the helicopter production base.

In 1991, Congress was concerned with the availability of a production base for future helicopters, with Boeing-Sikorsky selected to develop and build the LH,

eliminating Bell-McDonald. In addition, the AH-64A Apache production was ending, the AHIP had been canceled, and modifications to the CH-47 Chinook would end in FY92.

Since military helicopter production accounts for about 80 percent of domestic helicopter production, the Army expressed concern about the future health of the production base. Proponents for continuing production of the Apache cited the need to maintain a warm helicopter production base until the LH entered production. However, the procurement decisions were based essentially on affordability.

For procurement award decisions, the Army used the market mechanism of a competitive industry as its primary vehicle for ensuring that the Army received the best value. The Army made an effort to balance procurements among competing firms as is done for ammunition. This effort reflects the highly competitive nature of the industry and the fungibility of its product.

The Army intended to use a nondevelopment item, a light utility helicopter, to replace the aging UH-1 Iroquois utility helicopter. The Army believed that the number of available helicopter producers would allow the Army to take advantage of technology advances and high-quality standards of the commercial market to avoid a costly development program.

When questioned how the Army planned to provide spares support for the CH-47 after its production lines closed, the Army indicated that it was developing multiple sources, together with Boeing, to meet the requirement.

Congress also expressed concern as to why the Army couldn't maintain production of the Apache and AHIP while developing the LH since other Services appeared to be able to continue both procurement of current aircraft and simultaneously fund development of new aircraft.

The Army responded that its program was essentially built from an affordability standpoint. In the competition for resources, the Army essentially had to fund future development by curtailing production of current systems. The Army would not continue procurement of current systems by sacrificing future modernization.

## SECOND-SOURCING OF TOW 2 MISSILES

Congress questioned the Army about the economics of second-sourcing production of the TOW 2 missile when the prime contractor had excess capacity. While the Army expected second-sourcing to be more costly at the outset because of start-up costs, it believed that the winner-take-all future multiyear procurement would recoup more than those initial costs. The Army experienced such savings when it went from two sources to one for the multiyear procurement of the Hellfire missile.

## HEAVY TACTICAL TRUCK PRODUCTION BASE

A relatively minor congressional concern was the availability of an adequate industrial base to support the Army's heavy truck needs. The Army indicated that the base was adequate in terms of capacity and capability. Army truck procurements are essentially assemblies of commercially available components. Because of the size of the industry, the Army procurements barely touch its capacity, which makes for a highly competitive environment. The planned procurements of both the Heavy Equipment Transporter (HET) and the M915A2 5-ton truck foster the heavy truck production base, but the Army's program does not set the pace for the industry.

During the FY90 hearings, Congress was concerned about the production break at Bowen-McLaughlin and York (BMY) caused by canceling the fifth year of the multiyear procurement of M939A2 trucks. The Army indicated that a 13-month production gap would occur until beginning production of the Family of Medium Tactical Vehicle – but that wasn't too serious. The contract cancellation costs were covered by reduced procurements in the fourth year. If the FY90 requested procurement were funded, the gap would be reduced by 6 months.

## CLOTHING AND TEXTILES

Congress had some concern that, with the loss of the domestic textile and shoe industries, not enough capacity would be available to supply the forces in case of mobilization. The Army agreed with that concern but indicated that the law stipulates that uniforms and fabrics for them must be of U.S. origin. That law was meant to help retain the domestic base. While it ensured the availability of material to meet peacetime needs, the base may not be sufficient for a large mobilization.

Peacetime requirements are basically predicated on the number of recruits inducted each year. With the force structure expected to decline considerably in the future, so too will uniform procurements. The domestic shoe industry would not be sufficient to meet major mobilization needs.

## INDUSTRIAL BASE FOREIGN OWNERSHIP

When asked about foreign ownership and its possible impact on the industrial base, the Army indicated that it participated in the Committee on Foreign Investment in the U.S. (CFIUS) to review proposed foreign purchases. The Army makes recommendations if in their judgment the acquisition may be detrimental to national security interests.

## MOBILIZATION/RECONSTITUTION AND REPLENISHMENT

### Mobilization/Reconstitution

The changes in the strategic environment provide somewhat of a dilemma for industrial base considerations. On one hand, potential major regional conflicts are expected to occur with little warning, thus emphasizing the need for adequate war reserve stocks and possibly minimizing the importance of the production base's ability to provide war materiel. On the other hand, prolonged warning is expected for any potential threat in a possibly global context. A lengthy warning time may enhance the Army's ability to surge production, enabling additional reductions in prestocked ammunition reserves. Nonetheless, the past three U.S. military responses were made with very short warning, not considering the 6-month build up period available for ODS, which places increased emphasis on having available stocks. Even for ODS, no inactive ammunition plants were activated.

The Army maintains that the laid away industrial base is necessary to satisfy mobilization/reconstitution requirements. The ability to satisfy possible reconstitution requirements is based on having adequate warning time (and timely decisions) to permit industry to respond. For those military-unique sectors, such as conventional ammunition and armor vehicle production, facilities can be placed in layaway status and reactivated. The availability of personnel with critical skills remains a concern although some consideration is given to that issue in the analysis that supports the tank plant closure and delay in producing the Block III tank.

Congress asked about the expected surge capability remaining after the reductions of the industrial base because of the reduced procurements. The Army indicated that during the next 5 years it would make a considerable effort to study closely the responsiveness of the industrial base.

A continuing need exists for better understanding of the industrial base, its ability to support the declining force structure, and its capabilities as procurements decline. Increased consideration of the industrial base during the major weapon system acquisition process is a positive step.

When asked how the FY92/93 budget accommodated reconstitution planning, the Army responded that the budget considers three elements: mobilization planning, industrial production, and force regeneration. Specify to be considered are protecting the infrastructure, stockpiling critical materials, protecting the defense industrial base, and investing in basic science and high-payoff technologies.

Congress has recommended that reconstitution planning be fully integrated into defense planning, especially as it pertains to the industrial base. That has been initiated by including reconstitution as part of the national strategy, but more detailed planning is required.

Foreign military sales would be used to the extent possible to protect the production base for tanks, the Patriot missile system, and the Multiple Launch Rocket System. Ammunition would be produced for war reserves within available resources and ammunition plants would be laid away for possible future use. As indicated earlier, the Army recognizes the criticality of preserving the heavy armor industrial base and will accomplish that mostly through layaway until needed for Block III production.

### Replenishment

During the reviewed hearings, the industrial base's ability to replenish materiel losses following a war – especially a regional contingency – was not directly addressed by Congress. The question may be subsumed within either reactivation or reconstitution issues. Nevertheless, timely replenishment of war losses by a reduced industrial base as a separate element of the broader issue attention.

# CHAPTER 5

# THE PRODUCTION EXPANSION/ACCELERATION CAPABILITY ENHANCEMENT (PEACE) PROGRAM

## OVERVIEW

The Production Expansion/Acceleration Capability Enhancement (PEACE) program is designed to assist program/project/item managers allocate fixed resources between end-item procurement and investment in IPMs. This program can determine for some future conflict, the maximum total inventories available to the combat theater commanders within available financial resources. While it was developed for the Department of the Army in conjunction with this study, the PEACE program is generic and can be used by any Service or DoD agency responsible for procuring major end items, munitions, or secondary items.

Figure I-5-1 shows where and how the PEACE program contributes to the development of wartime combat capability. The shaded portion of the figure highlights the part of the overall planning, programming, and budgeting process for which the PEACE program is to be used. As noted, the PEACE program is not useful in the following instances:

- When a particular commodity (major end item, munitions, or secondary item) is adequately resourced within acceptable risk and no further funding is required in the Future Years Defense Plan.
- When DoD is intentionally accepting a risk by not applying resources to areas with recognized shortages.

When resources are applied to a specific commodity, the PEACE program can identify the optimum way to spend those resources to maximize combat capability on some future D-day. The PEACE program can also be used iteratively to determine the least-cost option for providing a specified capability. Future refinements could facilitate the computation for determining the least peacetime cost of providing predetermined quantities of an item based upon contingency requirements and assumptions of available warning.

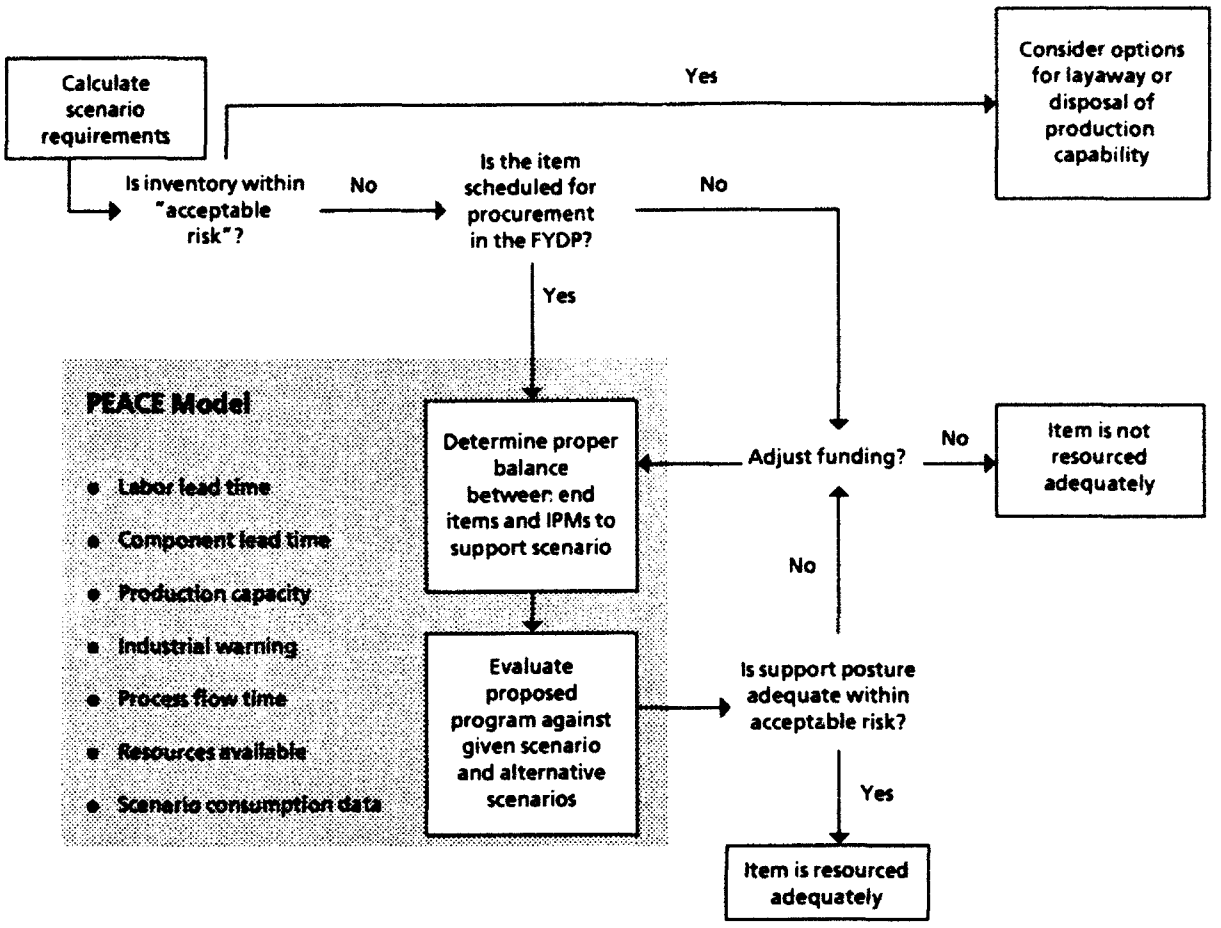



**FIG. I-5-1. CONTRIBUTION OF THE PEACE PROGRAM TO THE DEVELOPMENT OF WARTIME CAPABILITY**

The prototype program permits the user to calculate options for spending available resources on the basis of relatively limited amounts of data for a specific item and its components. The program also allows evaluation of these spending options against conflict scenarios and performance of "what if" analyses.

A users manual has been developed for the PEACE program and is available for distribution to selected agencies with a copy of the program's software. As of the publication of this report, the PEACE program is being evaluated in the Army's formal accreditation process.

The remainder of this chapter presents a summary of the PEACE program:

- First, we present an overview of the current IPM process, which sets the stage for the PEACE program.
- Next, we address the four factors that most influence production responsiveness and IPM development.
- Last, we discuss the capabilities of the PEACE model to include the input data requirements and provide the kinds of outputs that can be used by the item managers or program managers to assist them in performing analyses.

## THE CURRENT IPM PROCESS

The industrial readiness planning community receives post-M-day[1] production response data prepared by other organizations and private contractors. That community presumably coordinates its inputs with the production control specialists in their respective organizations. Those specialists also know the software necessary to determine their capability for expanding production. However, the industrial readiness planners face two problems:

- A credible job of accurately assessing a facility's production response capability requires a substantial amount of effort and costs money.
- The assessments are a function of some parameters that change almost daily making any specific assessment of production response capability out of date soon after it is completed.

Thus, we must first confront the problem of finding a balance between costs and data accuracy. As a result of the costs associated with producing the IPMs, only a limited number of them are currently developed for each end item. Compounding that problem has been the traditional focus of these IPMs on the mobilization rate (the "mob rate"). With the use of DD Form 2575 series of industrial preparedness planning documents, additional emphasis will be placed on identifying IPMs for incremental production increases. This orientation will facilitate crisis response planning.

---

[1]M-day traditionally represented the day on which partial mobilization was ordered by the President. The concept of a specific M-day for industrial preparedness planning is outmoded. Within the context of this report, M-day means any day on which increased production for any item is ordered.

In addition to the past focus on IPM development, the validation process needs improvement. Two processes – CRIB[2] and ROMPS[3] – conducted, respectively, by AMCCOM and AMC's Industrial Engineering Activity do a credible job of validating the ability of the production base to attain a specified production rate. However, neither process seems to validate sufficiently the rate at which the prime producer or producers can accelerate to maximum production and the month (after M-day) at which maximum capacity (within the existing "brick and mortar" and physical equipment configuration) can be attained. Furthermore, the IPMs are not yet fully integrated into the PMs' procurement programs. The PMs must be able to build IPMs, assess them, integrate them into the line-item procurement programs, and conduct tradeoffs with end-item procurement in ways that support the overall defense strategy and provide for accelerated production during contingencies.

## FACTORS THAT DETERMINE PRODUCTION RESPONSIVENESS

The ability to produce additional quantities of end items rapidly during a period of mobilization depends essentially on four factors:

- *Labor*: the time it takes to hire and train the additional people required to operate the existing facility at full capacity
- *Materiel*: the lead time to obtain the additional quantities of raw materials, components, and subcomponents needed in the production process
- *Production capacity*: the maximum output from the existing facility unconstrained by labor and materiels
- *Flow time*: the processing time it takes to make the item with adequate labor and materiels.

The data presented on the new DD Form 2575 require the development or calculation of the above four factors. The DD Form 2575 presents the result of some process developed by the prime contractor that combines estimates for the above factors into an expectation of what could be produced over time during periods of mobilization or industrial warning. The following subsections expand on the four factors and offer some insights into the way these factors combine to determine production expansion/acceleration capability.

---

[2]CRIB means Command Review of the Industrial Base.

[3]ROMPS stands for Review of Mobilization Production Schedule.

### Labor

During periods of acceleration, our production facilities need to hire and train new people. For the hiring process, we must address the following questions:

- Can the local community provide an adequate supply of capable people?
- If not, where do we find the needed labor and how long could we expect to wait for relocation and training?

A training program must be developed or initiated (this presumes that a partially accelerated program exists). That training program may require on-the-job training and/or the utilization of existing production personnel to train the new people. Initially, this training program could slow down production.

These issues must be addressed. Industrial planners must develop procedures for evaluating and validating labor lead times – the time required to hire and train an employee. Those lead times will vary as a function of the additional number of people required. The labor lead time to go from one shift to three shifts could be more than twice the time required to expand from a two-shift work force to a three-shift work force.

In the absence of a rigorous analysis of the labor issues, we are at the mercy of rough estimates as to the length of those lead times. As a minimum, we should explicitly state the labor lead time used in the development of post-M-day production response capability.

### Materiel

To produce additional end items, a prime contractor must order additional raw materials, components, and subcomponents from its vendors. A key factor is the lead times required for these components. For most materiel used for an end item, the lead times are probably very small (on the order of a few weeks or a month). On the other hand, a manageable number of key "pacing" components usually constrain the production process. We need to identify that handful of items and obtain estimates of their lead times. We also need to know the longest lead time for items not among those listed as most critical. For example, if a prime contractor is assembling 100 components to make an end item, it may well be that the longest lead time for 90 of them is 3 months and that the lead times for the remaining 10 items range from 5 months to 12 months. In that case, we could focus on the 10 items and develop IPMs

that would shorten their lead times to no less than 3 months (the constraint on the remaining 90 items). Alternatively, for the critical 10 long-lead-time components, we could stockpile 2 months of production for the item that has a 5-month lead time (and 9 months for the one with a 12-month lead time) and, with sufficient labor and production capacity, achieve maximum capacity in 3 months. This component stockpiling would take us to the point at which these components can be produced in adequate quantities.

### Production Capacity

The ability to produce large quantities of end items after M-Day also depends on the physical plant of the prime contractor and all tiers of subcontractors and the capacities of the equipment in their plants. We need to identify production bottlenecks caused by inadequate equipment and estimate the cost to eliminate such equipment constraints. Thus, for example, we could identify how much it would cost to increase the maximum capacity at a specific prime contractor's location by procuring two additional pieces of expensive equipment that would currently operate "around the clock" even though the rest of the facility is operating on a single-shift basis. We also need to know how long it would take to procure and install the new equipment. If the procurement and installation lead times are small compared to the warning time used for planning, we might be able to wait until increased production is requested to increase plant capacity in this manner.

### Flow Time

Even if we had all the labor and materiels required to meet the current production limits of a plant's equipment and configuration, we are still constrained by the physical process of building an item. Simple production processes tend to take much less time than complex production processes. Flow time for basic ammunition items may be measured in hours, whereas flow time for producing an aircraft could be months, and that for a submarine could be years.

The relationship between labor lead time, flow time, and materiel lead time also affects production expansion capability. For example, if we let the labor lead time be noted as $LB$ and let $N_i$ be the time into the production process when component $i$ is required, then there is a physical limit ($LB + N_i$) below which reducing materiel lead time for component $i$ is irrelevant. If the labor lead time ($LB$) is 4 months and all the components are required at the beginning of the process (*all* $N_i = 0$), then it makes no

sense to reduce the lead times for the components below 4 months. We have to wait that long for the labor.

On the other hand, if the first component in the previous example had a lead time of 8 months and was required 2 months into the production process ($N_1 = 2$), we would gain nothing by reducing the lead time for that one item below 6 months (i.e,. 6 months after mobilization − 4 months to get the people to begin working the extra shift plus 2 months before we need the component); we could only benefit by reducing the lead time for that item to 6 months from the current 8 months.

## THE PEACE MODEL

The PEACE model considers all of the above factors at various levels of detail and is designed to assist the program/project/product managers (PMs) develop and evaluate IPMs within a constrained budget total under various assumptions about industrial warning. It is designed to be used by the PM with inputs from either the contractor or the industrial planning community. An overview of the key inputs and outputs of the model are listed below:

### Peace Model Inputs

The program inputs to the PEACE model are as follows:

- *Time horizon:* the period over which we are to develop or assess a procurement program that will consist of two components: expenditures for end items and expenditures for IPMs that will enhance the production responsiveness post M-day.
- *Total inventories:* the total number of worldwide assets that can be applied against the contingency requirement addressed in this analysis.
- *Conflict months:* the number of months in the contingency being addressed
- *Monthly combat demands:* the monthly combat consumptio demands for this contingency.
- *Annual procurement:* the total procurement resources available to spend on this item in each year of the specified time horizon.
- *Average unit cost:* the cost of the item over the time horizon and how unit prices change with quantity procured.
- *Current prime capacity:* the total monthly production capacity available at the prime contractor facility within current brick and mortar and existing

equipment configuration and unconstrained by availability of labor and materials.

- *Maximum prime production capacity and equipment costs:* the costs of additional equipment needed to remove production constraints so that this facility can realize its inherent maximum production capacity constrained only by existing brick and mortar.
- *Time to achieve maximum capacity:* the time to procure and install equipment that is constraining the current production process.
- *Flow time:* the time it takes to assemble the end item, given that all materials and labor are available.
- *Labor lead times:* an estimate of the number of months it would take to hire and train a maximum capacity labor force under two conditions: (1) the facility is cold and we need to hire and train three shifts of people and (2) operations occur on a single 1-8-5 basis and we need to hire and train enough people to go to three shifts. These estimates assume that the facility would be operating at its maximum production capacity with all necessary equipment in place and constrained only by existing brick and mortar.
- *Number of critical components:* the top number ($N$) of critical components[4] that constrain the production process in terms of lead times or production capacity limitations. For each of these components the inputs are as follows:
  - Unit price of the component
  - Number of producers of this component
  - Quantity required per end item assembly.
- For each producer of each of the $N$ critical components, we must provide the following inputs:
  - *Current production capacity:* the total monthly production capacity available at the prime contractor facility within current brick and mortar and existing equipment configuration and unconstrained by availability of labor and materials.
  - *Maximum attainable production capacity and equipment costs:* the costs of additional equipment needed to remove production constraints so that this facility can realize its inherent maximum production capacity constrained only by existing brick and mortar.

[4]Currently in the model, $N$ is constrained to be no greater than 10. The program could be easily modified to handle a larger number of components.

- *Time to achieve maximum capacity:* the time to procure and install equipment whose absence is constraining the current production process.
- *Materiel lead times:* an estimate of the time (lead time) it would take for this producer to provide the prime contractor with maximum output from its facility under two conditions: (1) the producer starts with a cold production line and (2) the producer is operating a single 1-8-5 shift.
- *Fraction of production allocated*: an estimate of the fraction of the total production from this producer that will be earmarked for this end item.

- *Cost sharing indicator:* a flag that is set to 1 if equipment costs to increase total capacity will be shared by the other users of this component. Setting this to zero gives an indication of whether the investment is "cost-effective" even if the total cost of the equipment investment is borne by this end item.
- *Noncritical lead time:* an estimate of the largest lead time for all the remaining components not expressly considered above. This lead time must be smaller than any of the production lead time for all the above producers of the $N$ critical components.

## PEACE Model Outputs

The outputs of the PEACE model are as follows:

- A breakout of the total resources available for procurement for the end item between procurement for "all up" end items and procurement for IPMs. IPMs are characterized in terms of the following:
  - How much should be invested in equipment for each of the components to increase production capacity
  - How much should be invested in long-lead components, by component type.
- Production buildup schedules with and without the IPMs, including the following:
  - Projections of post-M-day and post-D-day inventories as a function of industrial warning
  - Assessment of combat sustainability against specified conflict scenarios.

# GLOSSARY

| | | |
|---|---|---|
| AAP | = | Army ammunition plant |
| ACE | = | Armored Combat Earthmover |
| ACP | = | assault command post |
| AHIP | = | Army Helicopter Improvement Program |
| AMC | = | Army Materiel Command |
| AMCCOM | = | Armament, Munitions, and Chemical Command (U.S. Army) |
| APDS | = | Armor Piercing Discarding Sabot |
| AR | = | Army Regulation |
| ARCENT | = | Army Component of U.S. Central Command |
| ASARDA | = | Assistant Secretary of the Army (Research, Development, and Acquisition) |
| ASL | = | authorized stockage list |
| ASM | = | Armored Systems Modernization |
| ASPPO | = | Armed Services Production Planning Officer |
| ATACMS | = | Army Tactical Missile System |
| AVSCOM | = | Aviations Systems Command |
| BCS | = | Battlefield Computer System |
| BDU | = | battle dress uniform |
| BFV | = | Bradley Fighting Vehicle |
| BLPS | = | Ballistics-Laser Protective Spectacles |
| BMY | = | Bowen-McLaughlin and York |
| BTU | = | British thermal unit |
| CAD | = | computer-aided design |
| CAM | = | computer-aided manufacturing |

| | | |
|---|---|---|
| CBPS | = | Chemical Biological Protection Shelter |
| CECOM | = | Communications and Electronics Command (U.S. Army) |
| CEOs | = | chief executive officers |
| CFIUS | = | Committee on Foreign Investment in the United States |
| CICA | = | Competition in Contracting Act |
| CIL | = | critical items list |
| CINC | = | Commander in Chief of a Unified or Specified Command |
| COCO | = | contractor-owned, contractor-operated |
| CONUS | = | contiguous United States |
| CRIB | = | Command Review of the Industrial Base |
| CRISP | = | Commercial Replacement Item Substitute Planning |
| D-day | = | day on which operations begin |
| DA | = | Department of the Army |
| DA CIL | = | Department of the Army Critical Items List |
| DATP | = | Detroit Arsenal Tank Plant |
| DBOF | = | Defense Business Operating Fund |
| DCS | = | Defense Communication System |
| DCSLOG | = | Deputy Chief of Staff for Logistics (U.S. Army) |
| DCSOPS | = | Deputy Chief of Staff for Operations and Plans (U.S. Army) |
| DD | = | design development |
| DESCOM | = | Depot Systems Command (U.S. Army) |
| DFARS | = | Defense FAR (Federal Acquisition Regulation) Supplement |
| DID | = | data item description |
| DLA | = | Defense Logistics Agency |
| DO | = | second-level priority designator in Defense Priorities and Allocation System |
| DoC | = | Department of Commerce |

| | | |
|---|---|---|
| DoD | = | Department of Defense |
| DoDI | = | Department of Defense Instruction |
| DPA | = | Defense Production Act |
| DPAS | = | Defense Priorities and Allocations System |
| DPSC | = | Defense Personnel Support Center |
| DX | = | designates programs of highest national priority in Defense Priorities and Allocation System |
| EOC | = | Emergency Operation Center |
| FAR | = | Federal Acquisition Regulations |
| FLAR | = | Flame Launcher and Rocket |
| FMC | = | fully mission capable |
| FMS | = | foreign military sales |
| FMTV | = | Family of Medium Tactical Vehicles |
| FST | = | Future Soviet Tank |
| FYDP | = | Five Year Defense Plan |
| GBU | = | general bomb unit |
| GFM | = | Government-furnished materiel |
| GFP | = | Government-furnished property |
| GMR | = | Graduated Mobilization Response |
| GOCO | = | Government-owned, contractor-operated |
| GOGO | = | Government-owned, Government-operated |
| GPH | = | gallon-per-hour |
| GPS | = | Global Position System |
| GS | = | general support |
| HEMTT | = | Heavy Expanded Tactical Truck |
| HETS | = | Heavy Equipment Transporter System |
| HMMWV | = | High Mobility Multipurpose Wheeled Vehicle |

| | | |
|---|---|---|
| HMX | = | high melt explosive |
| HQ | = | headquarters |
| IAMS | = | Integrated Army Mobilization Study |
| IBP | = | industrial base planning |
| IDA | = | Institute for Defense Analyses |
| IEA | = | Industrial Engineering Activity |
| IFF | = | identification friend or foe |
| IMIP | = | Industrial Modernization Incentives Program |
| IMT | = | Intensive Management Team |
| IPM | = | industrial preparedness measures |
| IPP | = | industrial preparedness planning |
| IPPL | = | Industrial Preparedness Planning List |
| IR&D | = | independent research and development |
| ISOPADS | = | Individual Soldier-Operated Personal Acoustic Detector System |
| LAP | = | load-assemble-pack |
| LAST | = | Light Applique System Technique |
| LATP | = | Lima Army Tank Plant |
| LEA | = | Logistics Evaluation Agency |
| LEAD | = | Letterkenny Army Depot |
| LH | = | Light Helicopter |
| LMI | = | Logistic Management Institute |
| LPO | = | Laser Protective Outserts |
| LRIP | = | low-rate initial production |
| M-day | = | mobilization day |
| MANTECH | = | manufacturing technology (program) |
| MAVS | = | Mobile Audio Visual System |

| | | |
|---|---|---|
| MBB | = | Messerschmitt-Blochau-Blohm |
| MEI | = | major end item |
| MICOM | = | Missile Command (U.S. Army) |
| MLAW | = | Manportable Laser Assault Weapon |
| MLRS | = | Multiple Launch Rocket System |
| MOREs | = | meals, ordered ready to eat |
| MRC | = | major regional contingency/conflict |
| MRE | = | meals, ready to eat |
| MSAAP | = | Mississippi Army Ammunition Plant |
| MSC | = | major subordinate command (U.S. Army) |
| MSE | = | Mobile Subscriber Equipment |
| MSR | = | minimum sustaining rate |
| NATO | = | North Atlantic Treaty Organization |
| NBC | = | nuclear, biological, chemical |
| NBCRS | = | Nuclear, Biological, Chemical Reconnaissance System |
| NDI | = | nondevelopmental item |
| NICP | = | national inventory control point |
| ODCSOPS | = | Office of the Deputy Chief of Staff for Operations (and Planning) (U.S. Army) |
| ODS | = | Operation Desert Shield/Desert Storm |
| OMA | = | Operations and Maintenance (Army) |
| OSD | = | Office of the Secretary of Defense |
| OSHA | = | Occupation Safety and Health Administration |
| PAC-2 | = | Patriot Antitactical Missile Capability – Level 2 |
| PEACE | = | Production Expansion/Acceleration Capability Enhancement |
| PEO | = | program executive officer |
| PGMs | = | precision guided munitions |

| | | |
|---|---|---|
| PLL | = | prescribed load list |
| PLS | = | Palletized Load System |
| PM | = | program/project management |
| POC | = | point of contact |
| POL | = | petroleum, oil, and lubricants |
| POM | = | program objective memorandum |
| POPS | = | Paperless Order Placement System |
| PPS | = | Production Planning Schedule |
| ProBase | = | Production Base |
| RDEC | = | requirements data exchange cards |
| RDT | = | research, development, and test |
| RDT&E | = | research, development, test, and evaluation |
| RDX | = | research and development explosive |
| RFP | = | request for proposals |
| RIF | = | reduction in force |
| ROM | = | refuel on the move |
| ROMPS | = | Review of Mobilization Production Schedule |
| ROWPU | = | Reverse Osmosis Water Purification Units |
| RSCAL | = | Remote Sensing Alarm |
| RSS | = | Rosette Scan Seeker |
| SADARM | = | sense and destroy armor |
| SATCOM | = | Satellite Communications |
| SINCGARS | = | Single Channel Ground Airborne Radio System |
| SRA | = | support force requirements analysis |
| SRS | = | sleep restraint system |
| SSA | = | Selective Service Act |
| SWA | = | Southwest Asia |

| | | |
|---|---|---|
| SWAPDOP | = | Southwest Asia Petroleum Distribution Operation |
| TACFIRE | = | Tactical Fire Control System |
| TACOM | = | Tank-Automotive Command (U.S. Army) |
| TASC | = | The Analytic Sciences Corporation |
| TOW 2 | = | Tube-Launched, Optically Tracked, Wire Command-Link Guided Missile, Version 2 |
| TRADOC | = | Training and Doctrine Command (U.S. Army) |
| TROSCOM | = | Troop Support Command (U.S. Army) |
| TTS | = | Tank Thermal Sight |
| UHF | = | ultra high frequency |
| ULCANS | = | Ultralightweight Camouflage Net System |
| V-Pack | = | Valve-pack |
| VHF | = | very high frequency |
| WRAP | = | war reserve automated process |
| WRS | = | war reserve stocks |

# Part II

# *Logistics Sustainability Assessment*

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# CHAPTER 1

# INTRODUCTION

## BACKGROUND

The logistics unit capability, selected major items, and ammunition assessments contained in this part of the analysis were conducted using two basic scenarios: (1) simultaneous short warning major regional contingencies in Southwest Asia and Korea; and (2) a general conflict in Europe with extended strategic warning. It is important to understand that these sustainment snapshots will change as force structure modifications and resource program adjustments are implemented.

## TASKING

The Assistant Secretary of the Army for Installations, Logistics, and Environment, tasked the Deputy Chief of Staff for Operations and Plans (DCSOPS) to integrate the lessons learned from Operation Desert Shield and future scenarios into the Graduated Mobilization Response methodology. DCSOPS initiated the Integrated Army Mobilization Study (IAMS) as a basis for an Army staff wide coordinated analytical effort. DCSOPS further tasked the Deputy Chief of Staff for Logistics (DCSLOG) for a logistics sustainment assessment of the IAMS scenario based forces. The Logistics Evaluation Agency (USALEA), a field operating agency of the DCSLOG accomplished the sustainment assessments as described in the next paragraph.

## SCOPE OF WORK

The analysis evaluated projected assets as of end fiscal year 1999 (FY 99). The central thrust of the study is an analysis of Army supportability within the IAMS scenario assumptions that were made in January and February 1991. The essential elements of analysis are Class V, VII and logistics units. Due to late arrival of requirements data, technical problems, and because of time constraints, Class III, IX, and non-modeled Class VII items were not studied.

## ORGANIZATION OF THIS PART

There are three chapters following the Introduction (Chapter 1).

Chapter 2 addresses logistics unit capability to project combat power with a predominantly CONUS-based Army.

Chapter 3 analyzes the adequacy of selected weapon systems (major items) to support the deployed contingency forces.

Chapter 4 details the adequacy of assets for selected conventional ammunition items in support of the contingency forces.

Chapters 2 through 4 are classified and have been removed for the unclassified version.

# Part III

# *Sample Options for U.S. Army POM 94-99 Decisions*

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# CHAPTER 1

# SUMMARY AND RECOMMENDATIONS

## SUMMARY

In preparing its future budgets, the Army must plan for a variety of combat systems in an environment of decreased spending and program terminations. A premium will therefore be placed on identifying innovative ways to maintain or restore the capability to meet future U.S. needs for battlefield combat power. Successfully meeting these requirements -- ranging from crisis response capabilities of the active and reserve forces to the reconstruction of wholly new forces -- will not only enhance the evolution of the present force structure; it will also bolster the industrial base as well as science and technology efforts that will support the long term defense objectives of the nation.

As part of the Integrated Army Mobilization Study (IAMS), and to help frame resourcing options that are useful in POM preparation, the Institute for Defense Analyses (IDA) was tasked to develop and demonstrate a methodology for assessing the cost/quantity tradeoffs for several key weapon systems. This methodology was used to identify various options for satisfying the resource requirements of a given scenario. By using the best available data, and by considering a spectrum of possible scenarios, investment options which are preferred across a range of assumptions may be selected. Four case studies were conducted. Together, they show the types of data that are needed to perform these assessments, and which factors of industrial base capabilities are most important.

## SCOPE

The primary objective of the IDA contribution to the IAMS was to develop a tradeoff methodology that can estimate and display costed supply options combining alternative plant status, Foreign Military Sales, procurement and ramp-up plans, and which is applicable to many scenarios. An additional, separate task involved IDA's providing data and consultation on surge profiles for selected systems, based on the Joint Industrial Mobilization Planning Process (JIMPP), to other study participants. A third task was to develop recommendations for implementing the tradeoff methodology.

The IDA tradeoff methodology was developed in close coordination with the study sponsors, and involved the following stages. After the presentation of an initial version of the

methodology, the Study Advisory Group approved the selection of four systems to be examined as cases studies: the Abrams Tank family, Apache Helicopter, TOW Missile, and the MLRS Missile. For each system, site visits to the Program Manager's facilities were conducted and data obtained. The data addressed programmatic elements, plant closure and restart costs, prime and major subcontractor data on ramp-up capabilities and other production cost information.

Each case study calculated how many systems would be available at the end of the FY 94-99 POM planning period under various assumptions. The range of quantities potentially available were combined with the investment and production costs and also with scenario-based system requirements. In this manner, two key questions were addressed: 1) Would currently projected U.S. assets (of each system examined) suffice to meet the battlefield objectives (of a given scenario)? 2) If not, what are some of the Army's major alternatives to address this issue?

The analyses of the four systems were documented in a series of papers and presented to the Army prior to the final General Officers Steering Committee meeting on December 18, 1991. They are included in this consolidated report also.

## CONCLUSIONS

There are three conclusions of the IDA analyses.

The tradeoff methodology and display techniques can aid decision-makers in developing and assessing options for POM development. They provide a structure for constructing options which have a range of quantity and cost results; viable options for various cost or quantity targets are then readily determined.

The supply options can be combined with requirements and warning time estimates from various scenarios to show feasible and infeasible options and relative costs. By developing a matrix of options, with several values considered for key variables (e.g., warning time or the amount of Foreign Military Sales), a more robust assessment may be made. Other measures of merit (e.g., output measures from a combat model) may be joined in this framework to illuminate which POM options satisfy stated or desired requirements.

Third, data collection efforts showed the willingness of program offices to help, but there was a scarcity of data on times and costs to ramp-up/restart production lines. Knowing the potential responsiveness of the production lines is critical to the decision to defer procurement to a post-warning period. Given the forecast decreases in the budget, such deferments are imperative, and so too is the need for better data on the capabilities of the industrial base.

## RECOMMENDATIONS

### 1. Implement the tradeoff methodology for a variety of high priority items.

Major end items were considered in this study. There is the potential to apply this approach to consumables as well. The tradeoffs at the item level should be based on combat effectiveness measures, in addition to cost measures. While more complex, the tradeoffs should also consider tradeoffs among systems (e.g., both platforms and munitions).

The next step towards implementing the tradeoff methodology within the Army is to complete the Validation, Verification and Accreditation process. This is now underway. AMC has been identified as the Accreditation proponent. The initial assessments of the Validation and Verification status of the IDA methodology were recently conducted, with the recommendation that Accreditation be pursued.

### 2. Assess tradeoffs between restarting production of current systems and accelerating future systems.

With many current systems nearing the end of the planned procurement, the costs of restarting plants during an emergency may increase, especially if steps to retain the existing capabilities are not taken. Tradeoffs which consider ways to bring future systems into procurement faster are thus important to evaluate.

### 3. Assess the future role of the Army arsenal system as a center for critical skills/technologies and as a source for surge capabilities.

The following perspectives on the roles of Army arsenals are appropriate for further study:

- **Repository of Special Skills and Technologies** - Determine what are the critical Army research and manufacturing skills and technologies, and assess whether private industry will necessarily maintain the required expertise.
- **Provision of a Flexible Surge and Spares Manufacturing Capability** - To ameliorate the potentially long lead times required for commercial vendors to ramp-up to an emergency production level (as was indicated in recent Industrial Base assessments), the Army arsenals may be able to use advanced manufacturing technologies to create a flexible surge production capability that could address a broad range of needs. What are the financial, administrative, or policy implications of such an approach? The focus here is on research that may enhance the Tri-Service Flexible Computer Integrated Manufacturing Program and the Army's Integrated Flexible Manufacturing System.

- **Center of Advanced Prototype Demonstrations** - If new production is replaced in part by a series of advanced technology demonstrators, would a dedicated DoD organization be better able than private industry to perform this role, given the changing financial incentives for industry to invest in advanced research and development?

**4. Strengthen the linkages between production possibilities/tradeoff assessments and warfighting analyses in various scenarios for POM input.**

Analyses of warfighting requirements are now more complex, having to consider greater uncertainty in the scale, duration and type of conflict which must be planned for. As demonstrated in the case studies below, there are significant potential benefits to producing large quantities of weapons during emergency conditions -- higher production rates during the emergency period may be more efficient, less peacetime procurement means lower POM program costs, and deferred procurement may allow technical advances to be more easily incorporated into the units ultimately produced. An integrated treatment of the industrial base planning and the warfighting analyses should be pursued.

## ORGANIZATION OF REPORT

The Option Papers developed as part of the case studies and presented to the study sponsor during December, 1991, comprise the remainder of this part of the report. Chapter 2 presents the Abrams Tank Family Option Paper, with a supplemental analysis provided in Chapter 3. Chapters 4, 5, and 6 address the Apache Helicopter, the TOW Missile and the MLRS, respectively.

# CHAPTER 2

# SAMPLE TANK OPTIONS FOR ARMY POM 94-99 DECISIONS

## INTRODUCTION

In preparing its FY1994-99 POM, the Army is building production plans for a variety of combat systems. The magnitude of impending budget cuts and program terminations puts a premium on identifying innovative ways to maintain/restore the capability to meet potential future U.S. needs for battlefield combat power. President Bush has recently highlighted the importance of such efforts--by making Reconstitution a key part of *The National Security Strategy of the United States* (August 1991):

> Beyond the crisis response capabilities provided by the active and reserve forces, we must have the ability to generate wholly new forces should the need arise....The ability to reconstitute is what allows us safely and selectively to scale back and restructure our forces in being. This difficult task will require us to invest in hedging options whose future dividends may not always be measurable now. It will require careful attention to the vital elements of our military potential: the industrial base, science and technology, and manpower....We and our allies must be able to reconstitute a credible defense faster than any potential opponent can generate an overwhelming offense.

As a part of the Integrated Army Mobilization Study (IAMS), and to help the Army frame resourcing options for several planning scenarios in the POM 94-99 time frame, the Institute for Defense Analyses (IDA) has developed a means of assessing cost/quantity production tradeoffs for key weapons systems. IDA is compiling data and preparing production tradeoffs on each of four systems: the Abrams tank, the Apache helicopter, the TOW missile, and the Multiple Launch Rocket System (MLRS). Each program office was visited, and data are now being assessed. This paper describes the basic tradeoff technique and then illustrates it with data for the Abrams tank using material that has been reviewed with the Abrams program manager, Col. John Caldwell, and his staff. The paper concludes with a recommendation that this approach be used to develop options for the Army's POM 94-99.

## TWO INTEGRATED ARMY MOBILIZATION STUDY (IAMS) QUESTIONS

Two key IAMS questions are as follows:

- Would currently projected U.S. tank assets suffice to meet battlefield objectives as stipulated in a long-warning European scenario occurring at the end of the POM 94-99 period?
- If not, what are some of the Army's major alternatives to address this issue?

IAMS advisors have tasked CAA to provide estimates on the first question. The next section provides some initial assessments by IDA that may help address the second.

## APPROACH

### Collect Production, Planning and Inventory Data

Production of new Abrams tanks for U.S. use is now scheduled to end in FY1993. U.S. Foreign Military Sales (555 to Egypt and 465 to Saudi Arabia) support continued production of new tanks through CY1997. A current proposal to convert up to 2,180 U.S. M1s and M1A1s to M1A2s is now in markup in Congress. If funded for the POM 94-99 period, this would upgrade the battlefield capability of many existing U.S. Abrams tanks in ways that were valuable in the Persian Gulf (See Appendix E).

The projected October, 1993 Army inventory of 16,081 battle tanks--7,087 Abrams and 8,994 other tanks (including 5,586 M60A3)--is a significant military asset for potential conflict scenarios in the 1990s. The inventory will become even more capable should some form of conversion program be funded for POM94-99. On the other hand, current Army POM 94-99 plans do not explicitly indicate any projected net additions to U.S. tank inventories.

If the Army should need more tanks than it now has, it can produce them or obtain them from other countries. This analysis focuses on U.S. production possibilities. Appendix A summarizes the tank production capability and cost data that have been utilized in preparing this paper.

One basic fact to keep in mind is that the current U.S. facilitized monthly Abrams tank production **capacity** is 120, i.e., approximately one-third of an Armored Division worth of tanks per month. At this rate, the U.S. could build one division's worth per quarter, or four divisions worth per year. If the U.S. determines that it needs to produce more than four divisions worth of additional tanks for a particular future scenario, it will need to have either:

- more than a year's worth of emergency production time (at 120 tanks per month),

- a capability to produce more than 120 tanks per month in an emergency,
- some additional production in peacetime, or
- some other source of additional tanks (either FMS buy-backs or foreign production).

To keep track of some of these possibilities in an orderly way, and to integrate them with the best available cost data for the Abrams, it was worthwhile to develop a simple computer model.

### Develop An Army Production Tradeoff Model

IDA has developed a model and a graphical display for assessing and summarizing the quantities and costs of additional tanks that could be produced **for U.S. use** through various production plans over the remainder of the 1990's. The model projects a potential peacetime production program, and then examines a number of possible alternatives for surging production upon warning. The model calculates two things: the total quantity of tanks produced (with peacetime and emergency periods combined), and the costs of producing the tanks for that case. Appendix B provides an overview of the model and the display technique.

The tank quantity estimates represent the sum of three components: the numbers of tanks produced **for U.S. use** during each of three periods--(1) A peacetime "prewarning" period; (2) a "ramp-up" period; and (3) an "emergency production" period (after "ramp-up").

These three quantity components are calculated in turn as follows:

- Production during prewarning equals the length (in months) of the prewarning period times the peacetime rate per month;
- Production during ramp-up is assumed (in this version) to equal the peacetime monthly rate times the number of months estimated as needed (after warning) to achieve the selected emergency production rate.
- Production during the "emergency production" period is assumed to equal the selected emergency monthly rate times the length (in months) of the emergency production period (i.e., the length of the warning period minus the length of the ramp-up period).

The cost algorithm calculates, for each production plan, the sum of three cost elements:

- plant "layaway" costs incurred during the period (both fixed and variable);
- plant "restart" costs; and
- the relevant production costs (fixed and variable) for each phase of the production plan.

## Develop Alternatives

### Twenty One Initial Cases and The Display "Cube"

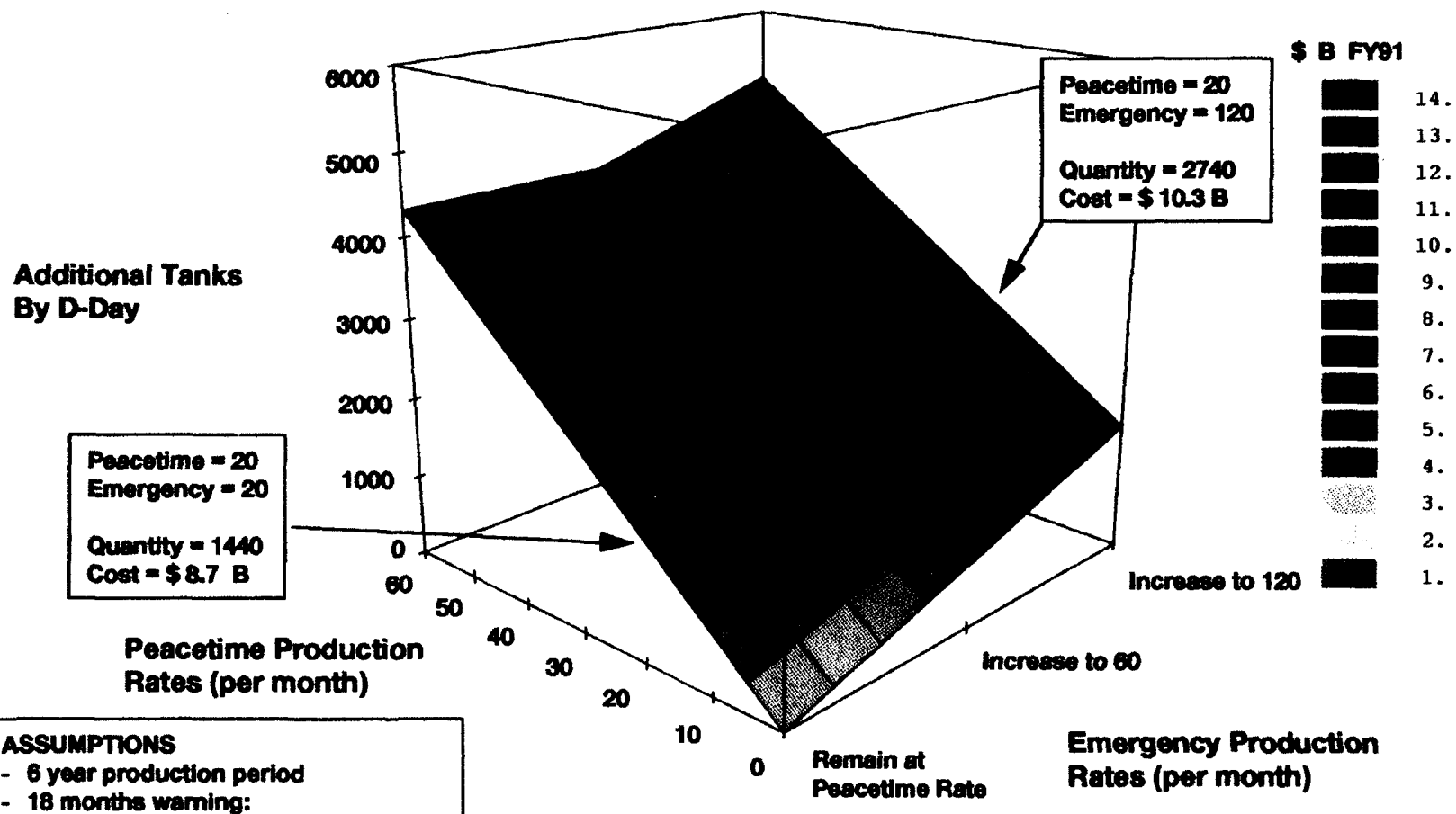
Figure III-2-1 presents results for each of 21 separate "what-if" planning cases. Along the vertical dimension, the display Cube in the Figure shows the number of additional tanks produced by the **end** of a 72 month production period (by D-Day) in each case. The total dollar cost of a given case (in Billions of 1991$) is indicated by the color scheme. (Note the color legend on the upper right side of Figure III-2-1.) For orientation, note that the most costly production cases are in the far back corner of the Cube, that they cost about $14B, and are shown in dark red; by sharp contrast, the least expensive cases run in the $1-2B range and may be seen in a light brown/ yellow at the bottom front center of the display.

All the cases in Figure III-2-1 share five principal assumptions. These can be seen at the bottom left corner of the Figure.

- First, the overall production period considered here is 72 months long (beginning in October of 1993 and ending September 30, 1999).
- Second, warning is assumed to occur on April 1, 1998, and the warning period to last for 18 months--until D-Day on October 1, 1999.
- Third, five full months of "extreme national emergency priority" ramp-up time (after warning) is assumed required in these cases in order to achieve the emergency production rate. The ramp-up period is followed by 13 months of production at emergency rates.
- Fourth, no FMS is assumed in any of these cases (more on this later).
- Fifth, total costs are included in these estimates, including any restart and production costs during the warning/emergency period.

The 21 cases in Figure III-2-1 include three groups of seven: a first seven in which one of the seven peacetime monthly production rates shown at the bottom left front of the Cube (0,10,20,30,40,50, and 60) is maintained through the entire 72 month period, i.e., no production "surge" occurs and production remains at the peacetime rate through the entire warning period; a second seven cases in which each peacetime rate is maintained until warning and then production is increased to 60 per month for the last 13 months of warning; and a final seven cases in which the peacetime rate is maintained until warning and then a rate of 120 tanks per month is achieved for the last 13 months of the 18 month warning period.

# SAMPLE OPTIONS FOR POM 94-99
# Main Battle Tank




**ASSUMPTIONS**
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- Foreign Military Sales = 0 / month
- No Emergency Supplemental Budget

Figure III-2-1

IDA September 6,1991

The cases displayed in Figure III-2-1 thus range from completely closing down the tank plants ("total shut down") throughout the period up to a plan to produce 60 tanks per month throughout the peacetime period and then, on warning, to increase to 120 per month. The total shut-down case (i.e., 0,0) may be seen in the front bottom corner of the Cube in Figure III-2-1, while the 60 per month in peacetime combined with mobilization up to 120 per month (60,120) can be seen in the far back upper corner of the Cube.

Cases 1 and 2, described below, are two of the many notional plans displayed in Figure III-2-1. A focus on these two can help illustrate the technique and demonstrate the value of systematically capturing assessments of contingency production capabilities in planning the POM.

### Case One: Production at 20 New Tanks Per Month for 72 Months (1,440 Tanks, $8.7B)

Figure III-2-1 highlights this case (toward the bottom front left in the figure), and indicates (in the box) that such a plan would result in 72*20 or 1,440 tanks, at an estimated total cost of $8.7B (in FY1991 dollars).

**Case One Calculations:** Table III-2-1 shows the quantity and cost calculations for this case. The tank quantity calculation is self-evident, i.e., 72 months at 20 tanks per month equals 1440 additional tanks. The cost calculation warrants some explanation. First, since current (August 91) Abrams tank production is 60 per month, this case would involve a partial layaway of tank production facilities (from the level needed to produce 60 per month down to the level needed to produce 20 per month). Layaway costs are estimated at $231M in fixed (one-time) costs and $1.6M/mo. in variable maintenance costs (See Appendix A for details). Given 72 months of partial layaway in this first case, the total layaway costs will thus equal $386M. There are no restart costs, since a production rate of 20 per month is maintained over the whole period. Finally, two production costs need to be considered--the fixed cost of being in production at all in a given month (estimated at $7.4M/month), and the estimated unit cost of an M1A2 Abrams at a production rate of 20 per month ($5.4M per tank). The total production costs are thus $8.309B. In Figure III-2-1, the total of layaway and production costs is rounded off to $8.7B, as shown on the lower left side.

**Table III-2-1. Case One Calculations**

| | | | | | | |
|---|---|---|---|---|---|---|
| Quantity | | | | | | |
| Total Quantity | = 20 Tanks/mo x 72 mo. | | | = | 1440 Tanks | |
| Cost | | | | | | |
| Layaway: | One time | = | $231M | | | |
| | Monthly | = | $1.6M/mo x 72mo | = | $155.2M | |
| | | | | | | $386M |
| Production: | Monthly | = | $7.4M/mo. x 72mo | = | $533M | |
| | Unit | = | $5.4M/tank x 1440 | = | $7,776M | |
| | | | | | | $8,309M |
| Total | | | | | | $8,695M |

## Case Two: Produce 20 New Tanks per Month for 59 Months, Then Mobilize to 120 Tanks per Month for 13 Months (2,740 Tanks, $10.3B)

By contrast, consider a second tank production plan (Case 2), again lasting 72 months, in which the peacetime (prewarning) monthly rate is also 20 per month. On warning, however, the rate is increased to 120 per month as rapidly as possible. Again, assume warning occurs at the start of the 55th month of the production plan and that it is feasible to ramp-up to a production rate of 120 per month by the start of the sixth month after warning, i.e., by the start of month 60. Figure III-2-1 displays this second case as well, toward the top back right of the Figure, and shows (again in the second highlighted box) that a total of 2740 tanks would be produced at an approximate total cost of $10.3B (FY91$).

**Case Two Calculations:** Table III-2-2 provides the summary calculations for this case. The additional 1,300 tanks in this case (as compared with Case 1) result from producing at a rate of 120 per month for the last 13 months of the plan as opposed to 20 per month for those last 13 months. In short, the second case features a net production increment (over the first case) of 100 tanks per month in each of those 13 months.

**Table III-2-2. Case Two Calculations**

| | | | | | | |
|---|---|---|---|---|---|---|
| Quantity | | | | | | |
| Peacetime | = 20 | Tanks/mo x 54 mo | = | 1080 | | |
| Ramp Up | = 20 | Tanks/mo x 5 mo | = | 100 | | |
| Emergency | = 120 | Tanks/mo x 13 mo | = | 1560 | | |
| Total | | | | 2740 | Tanks | |
| Cost | | | | | | |
| Layaway: | One time | = $231M | | | | |
| | Monthly | = $1.6M/mo x 54 mo | = | $86.4M | | |
| | | | | | $ 317M | |
| Restart: | One time | | = | | $ 348M | |
| Production: | Monthly | = $7.4M /mo x 72 | = | 532M | | |
| | Unit (@ 20/mo) | = $5.4M/mo x 59 | = | 6,372M | | |
| | Unit (@ 120/mo) | = $1.73M/mo tank x 1560 | = | $2,699M | | |
| | | | | | $9.603M | |
| Total | | | | | $10,268M | |

The cost of the 2,740 tanks in Case 2 can be explained as follows. Layaway costs include the same fixed cost as the first case, but the variable costs run for 54 rather than 72 months. Total layaway costs thus equal $317M. In this case, a one time restart cost (from 20 to 120 tanks per month ) of $348M is involved. Fixed production costs of $7.4M per month for 72 months are incurred in this case too, just as they were in Case 1. Unit production costs vary from $5.4M for the 59 months at the 20 tank per month rate down to an estimated $1.73M per tank for the 13 months of production at 120 per month. Total production costs are thus estimated at $9.6B. Layaway, restart and production costs for this second case thus total $10.268B, rounded to $10.3B in Figure III-2-1.

## Alternative Ways To Produce 2,000 Additional Tanks By D-Day

Cost tradeoffs can be examined in Figure III-2-1 by identifying alternative ways to obtain a given number of tanks. Consider, for instance, a demand for an extra 2000 tanks over this period. Using the calculus and assumptions illustrated above, one finds there are three basic strategies.

- Produce at approximately 30 per month; do not surge: Cost = $10.7B
- Produce at approximately 20 per month, surge to 60 per month: Cost = $9.9B
- Produce at approximately 10 per month, surge to 120 per month: Cost = $8.2B

## Examine Alternative Cases/Scenarios

Sample production plans have been developed and presented in this paper thus far to show a range of ways that the Army could obtain additional U.S. tanks that might be needed by D-Day in a hypothetical European theater (or other major) conflict. Several other kinds of cases and model features are described below.

### Foreign Military Sales

The tank cases shown in Figure III-2-1 offer a useful starting point for considering the cost impacts of Foreign Military Sales. Figures III-2-2 through Figure III-2-4 depict the effects of a range of FMS (from 10-30 tanks per month) on the costs (to the U.S. taxpayer) of each of the 21 production cases described in Figure III-2-1. To illustrate, Figures III-2-2 through Figure III-2-4 highlight the effects on Cases One and Two (from Figure Figure III-2-1) of FMS sales at various levels per month. The cost of Case One drops from $8.7B (in Figure III-2-1) with no FMS down to $6.3B (in Figure III-2-4) if FMS is maintained at 30 units per month until warning (Note that FMS is assumed to be discontinued upon warning in all these sample cases). These savings stem from reduced layaway costs and reduced peacetime unit production costs. Case Two's costs are reduced accordingly too (from $10.3B in Figure III-2-1 to $7.6B in Figure III-2-4), since a significant part of Case Two's costs arise from the peacetime production at "Case One rates" (i.e., 20 per month). In addition, Case Two's restart costs are also reduced through peacetime FMS. (Again, Appendix A provides all the relevant cost data that IDA has drawn upon in preparing these estimates.)

### Funding Perspectives: Total Dollar Costs or POM Dollar Costs

Figures III-2-1 through III-2-4 have depicted all cases in terms of their total dollar costs in the POM 94-99 period. Figures III-2-5 through III-2-8 take a different funding perspective. They are identical to Figures III-2-1 through III-2-4, respectively, except that Figures III-2-5 through III-2-8 presume that a Supplemental Budget would be available to cover all tank plant restart and production costs after Warning Day, i.e., beginning on the 55th month of the 72 month overall production period. Under this assumption, it makes sense for decision makers to review alternatives in view of their relative POM dollar costs. A perspective of this sort thus

permits the decision maker to look at POM dollar expenditure patterns in terms of their relative payoffs on "D-Day."

### Other Scenarios, Warning Times, Ramp-Up Times, Etc.

The model and display techniques can be applied to short-warning planning scenarios--such as a Major Regional Contingency (East)--as well. In those kinds of cases, however, which are also clearly far more likely than the long warning European contingency, the model (and the underlying data) is expected to show that the Army has no real options other than relying on tanks already in inventory and, perhaps to a very limited extent, accelerating deliveries of any tanks already on order and therefore "in the pipeline."

## CONCLUSIONS AND RECOMMENDATIONS

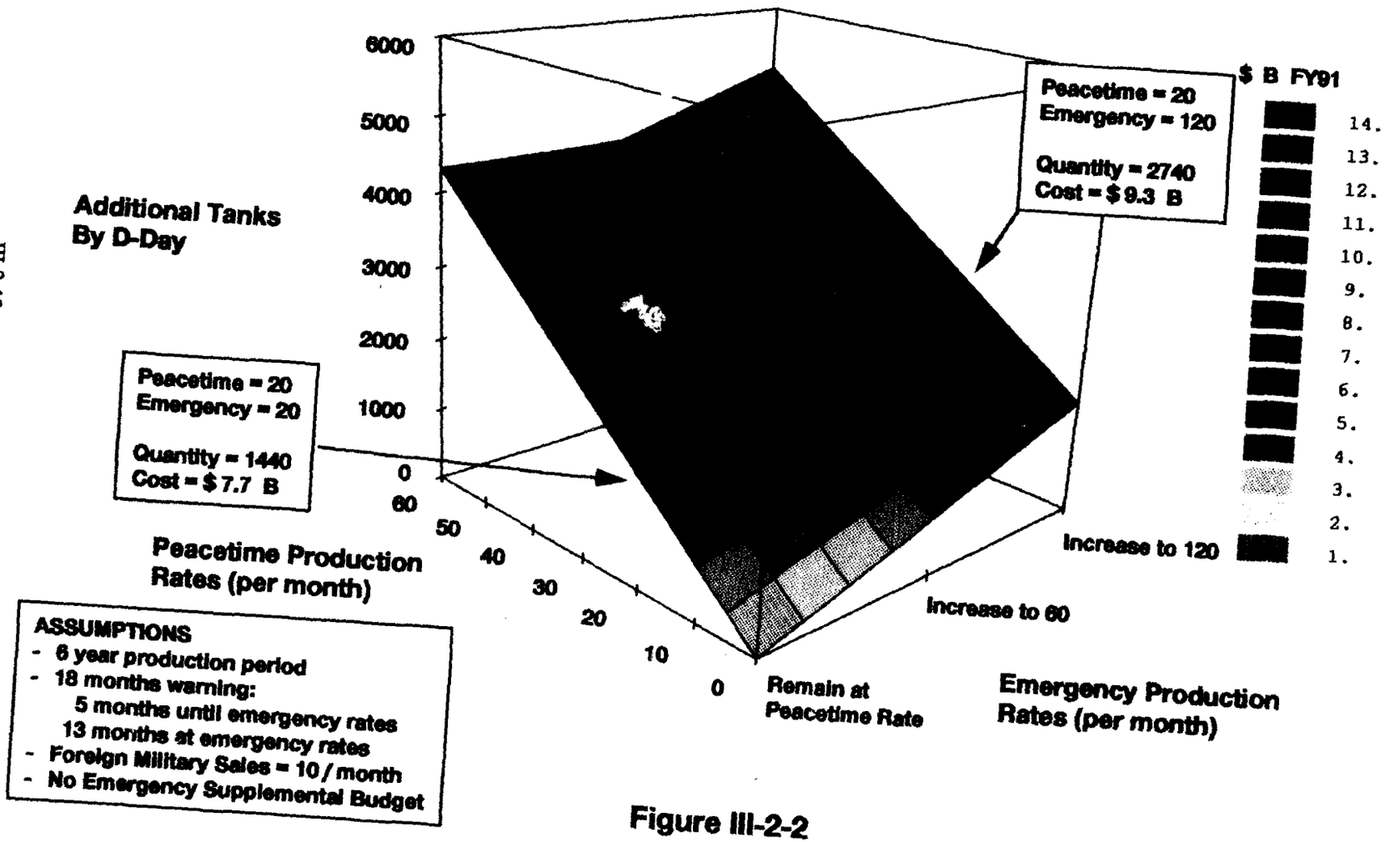
This paper presents an initial set of production options for consideration by the Army in planning to meet potential demands for additional tanks in the context of one of the Integrated Army Mobilization Study scenarios--a relatively long-warning European war scenario The approach can be of use in assessing and depicting production possibilities and their limits during projected warning periods for a range of planning scenarios in the 1990's. The production tradeoff methods illustrated here with data on the Abrams may be useful for other systems as well. This decision aid may also help provide practical insights concerning the costs and payoffs of various "hedging options" that the President has called for to flesh out a viable Reconstitution component of the National Security Strategy. More specifically, it could assist the Army in identifying concrete actions in its 1994-99 POM .

A cautionary note concerning these initial assessments does need to be struck. The relatively low unit costs of production estimated in some of the emergency cases, such as Case Two (which make them look relatively more attractive from a cost standpoint) may be partially offset by rapid price inflation during such periods. A second caution in interpreting these numbers is that there is, unfortunately, still significant uncertainty as to the ramp-up times to emergency production rates. More often than not ramp-up time estimates that have been obtained through "normal" channels significantly underestimate what could be done to speed things up under real mobilization conditions. But when critical sub-tier suppliers start going out of business and when key skilled labor must shift to other jobs, ramp-up times could become quite long.

Good quality information on defense industrial capabilities is no less expensive to obtain than good quality information in many other areas and fields. Given the importance to the

nation's security of building a prudent balance between on-hand assets and potential (mobilizable) power, IDA recommends that the Army (1) adopt an assessment and option development scheme of this kind for the upcoming POM, using the best available cost and production data concerning key systems; and (2) accelerate efforts to obtain data on key systems that is at least as good as that available for the Abrams tank.

# SAMPLE OPTIONS FOR POM 94-99
## Main Battle Tank

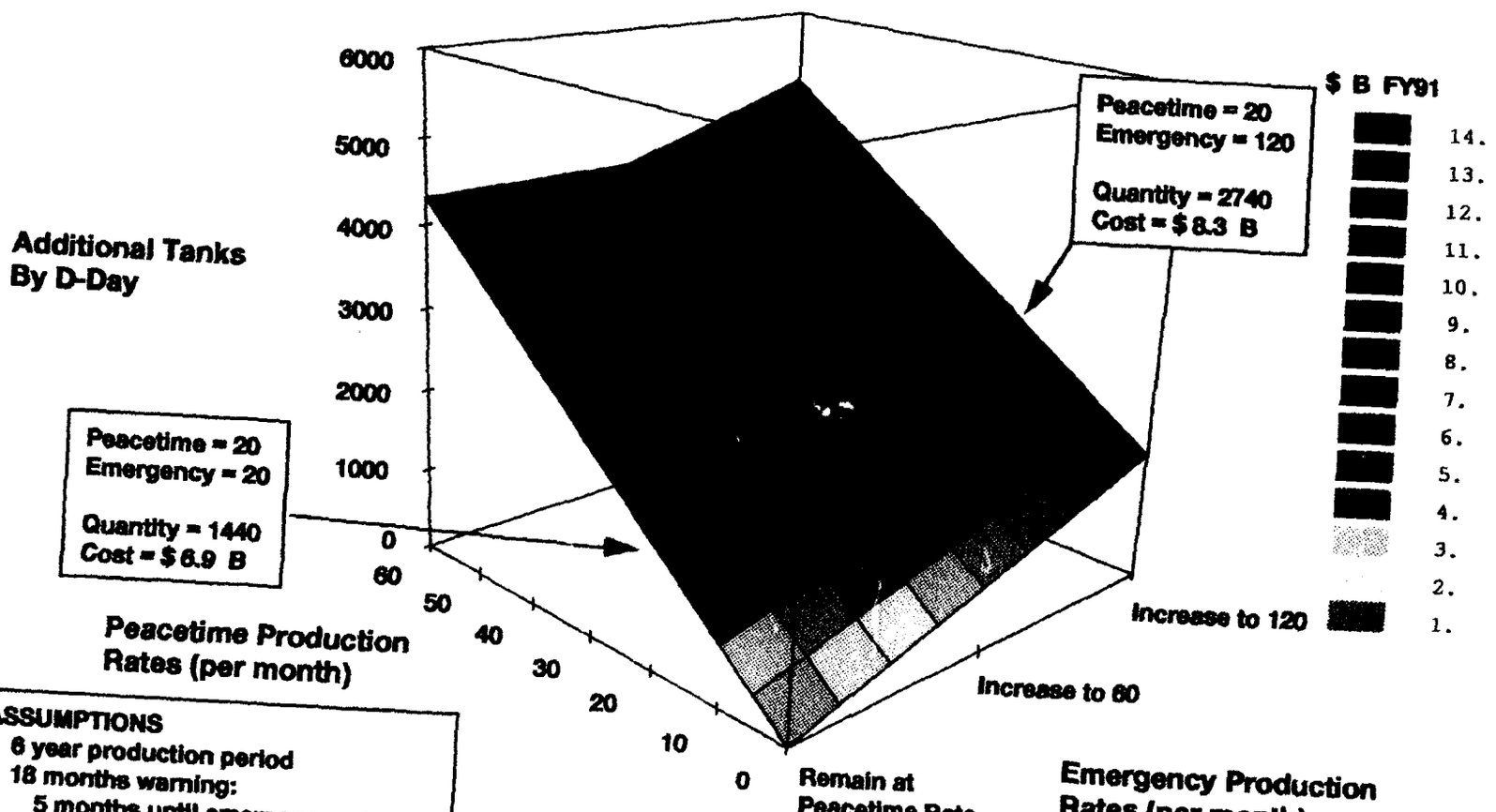



**ASSUMPTIONS**
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- Foreign Military Sales = 10 / month
- No Emergency Supplemental Budget

Figure III-2-2

IDA September 6,1991

# SAMPLE OPTIONS FOR POM 94-99
## Main Battle Tank

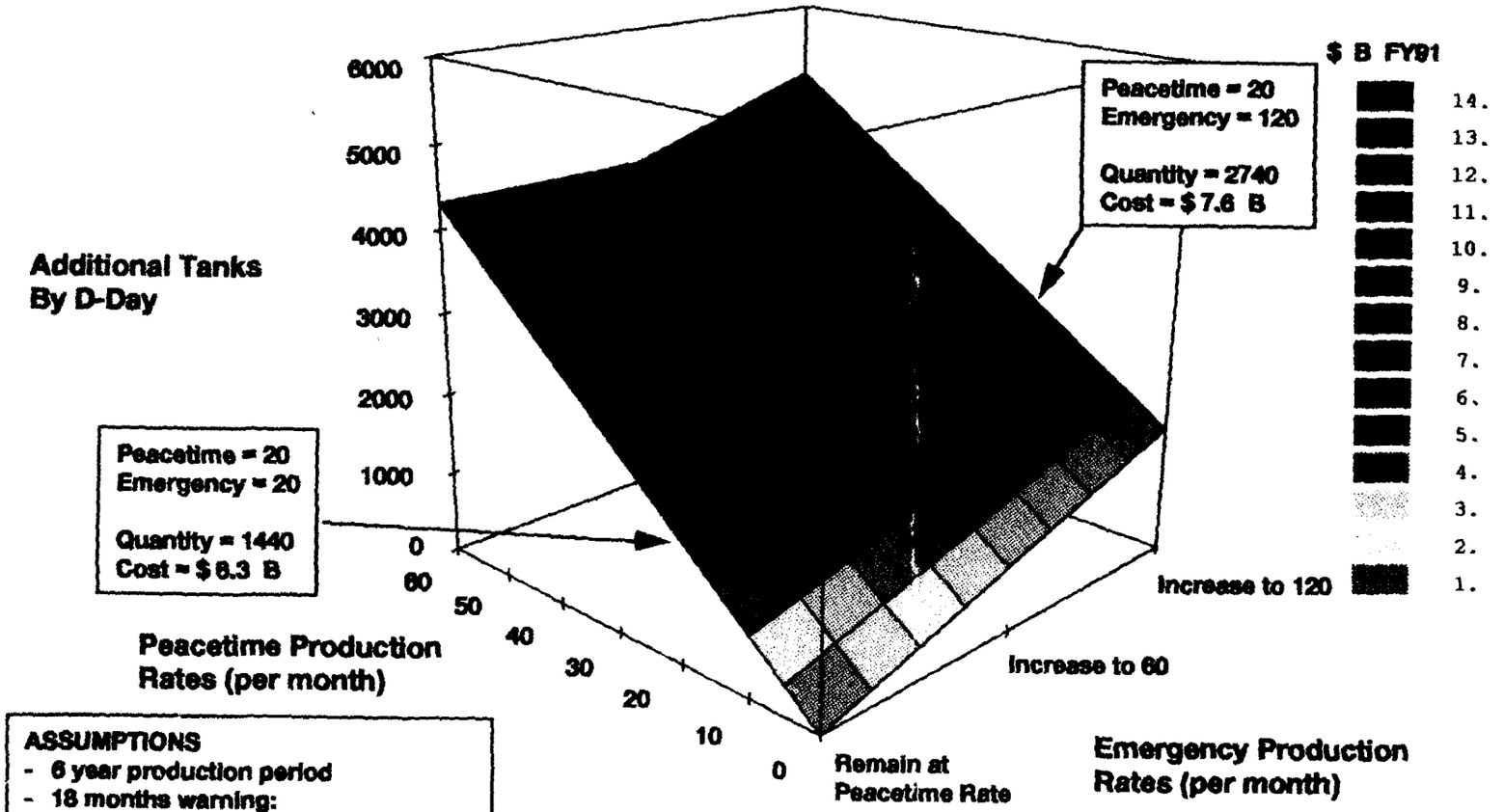



**ASSUMPTIONS**
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- Foreign Military Sales = 20 / month
- No Emergency Supplemental Budget

Figure III-2-3

IDA September 6,1991

# SAMPLE OPTIONS FOR POM 94-99
## Main Battle Tank

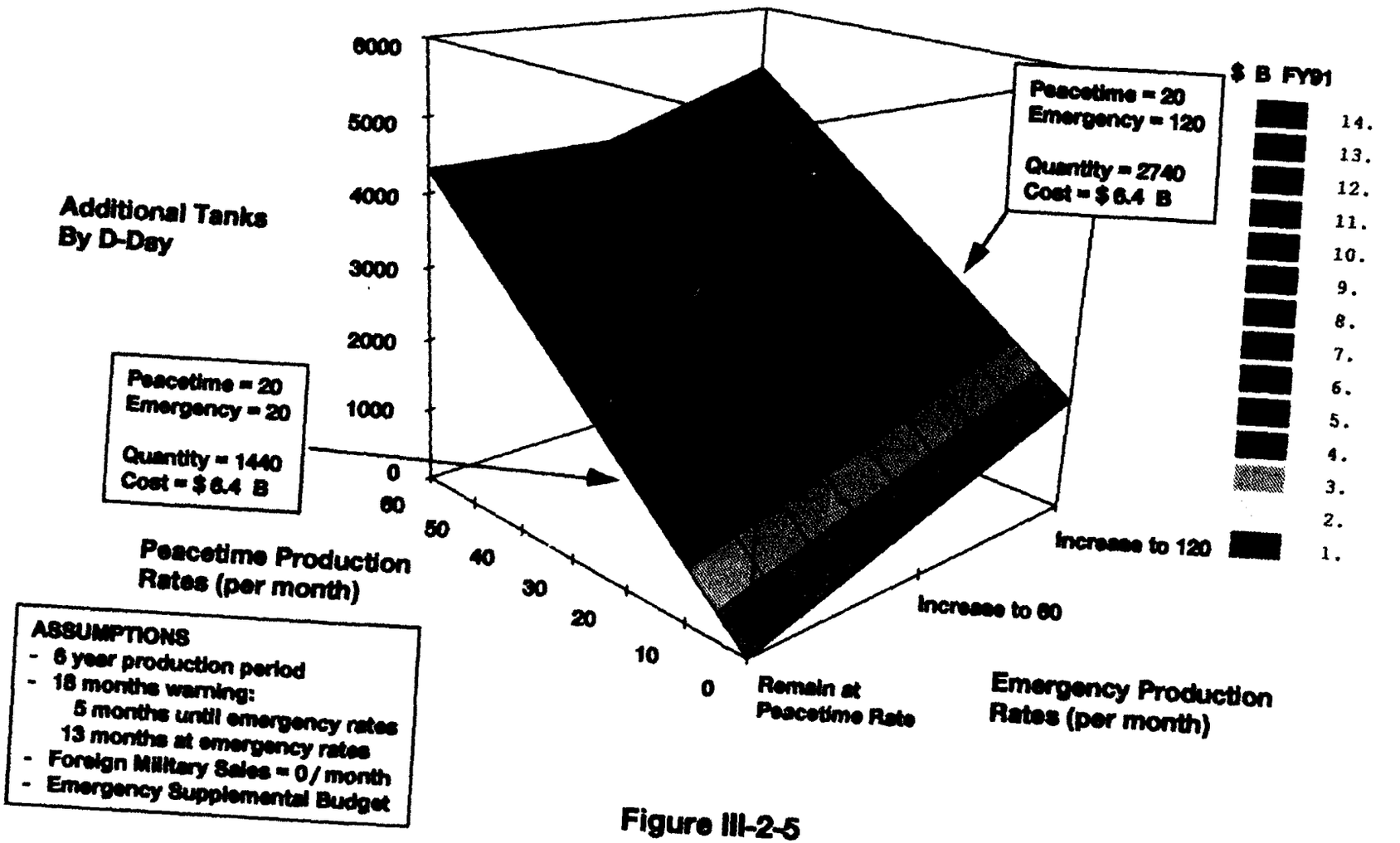



**ASSUMPTIONS**
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- Foreign Military Sales = 30 / *month*
- No Emergency Supplemental Budget

Figure III-2-4

IDA September 6,1991

# SAMPLE OPTIONS FOR POM 94-99
## Main Battle Tank

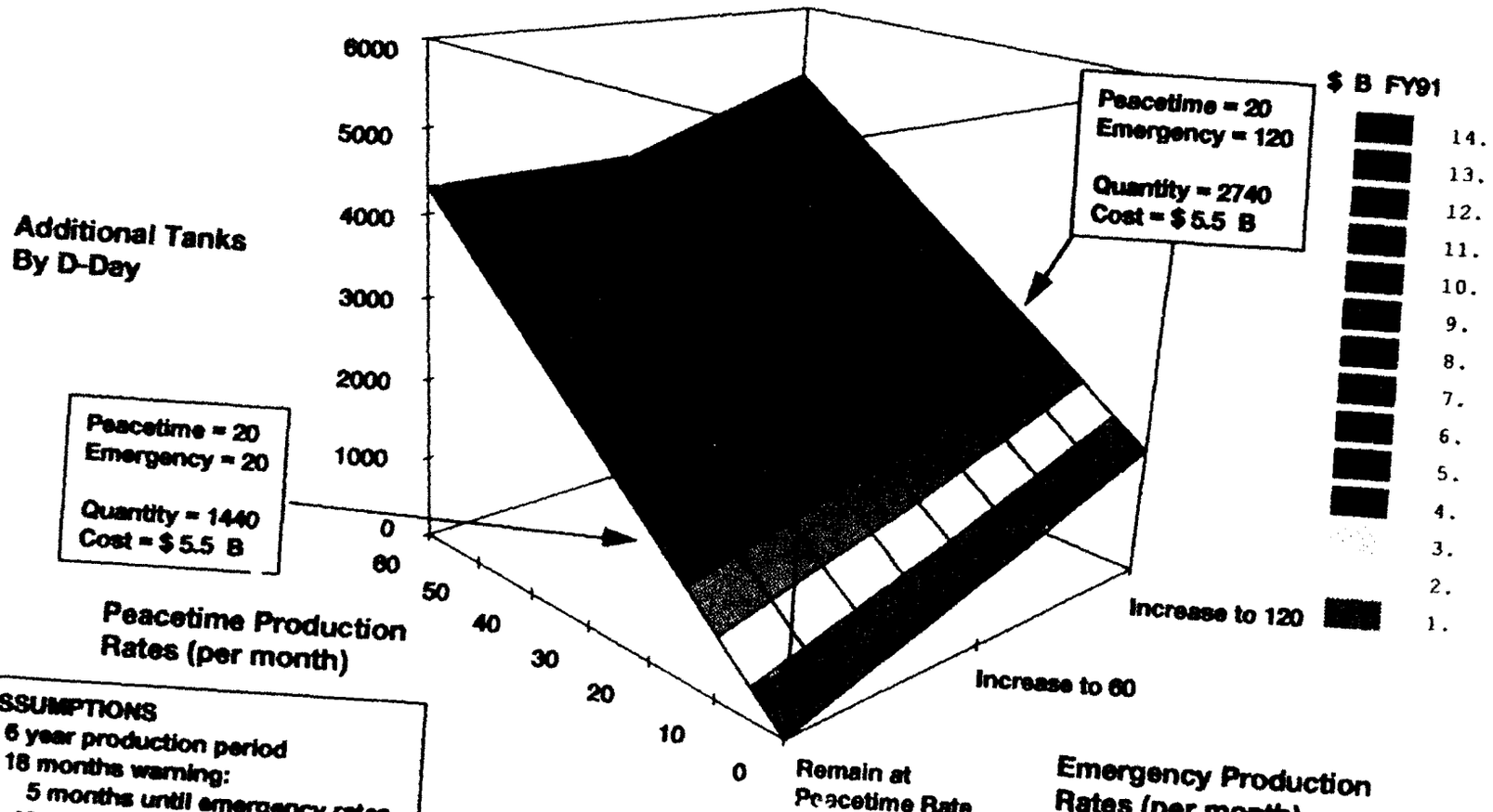



ASSUMPTIONS
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- Foreign Military Sales = 0 / month
- Emergency Supplemental Budget

Figure III-2-5

IDA September 6,1991

# SAMPLE OPTIONS FOR POM 94-99
## Main Battle Tank

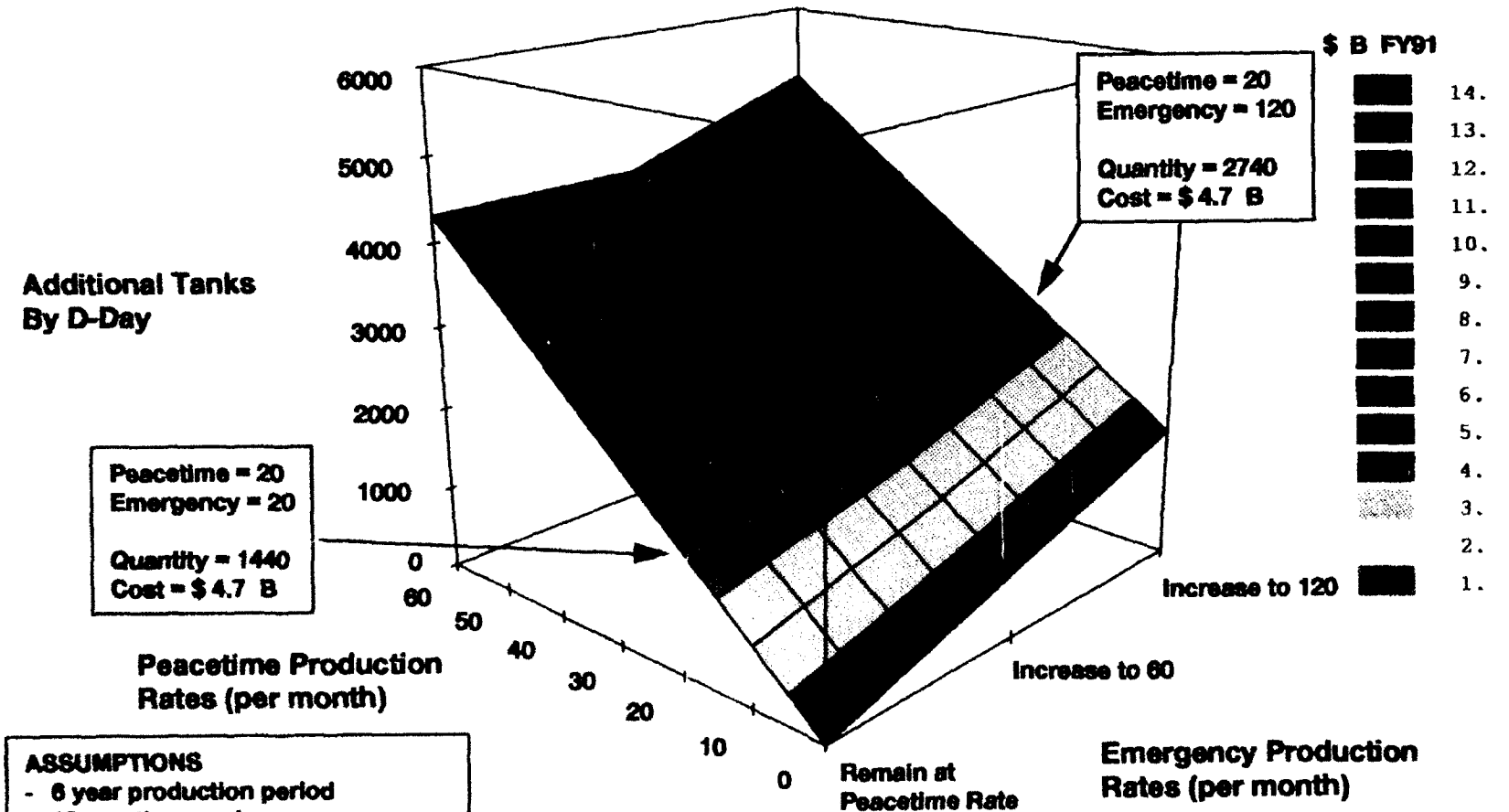



**ASSUMPTIONS**
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- Foreign Military Sales = 10 / month
- Emergency Supplemental Budget

Figure III-2-6

IDA September 6, 1991

# SAMPLE OPTIONS FOR POM 94-99
## Main Battle Tank

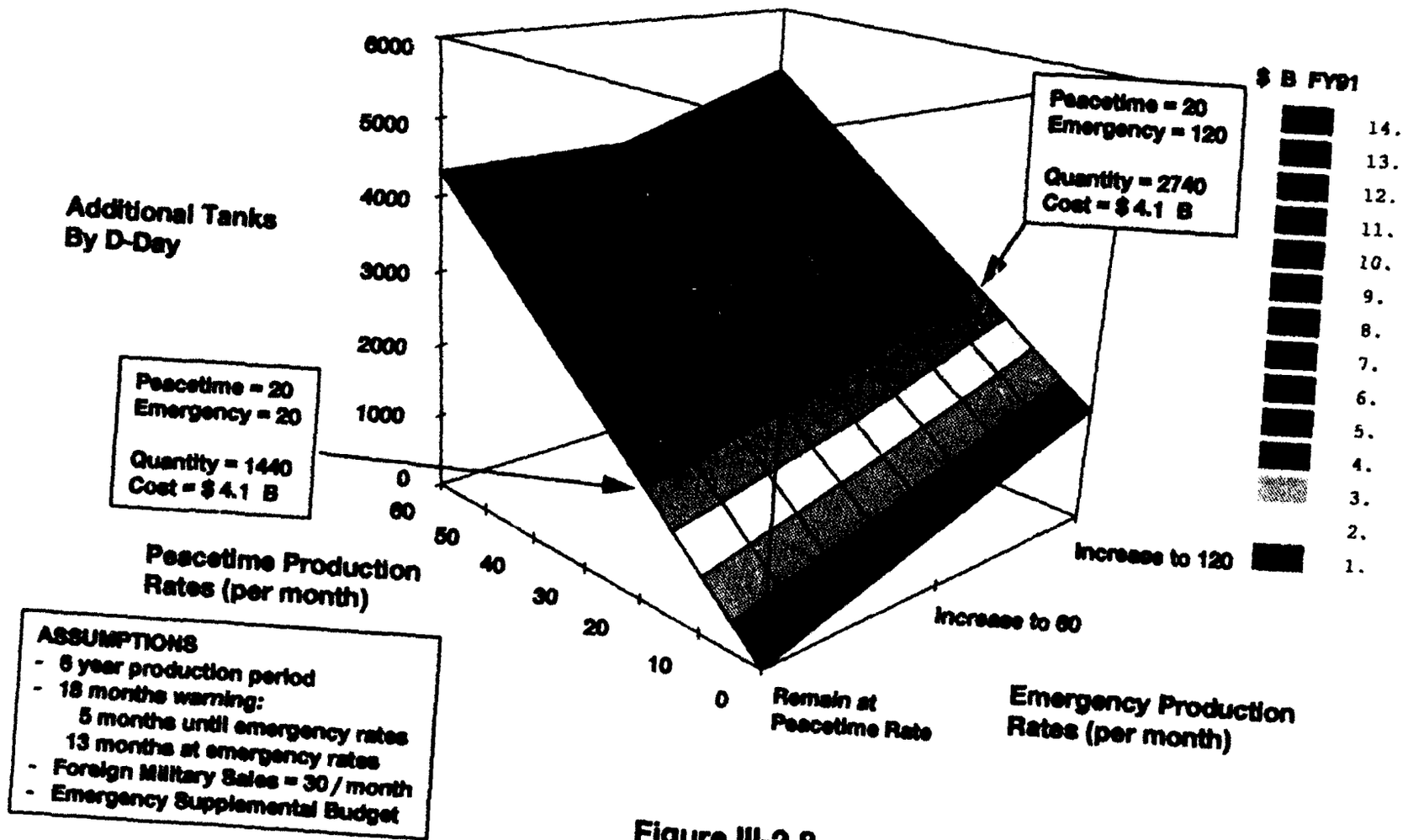



**ASSUMPTIONS**
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- Foreign Military Sales = 20 / month
- Emergency Supplemental Budget

Figure III-2-7

IDA September 6,1991

# SAMPLE OPTIONS FOR POM 94-99
## Main Battle Tank




**ASSUMPTIONS**
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- Foreign Military Sales = 30 / month
- Emergency Supplemental Budget

Figure III-2-8

IDA September 6,1991

# APPENDIX A TO CHAPTER 2

# ABRAMS TANK DATA

## APPENDIX A TO CHAPTER 2

## ABRAMS TANK DATA

### DATA COLLECTION

A recent visit to the Tank and Automotive Command (TACOM) and the program office (PM Abrams)[1] updated the 1986 study with the information that both the transmission plant and the Lima and Detroit tank plants, together, are currently facilitized to 120 tanks/month. The estimated throughput rate remains at 45 days during surge/mobilization. No new estimates of capacity expansion beyond the 120 tanks/month were provided. Therefore, the inputs to the model assume that the current U.S. capacity for Abrams tanks is 120 vehicles/month.

The throughput time estimate of 45 days was confirmed. However, a total ramp-up time of 6 months was estimated provided all suppliers, components and sub-assemblies were available in the needed quantities.

The second study providing major input to this analysis is the *Abrams Program Closure Study*, reported by AMSTA-ICC in September 1990.[2] This study considered the costs of preserving the surge production capability for the Abrams even though the actual production rate may be zero. Consideration of "trickle" production rates of 10, 15, 20, and 30 tanks per month was included. Finally, the one-time costs of restarting/surging the production lines from the lowered production rates to 60 or 120 tanks per month were estimated.

Another significant data input is the production cost of the Abrams. For purposes of this presentation, we have used the estimates of weapon system costs provided in Congressional hearings.[3] These costs assume that future tank production after a partial or complete layaway would be for the M1A2.

---

1 IDA staff visited and met with personnel at U.S. Army Tank-Automotive Command, Detroit Army Tank Plant, and Abrams Program Management Office on 30-31 July 1991. Updated information was provided by a number of individuals during those meetings.

2 U.S. Army Tank-Automotive Command. "Abrams Program Closure Study," September 1990. AMSTA-ICC. Viewgraphs only.

3 U.S. House of Representatives. "Hearings before a Subcommittee of the Committee on Appropriations" 101st Congress, Second Session, Part 5, page 58.

**Table III-2-A-1. Layaway Costs From The *Abrams Program Closure Study***

| Monthly Production Reduced To | Total Fixed Costs, Millions | Variable Cost, Millions |
|---|---|---|
| Zero | $551 | $4.8/mo |
| 10 Units | 303 | 1.9/mo |
| 15 Units | 258 | 1.7/mo |
| 20 Units | 231 | 1.6/mo |
| 30 Units | 200 | 1.3/mo |

**Table III-2-A-2. Surge and Restart Costs From The *Abrams Program Closure Study***

| Quantity (vehicles/mo.) | | Cost, Millions $ |
|---|---|---|
| From | To | |
| 0 | 60 | $ 740 |
| 0 | 120 | 1,013 |
| 10 | 60 | 300 |
| 10 | 120 | 549 |
| 15 | 60 | 240 |
| 15 | 120 | 449 |
| 20 | 60 | 215 |
| 20 | 120 | 413 |
| 30 | 60 | 170 |
| 30 | 120 | 348 |

**Table III-2-A-3. Weapon System Unit Costs**

| Production Rate | | $Per Vehicle, Million |
|---|---|---|
| Monthly | Annual | |
| 10 | 120 | 6.8 |
| 20 | 240 | |
| 30 | 360 | 4.6 |
| 43 | 516 | 3.8 |
| 120 | 1440 | 1.73[4] |

## COST EQUATIONS

These cost equations are shown on Figures III-2-A-1 through III-2-A-5. Cricket-Graph software was used to develop the cost equations based on the data shown in Tables III-2-A-1 through III-2-A-5.

1. Fixed costs to Layaway from a Rate of 60 vehicles per month.

   $y = 550.86 - 37.846\,x + 1.5467\,x^2 - 0.022506\,x^3$

   where

   y = Fixed costs, million $

   x = Production rate after layaway, vehicles per month

2. Variable Layaway Costs from a rate of 60 vehicles per month.

   $y = 4.7962 - 0.50033\,x + 0.025791\,x^2 - 0.00043342\,x^3$

   where

   y = Variable plant layaway costs, million $/month

   x = Production rate after layaway, vehicles per month

3. Restart costs to a production rate of 60 vehicles per month.

   $y = 739.8 - 71.852\,x + 3.337\,x^2 - 0.052512\,x^3$

   where

---

4 Estimated cost based on cost curve developed from other unit costs in this table.

y = Costs to bring plant back up to a production rate of 60 vehicles per month, million $

x = Production rate before surge, vehicles per month

4. Restart costs to a production rate of 120 vehicles per month.

$y = 1{,}013.3 - 71.783\,x + 2.9392\,x^2 - 0.042845\,x^3$

where

y = Costs to bring plant back up to a production rate of 120 vehicles per month, million $

x = Production rate before surge, vehicles per month

5. Unit Production Costs of M1A2s.

$y = 11.52 - 4.7084 \log x$

where

y = unit production cost, million $ per vehicle, FY1992 dollars

x = production rate, vehicles per month

Note that these equations address production costs only and do not include any operational or system support costs.

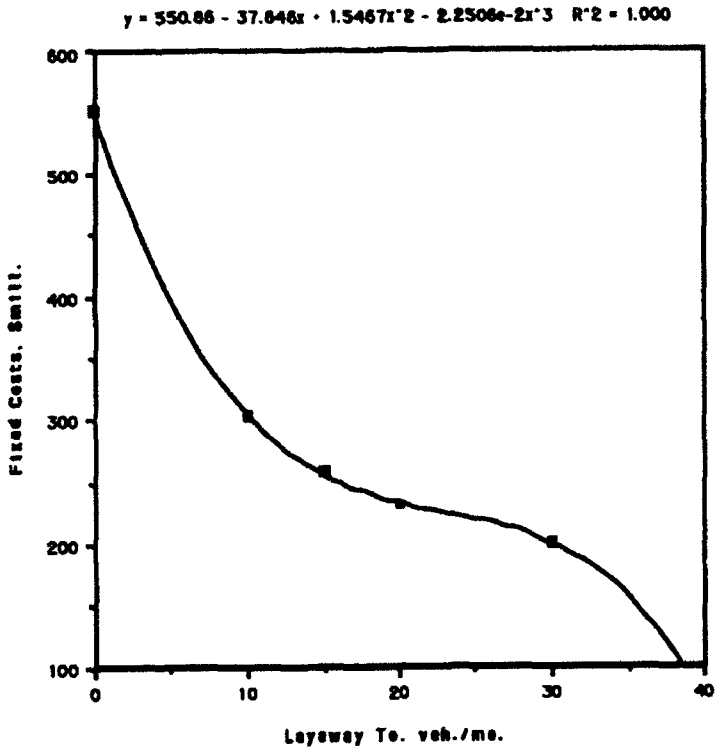



**Figure III-2-A-1. Fixed Costs to Layaway From 60 Veh./Mo.**

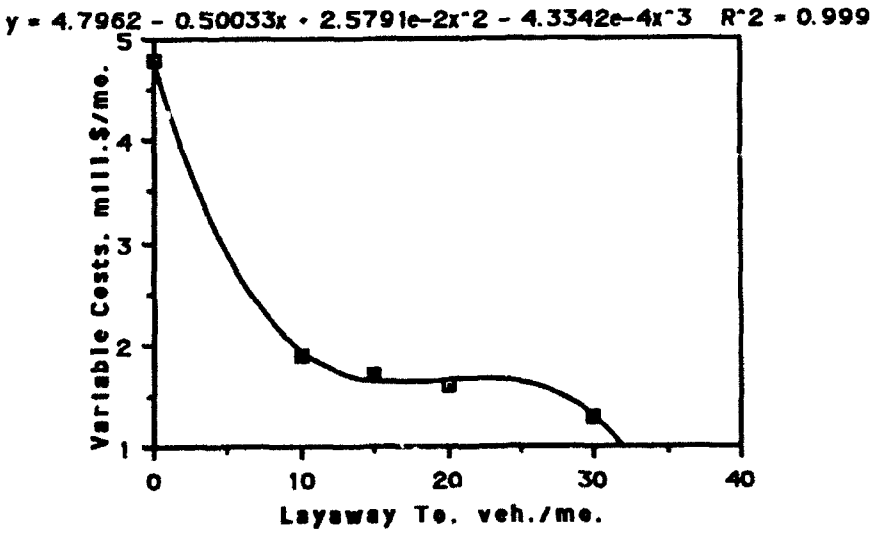



**Figure III-2-A-2. Variable Layaway Costs From 60 Veh./Mo.**

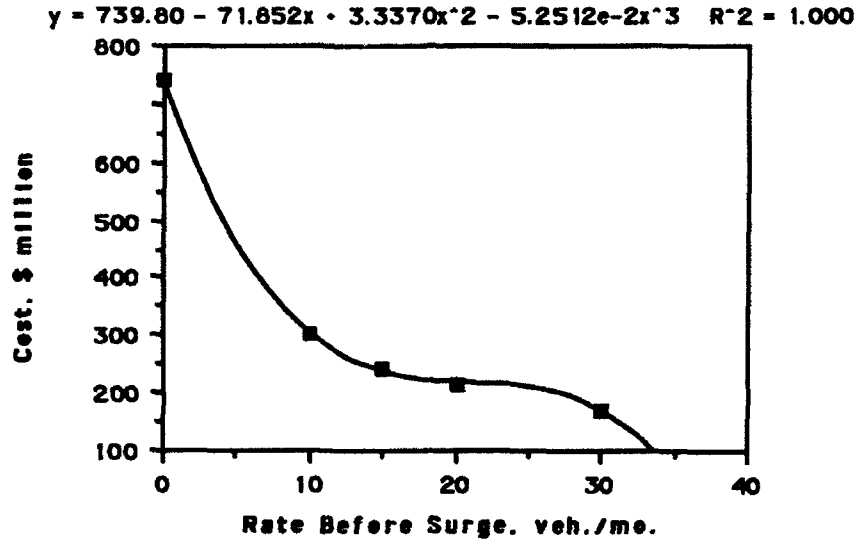



**Figure III-2-A-3. Restart Costs To 60 Vehicles Per Month**

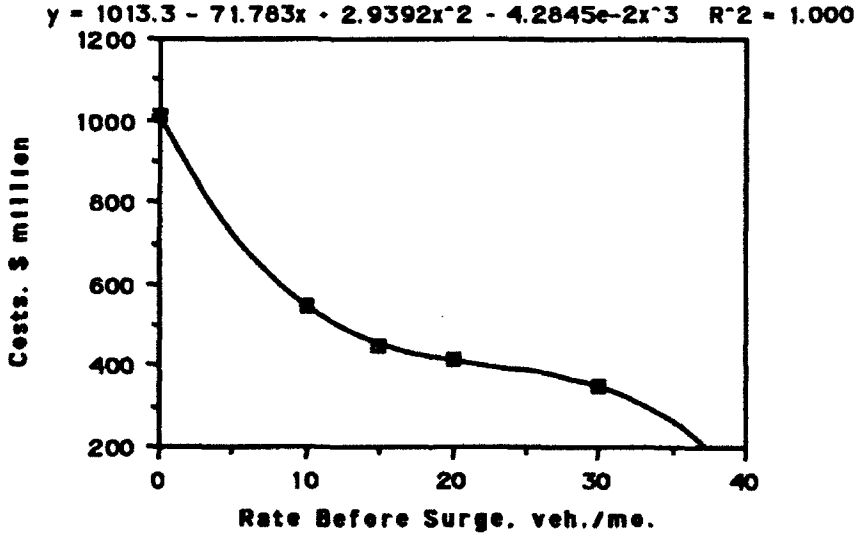



**Figure III-2-A-4. Restart Costs to 120 Vehicles Per Month**

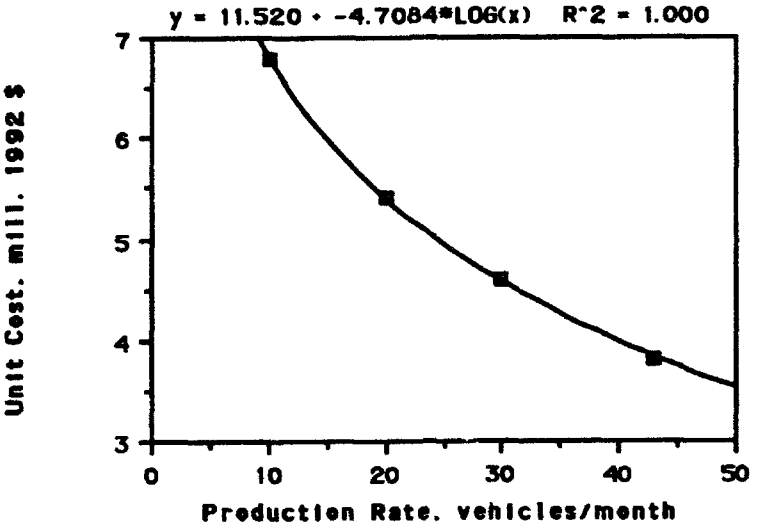



**Figure III-2-A-5. Unit Production Cost**

## PROGRAM HIGHLIGHTS

**Sources: SAR 12/31/90 and ARMY 1990-91 Green Book 10/90**

| | |
|---|---|
| January 8, 1973 | M1 Abrams Tank Program formally approved with the release of DCP #117. |
| November 12, 1976 | Award of a Full Scale Engineering Development/producibility Engineering and Planning contract for the first generation tank. |
| November 19, 1981 | SECDEF authorized production beyond 30 tanks per month. |
| August 28, 1984 | Army Systems Acquisition Review Council (ASARC) approved production for the M1A1 tank. |
| December 12, 1984 | Defense Systems Acquisition Review Council (DSARC) approval for the M1A1 tank |
| May 30, 1986 | Last 105mm M1 Abrams Tanks accepted by the Government. |
| December 1986 | First M1A1s were fielded. |
| December 2, 1988 | Defense Acquisition Board (DAB) gave its conditional approval for the Block if improvement programs. |
| December 14, 1988 | M1A2 Full Scale Development (FSD) contract was awarded. |
| January 25, 1989 | DEPSECDEF issued an Acquisition Decision Memorandum (ADM) approval for the Army to proceed with the M1A2 modernization program pending the publication of a complete Cost and Operational Effectiveness Analysis (COEA). |
| October 18, 1989 | DEFSECDEF signed another ADM that established the baseline (FY91-97) procurement objective of 2,926 3rd generation Abrams Tanks. However, subsequent budget decisions reduced the program to a FY91 procurement objective of 52 M1A2s to demonstrate readiness for continued production. |
| December 1991 | First fully operational M1A2 prototype scheduled for delivery. |
| November 1992 | First M1A2 production tank scheduled for delivery. |

## PROPOSED AGENDA

### Meeting With M1 Abrams Program Office Personnel

It is proposed that the meeting with Program Office Personnel consist of seven parts as outlined below. The purpose is to determine whether the data obtained in past studies are appropriate for POM review. If not, what modifications should be made and what are the PM's primary recommendations for industrial base planning.

- A background presentation on the current need for information by IDA visitors. It is expected that this would be relatively short and informal. Its purpose would be to provide PM personnel with the IDA perception of the need for the study and the PM's role.
- In 1986, IDA conducted a study which indicated that the realistic M1A1 production rate, under mobilization conditions, would be 120 tanks per month with the existing plant and facilities at Lima and Detroit. However, the capacity for transmissions at Indianapolis was 110 units per month. Therefore, with no additional equipment investment, the real capacity for M1A1 tanks was 110 tanks per month.

An investment of $4.7 million would raise the Indianapolis capacity to 150 units per month, which would also be the brick-and-mortar capacity of the Indianapolis transmission plant. Therefore, the real capacity for M1A1 tanks, after a $4.7 million investment, would be 120 tanks per month, the capacity for Lima and Detroit.

An investment of $27 million at Lima would increase the capacity of Lima/Detroit to 220 tanks per month. However, the Indianapolis capacity of 150 tanks per month would become the constraining capacity. We concluded that the maximum U.S. capacity for M1A1 tanks would still be 150 tanks per month even if a total investment of $31.7 million were made at Indianapolis and Lima/Detroit.

Are these conclusion still valid? Have investment and/or process changes over the last 5 years changed the results? Have other contractors surfaced as constraining suppliers?

- In September, 1990, AMSTA-ICC issued a study which included layaway and start-up costs for the Abrams plant and major sub-contractors. A summary of those costs is in Tables III-2-A-4 and III-2-A-5.

**Table III-2-A-4. Layaway Costs: FY1991 Dollars in Millions**

| Action | Primary Fixed Costs | Auxiliary Fixed Costs | Total Fixed Costs | Variable Costs mill/mo. |
|---|---|---|---|---|
| Reduce production to 0 | $489 | $136 | $625 | $3.8 |
| Reduce production to 10/mo. | 207 | 96 | 303 | 1.9 |
| Reduce production to 15/mo. | 177 | 81 | 258 | 1.7 |
| Reduce production to 20/mo. | 159 | 72 | 231 | 1.6 |
| Reduce production to 30/mo. | 147 | 53 | 200 | 1.3 |

**Table III-2-A-5. Surge and Restart Costs: The fixed costs to go from the stated quantity to the stated quantity (per month).**

| Quantity (vehicles/mo.) | | Cost |
|---|---|---|
| From | To | $Million, 1991 |
| 0 | 60 | $740 |
| 0 | 120 | 1,013 |
| 10 | 60 | 300 |
| 10 | 120 | 549 |
| 15 | 60 | 240 |
| 15 | 120 | 449 |
| 20 | 60 | 215 |
| 20 | 120 | 413 |
| 30 | 60 | 170 |
| 30 | 120 | 348 |

Are these estimates still valid? If not, please provide the most recent estimates (Table III-2-A-6).

- The cost of producing Abrams tanks at Lima/Detroit consists of fixed and variable cost components. Please provide your current estimates of production costs at the

following production rates for each major Abrams configuration (M1A1, M1A2, etc.).

**Table III-2-A-6. Table for Survey Responses**

| Quantity (vehicles/mo.) | Fixed Cost, $mill./mo. | Variable Cost $mill./vehicle |
|---|---|---|
| 1 | | |
| 10 | | |
| 15 | | |
| 20 | | |
| 30 | | |
| 60 | | |
| 120 | | |

- Based on experience and expertise, it is expected that the Program Manager and PM Office personnel have developed a number of optimum strategies for differing scenarios to maintain the industrial base for Abrams tanks. It is requested that you share these strategies with us.
- Please review and update the estimates (Table III-2-A-7) provided to IDA by the Army for a recent JCS study. Mobilization assumed that the production facility is a "warm base." That is a manufacturing facility/line that is scheduled to be producing by M-Day. The rates for mobilization should be your estimate of "best" production capacity rates. The responses should be for production output and not only U.S. deliveries.

Mobilization (MOB) without Industrial Preparedness Measures (IPMs) is the monthly maximum production rate under mobilization conditions with current facilities, without IPMs. "Without IPMs" means that no additional industrial preparedness measures have been taken prior to M-day. An IPM is some identifiable investment or other action that would facilitate a rapid increase in production above "business as usual" peacetime levels, e.g., inventories of parts, special tooling or test equipment, streamlined labor training procedures, expedited contracting procedures, emergency modifications of peacetime testing procedures or military specifications, etc. Mobilization with IPMs is the reported monthly maximum production rate under mobilization conditions within current facilities with IPMs, if the IPMs were in place in the plant prior to M-day.

**Table III-2-A-7. Mobilization Data**

| Entry | Current | MOB W/O IPMs* | MOB W/IPMs* |
|---|---|---|---|
| Monthly Entry: | | | |
| - Monthly Average Production | 60 | N/A | N/A |
| - Monthly Maximum Capacity | N/A | 60 | 120 |
| - Months Needed to Reach Maximum Capacity: | N/A | 0 | 18 |
| Cumulative Production | | | |
| - 6 months | 360 | 360 | 411 |
| - 12 months | 720 | 720 | 948 |
| - 18 months | 720 | 1,080 | 1,612 |
| - 24 months | 720 | 1,440 | 2,332 |

*Source Notes: Data received from IP planner at TACOM. Current production extends only through September 1991. Data for MOB w/IPM's assumes a linear build up from M+1 to M+18 (IEA estimate). Maximum capacity of 120 per month can not be reached until M+18 when starting from a warm base. The transmission is the limiting component for the tank. The current tank facility can operate at 120 per month (3-8-6) if transmissions are available in adequate supply.

- What are the present estimates for tank production of the Abrams from now through FY99? How has the Abrams Tank Production/Conversion chart from the Plant Closure Study of 18 September 90 changed? Identify the present forecast for Foreign Military Sales and procurement for the Marines.

## IDA VISIT

Day: 30 July 1991

| Time | Subject | Location | Briefers |
|---|---|---|---|
| 1000 | DATP Plant Tour | DATP | Mr. R. Krishnan |
| 1300 | Meeting with ABRAMS PM | PM Office | Col. J. Caldwell |
| 1400 | ABRAMS Production (Army, FMS, Block III etc.) | B229, W430 | Mr. A. Sarkisian<br>Mr. L. Lypeckyj<br>Maj. P. Tuttle |
| 1500 | CCAM Review | B229, W430 | Mr. J. Cox |

Day: 31 July 1991

| Time | Subject | Location | Briefer |
|---|---|---|---|
| 0800 | Review of Program Closure Study Outline of Study | B229, W300 | Mr. J. Willis<br>Mr. B. Hill |
| 0930 | Cost Data | | Mr. R. McLure<br>Ms. S. Rachofsky<br>Mr. S. Gehres |
| 1300 | General Discussion Conclusions | B229, W300 | |

# APPENDIX B TO CHAPTER 2

# INVESTMENT TRADEOFF METHODOLOGY

## APPENDIX B TO CHAPTER 2

## INVESTMENT TRADEOFF METHODOLOGY

The investment tradeoff methodology was designed to provide the decision maker a new capability for performing complex assessments involving several factors, where there are several criteria on which the evaluations may be based.

For the case studies include in this paper, the problem was framed in terms of factors that the decision maker might possibly control, and factors that are represented as planning estimates but which are not decision options. In the former category are 1) the peacetime production rate for the system, 2) the ultimate surge capacity for the system, and 3) the amount of Foreign Military Sales (FMS). In the latter category are: 4) the amount of warning time before D-Day, 5) the amount of ramp-up time required to achieve the emergency production rates (given warning), and 6) whether the monies expended during the warning period for surging the production are supplied by an emergency supplemental budget.

For both categories of factors, parametric variations over a range of possible values were explored. This approach was thought to be helpful in discovering those situations where one's externally based cost or quantity requirements were satisfied.

For specific values of each of the above factors (e.g., for a given peacetime production rate, with an assumed surge capacity, coupled with a specific warning time, etc.), it is possible to determine how many systems would be produced at various times, and what would be the cumulative costs. The quantity calculation is straightforward. The cost calculation involves several factors, only a few of which have been addressed here.

As discussed above, the following factors enter the cost calculus:

- The cost to layaway the plant. There are both fixed and variable portions of this cost component.
- The cost to surge to the emergency production rate. (Degenerate cases may occur, e.g., do not decrease from the current level, or do not surge at all.
- The unit production cost. This depends on the number of units produced per month.

A computer model was created to carry out the arithmetic. While the source data were discrete, there were enough data points to allow a cost equation to be developed for each of the above factors. The model is based on these equations. To illustrate the calculations, a specific example is carried out in the next section.

The final element of the tradeoff methodology is a new technique for quickly and flexibly depicting the results of varying several decision variables jointly. This display technique, which shows the results for a matrix of options in terms of surfaces, is what generated the figures throughout this report.

# APPENDIX C TO CHAPTER 2

# SAMPLE RESULTS

## APPENDIX C TO CHAPTER 2

## SAMPLE RESULTS

### OVERVIEW

The investment tradeoff methodology was used to conduct an initial, illustrative analysis of some key factors being considered by the M1 plant closure discussions--peacetime production rates, Foreign Military Sales, and funding assumptions.

One example tradeoff analysis is to determine which investment strategies yield a given quantity of tanks by a given time. For example, which strategies of investment would produce 2000 tanks by a hypothetical D-Day, where D-Day is assumed to be 6 years in the future?

Using the calculus outlined above, one finds there are three basic strategies:

- Produce at approx. 30 per month; do not surge Cost = $10.7 B
- Produce at approx. 20 per month, surge to 60 per month Cost = $ 9.9 B
- Produce at approx. 10 per month, surge to 120 per month Cost = $ 8.2 B

If Foreign Military Sales are assumed, at the level of 30 per month, (where the FMS units are not available to the US), then these three strategies now cost $ 8.1, $7.4 B, and $5.9 B B respectively.

Lastly, the effect of funding the surge actions using an emergency supplemental budget are explored. The effect is to make all actions which occur after warning occurs cost zero. In this case, the strategies cost $ 5.4, $4.1 B, and $2.6 B respectively. A level of FMS of 30 units per month is assumed here.

To place these in a broader context, and to allow comparison among cases at different quantity and cost levels, the tradeoff methodology explored parametric variations of several factors. The results are shown in Figures III-2-1 through III-2-8. To introduce these somewhat complex results, a specific example if given first.

### AN EXAMPLE CALCULATION

As a basis for understanding the quantities and costs shown in the color plots in this report, a specific example of one investment option will be discussed. This one case corresponds to one of the points annotated in Figure III-2-1 (page III-2-5).

This example assumes the peacetime production rate has been decreased to 20 units per month, and that the intended surge capacity is 120 units per month. Furthermore, a 6 year (72 month) period is assumed prior to D-Day, with warning occurring 18 months beforehand. There are thus 54 months of peacetime production, a ramp-up period (assumed to be 6 months long, and in which production remains at 20 units per month) followed by 13 months of production at the emergency rate of 120 units per month (it is assumed that the surge rate is in effect at the end of the ramp-up period, i.e., at month 60).

The total quantity produced by D-Day (month 72) is 2740. This is calculated by combining:

| | | | | |
|---|---|---|---|---|
| 54 months | x | 20 | = | 1080 |
| 5 months | x | 20 | = | 100 |
| 13 months | x | 120 | = | 1560 |
| Total | | | = | 2740 |

The cumulative costs, through month 72 are $10.3 Billion. The calculation is as follows:

| | | | |
|---|---|---|---|
| Fixed cost to layaway -- from 60 to 20 | = | $ 231 | M |
| Variable cost to maintain plant -- (rate of 20 units per month, $1.6 M per month, for 59 months) | = | 94.4 | M |
| Fixed cost to surge -- from 20 to 120 units per month | = | 413 | M |
| Monthly cost of being in production (= $7.4 M per month, 72 months) | = | 533 | M |
| Unit production costs | | | |
| ($5.4 M per unit, 20 units, 59 months) | = | 6372 | M |
| ($1.73 M per unit, 120 units, 13 months) | = | 2699 | M |
| Total | = | 10.3 | B |

## THE EFFECT OF FOREIGN MILITARY SALES AND THE USE OF AN EMERGENCY SUPPLEMENTAL BUDGET

To evaluate the effects of varying production rates, FMS, and scenario factors, a computer program first generated the quantity and cost results for each possible combination. Six dimensions were varied: peacetime production rate, emergency production rate, FMS rates, whether there was an emergency supplemental budget, ramp-up time (to the emergency rate), and warning time.

Tradeoffs were assessed by first comparing the tradeoffs among peacetime and emergency production rates. By placing these two factors on the x and y axes, one obtains a

matrix of options. Figure III-2-1 shows these factors as the two horizontal axes. For each option (i.e., a combination of the two rates), the model calculates how many tanks were produced, say, by D-Day, and what was the cumulative cost.

To show both the quantity and cost for each option in the matrix, the Graphical Analysis System (developed by IDA) was used. This system can create a surface by connecting 'heights' above a grid of points. Viewing the matrix of options as a horizontal grid, one now has a surface showing the quantities produced for the options shown. In the example above, one would have a height of 2740 above the case of 20 combined with 120. See Figure III-2-1.

In the same manner, each case in the matrix has an associated cost. By using a color function, the costs at each point may be depicted on the quantity surface. In Figure III-2-1, for example, green represents points where the costs is approximately $5 billion, according to the color legend provided.

The value in this approach is two-fold. First, in Figure III-2-1, one now has four factors easily represented--x axis, y axis, height and color. Second, one can compare this set of tradeoffs, which involved no FMS and no emergency supplemental budget, with cases in which both of these assumptions are varied. This is done in the series of figures that follow Figure III-2-1.

Figures III-2-1 through III-2-4 depict the cases where FMS varies as 0, 10, 20 and 30 units per month, respectively, and in which there is no emergency supplemental budget. Figures III-2-5 through III-2-8 show the same FMS variations, but with the assumption of an emergency supplemental budget.

## CONCLUDING REMARKS

One may approach these illustrations of the methodology from two other perspectives. First, one may depict an equal quantity curve on one of the surfaces. For example, the curve at height 2000 in Figure III-2-1 passes through several billions of dollars, depending on whether one has a high surge capacity or not.

Second, these figures may be used to ask: What options would fit within an overall budget ceiling, and under which set of assumptions. Here, one could pick a dollar amount, find the corresponding color, and rapidly determine which options remained at that color (or 'less').

# APPENDIX D TO CHAPTER 2

# IDA PROPOSED CONTRIBUTION TO THE IAMS STUDY

# INTEGRATED ARMY MOBILIZATION STUDY

## PROPOSED CONTRIBUTION BY THE

## Institute for Defense Analyses (IDA)

**OBJECTIVE**

- Develop options for Army POM 94-99 (for selected systems) that combine alternative plant status, procurement, ramp-up, capacity and cost elements to best satisfy stated Army requirements

**CANDIDATE SYSTEMS**

- AH-64
- Abrams Main Battle Tank
- MLRS and/or 155mm HOW (SP/TOW)
- TOW2

**APPROACH**

- Obtain Information from Program Offices
  - — Programmatic Policy Options
  - — Most Current Production Bottleneck/Cost Data
  - — Major subcontractor information
  - — Plant closure/restart data
  - — Key data limitations
- Build Strawman Issue-Option Papers for Each System
- Revise/Refine for POM Assessments with feedback from Key participants

**SCHEDULE**

- Tank Strawman option paper in preparation (avail 7/31/91)
- Final Option packages to meet overall study schedule

# APPENDIX E TO CHAPTER 2

# ABRAMS TANK PRODUCTION PLANS AND CONVERSION PROPOSALS (AUGUST, 1991)

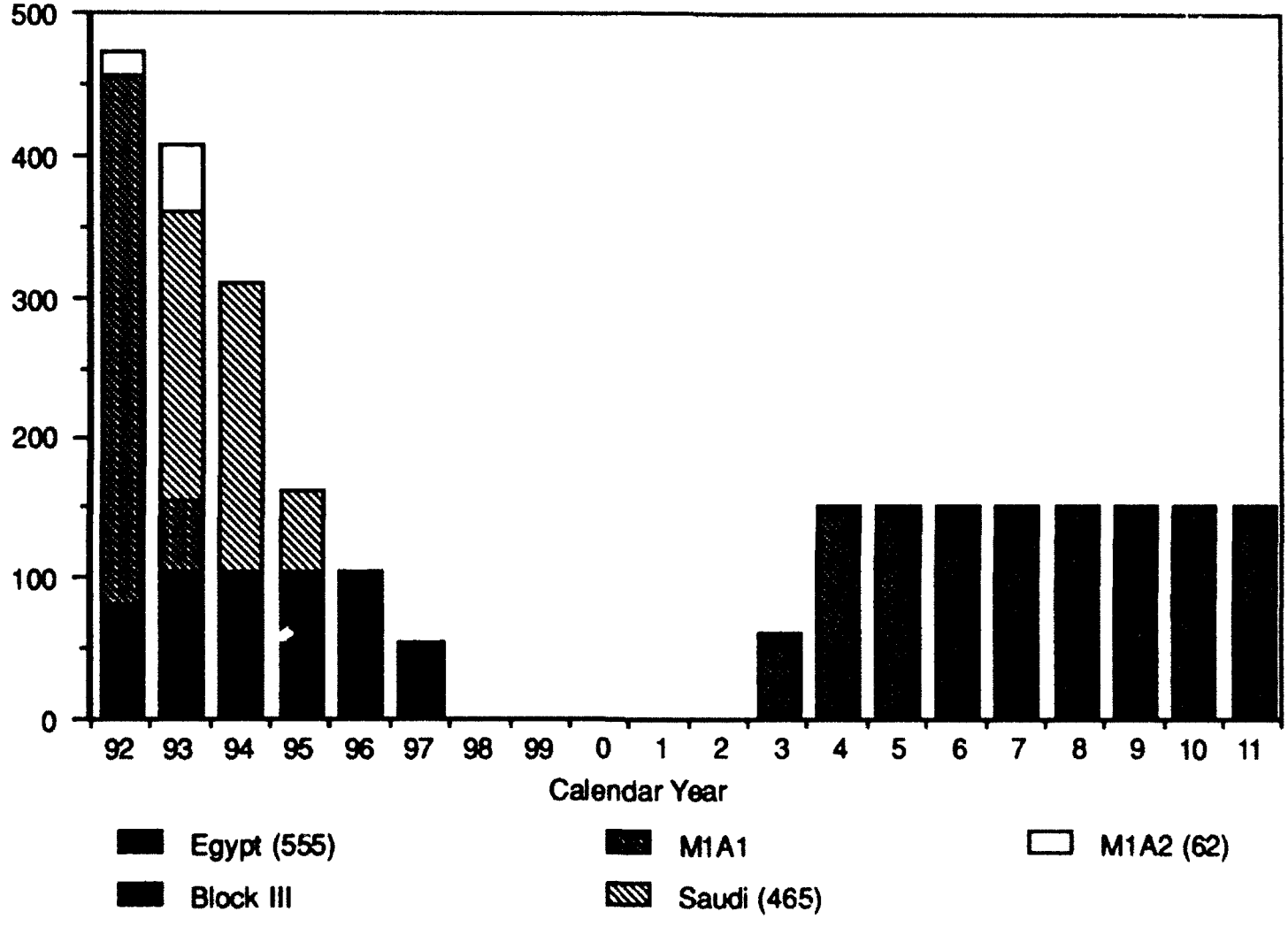



**Figure III-2-E-1. Projected Tank Production Without M1A2 Conversion**

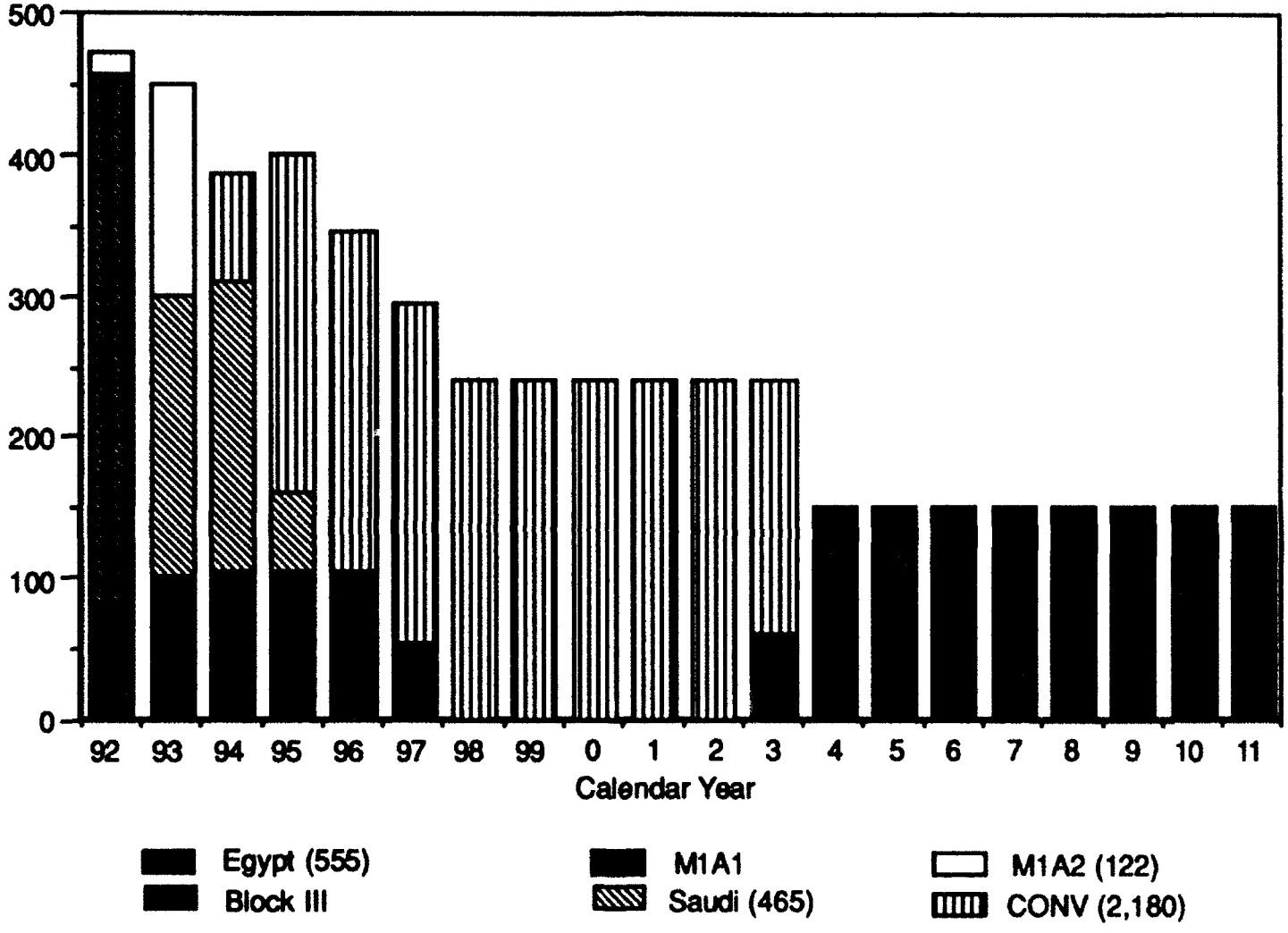



**Figure III-2-E-2. Projected Tank Production With M1A2 Conversion**

# CHAPTER 3

# SAMPLE TANK OPTIONS FOR ARMY POM 94-99 DECISIONS

# A SUPPLEMENTAL ANALYSIS

## INTRODUCTION

In discussions with SARDA and DCSLOG, the point was made that for cases of zero peacetime production, the time to ramp-up to an emergency production rate of 60 or 120 units per month was stated as being at least 48 months in the Plant Closure Study. This is in contrast with the assumption made in the IDA draft working, "Sample Tank Options for Army POM 94-99 Decisions," August 28, 1991, which assumed a uniform 6 month ramp up time, independent of the peacetime production level. This supplemental analysis shows the effect of this revised assumption for some of the cases examined in the aforementioned paper (See Chapter 2 of this report). Table III-3-1 provides the new results.

## ANALYSIS

Figure III-3-1 depicts this change. Note that due to the 18 months of warning and the 48 months required to ramp-up, there are no additional tanks produced for the cases lying on the front edge of the figure, i.e., for cases with zero peacetime production.

The 48 month ramp-up time is due to the Department of Energy facility (which is involved in the armor production) having to close down completely. Since Foreign Military Sales units would not have the advanced armor, such actions would not affect the cases of zero U.S. peacetime production. Conversion of the M1 to the M1A2, as opposed to new M1A2 production, would. The quantities of M1s which are converted to M1A2s are included in the peacetime production rates, in that the monthly rates shown in the figure (10, 20, 30 units per month, etc.) may represent any allocation among new or converted units.

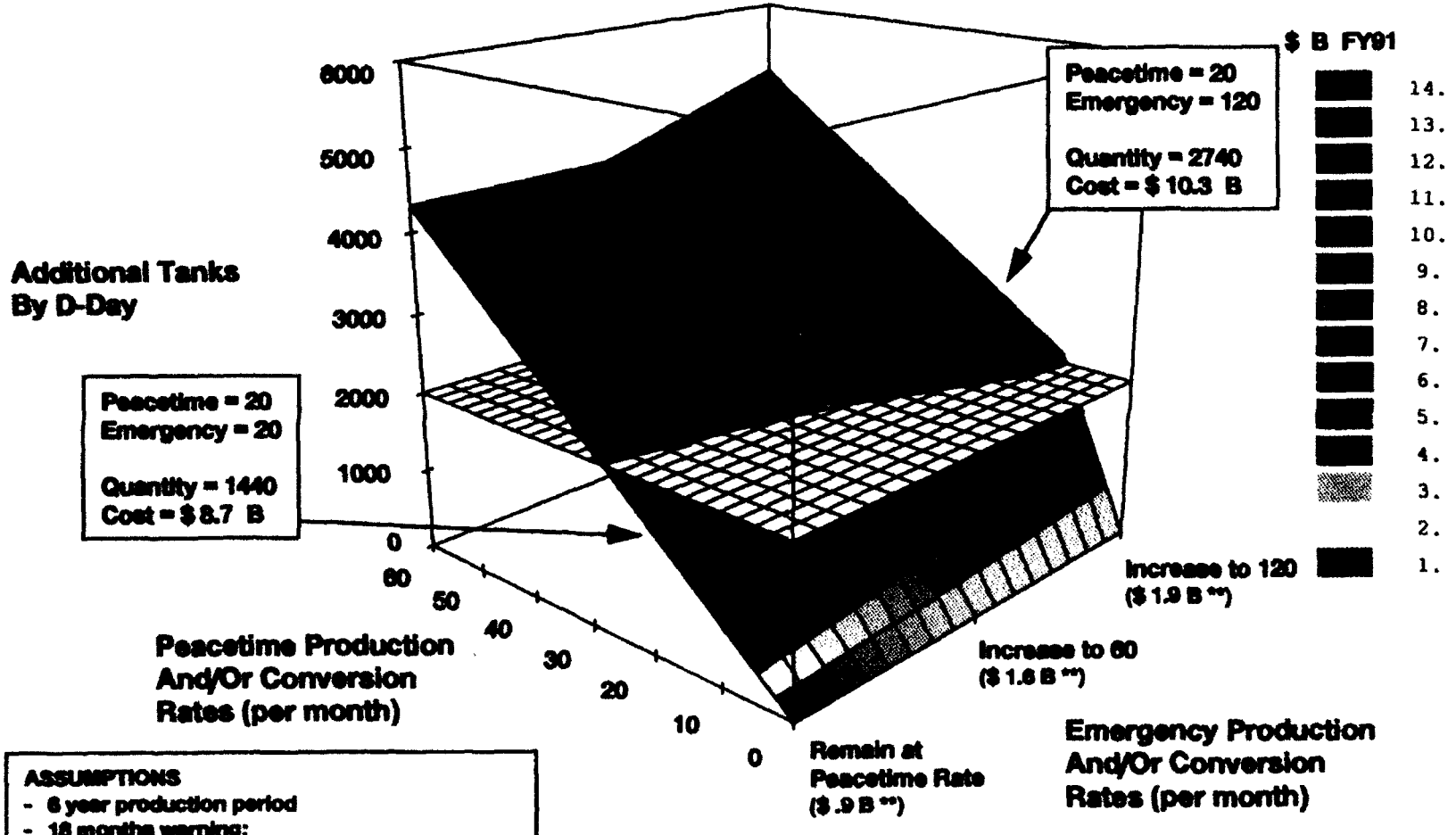
In Figure III-3-1, the three cases associated with a peacetime production rate of zero represent three levels of emergency production: 1) no emergency production, 2) 60 units per month of emergency production, and 3) 120 units per month of emergency production. In this analysis, production of new M1A2s is assumed to be equivalent to conversion of M1s to M1A2s (in both cost and process time).

For these three cases, zero units are produced or converted by the end of the 6 year period, due to the 18 month warning period and the 48 month leadtime. The costs ($ M FY91) for the three cases are given in the figure, and are detailed as follows.

**Table III-3-1. Comparison of Cases with Leadtimes of 48 and 6 Months**

| Emergency Production Rate (per mo) | Fixed Layaway Costs | Variable Layaway Costs(/mo) | Months in Layaway Status | Restart Costs | Production Costs (Unit + Plant) | Total Costs |
|---|---|---|---|---|---|---|
| **Leadtime 48 Months** | | | | | | |
| 0 | 551 | 4.8 | 72 | 0 | 0 | 897 |
| 60 | 551 | 4.8 | 72 | 740 | 0 | 1637 |
| 120 | 551 | 4.8 | 72 | 1013 | 0 | 1910 |
| **Leadtime 6 Months** | | | | | | |
| 0 | 551 | 4.8 | 72 | 0 | 0 | 897 |
| 60 | 551 | 4.8 | 59 | 740 | 2550 | 4125 |
| 120 | 551 | 4.8 | 59 | 1013 | 2795 | 4643 |

# SAMPLE OPTIONS FOR POM 94-99
## Main Battle Tank




**ASSUMPTIONS**
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- If Production = 0, then 48 month ramp-up
  For these 3 cases, costs denoted by ** on axis
- Foreign Military Sales = 0 / month
- No Emergency Supplemental Budget

Figure III-3-1

IDA October 8, 1991

# CHAPTER 4

# SAMPLE APACHE OPTIONS FOR ARMY POM 94-99 DECISIONS

## INTRODUCTION

In preparing its FY1994-99 Program Objective Memorandum (POM), the Army is building production plans for a variety of combat systems. The magnitude of impending budget cuts and program terminations puts a premium on identifying innovative ways to maintain/restore the capability to meet potential future U.S. needs for battlefield combat power. President Bush has recently highlighted the importance of such efforts -- by making Reconstitution a key part of *The National Security Strategy of the United States* (August 1991):

> Beyond the crisis response capabilities provided by the active and reserve forces, we must have the ability to generate wholly new forces should the need arise....The ability to reconstitute is what allows us safely and selectively to scale back and restructure our forces in being. This difficult task will require us to invest in hedging options whose future dividends may not always be measurable now. It will require careful attention to the vital elements of our military potential: the industrial base, science and technology, and manpower....We and our allies must be able to reconstitute a credible defense faster than any potential opponent can generate an overwhelming offense.

As a part of the Integrated Army Mobilization Study (IAMS), and to help the Army frame resourcing options for several planning scenarios in the POM 94-99 time frame, the Institute for Defense Analyses (IDA) has developed a means of assessing cost/quantity production tradeoffs for key weapons systems. IDA is compiling data and preparing production tradeoffs for four systems: the Abrams tank, the Apache helicopter, the TOW missile, and the Multiple Launch Rocket System (MLRS). Each program office was visited, and data are now being assessed. This paper describes the basic tradeoff technique and then illustrates it with data for the Apache helicopter using material that has been reviewed with the Apache Program Manager's (PM) staff including the Deputy PM. The paper concludes with a recommendation that this approach be used to develop options for the Army's POM 94-99.

## TWO QUESTIONS

Two key IAMS questions are as follows:

- Would currently projected U.S. attack helicopter assets suffice to meet battlefield objectives as stipulated in a long-warning European scenario occurring at the end of the POM 94-99 period?
- If not, what are some of the Army's major alternatives to meet those needs?

IAMS advisors have tasked U.S. Army's Concepts Analysis Agency (CAA) to provide estimates on the first question. The next section provides some initial assessments by IDA that may help address the second.

## APPROACH

### Collect Production, Planning and Inventory Data

Production of new Advanced Attack Helicopters, AH-64As (Apaches), is scheduled to end in September 1994. Production for U.S. acquisition is scheduled to end in October 1993. This would bring the total U.S. AH-64A buy to 807. The period from October 1993 through September 1994 is allocated to the production of Apaches for Israel (18), Egypt (24), and Saudi Arabia (12). The current plan is to convert existing AH-64As to B, C, or D models with enhanced capabilities.

The projected May, 1995 Army inventory of 807 Apaches - 245 AH-64As, 254 AH-64Bs, 81 AH-64Cs and 227 AH-64Ds (Longbow Apaches) - is a significant military asset for conflict scenarios in the 1990s.

The only new production of Apaches, as opposed to enhancements/upgrades, after September 1994 would come from Foreign Military Sales (FMS). The optimistic potential FMS rate is 9 helicopters per month. The pessimistic FMS forecast is 4.5 per month (refer to Appendix A). The FMS production is important to the U.S. retention of a capability to produce new Apaches. Refer to Appendix A for a discussion of potential subcontractor problems with Apache fuselage production.

If the Army should need more Apaches than it now has, it can produce them or obtain them from other countries. This analysis focuses on production possibilities. Appendix A summarizes the Apache production capability and cost data that has been utilized in preparing this paper.

One basic fact is that the current U.S. facilitized monthly Apache production **capacity** is 15, i.e., slightly over 70[1] percent of a division's assets of attack helicopters per month. At this rate, the U.S. could build the attack helicopters for a little over two divisions per quarter[2], or eight Apache divisions per year. If the U.S. determines it needs to produce more than eight Apache divisions for a particular future scenario, it will want to have either:

- more than a year's worth of emergency production time (at 15 Apaches per month),
- a capability to produce more than 15 Apaches per month in an emergency,
- some additional production in peacetime, or
- some other source of additional attack helicopters (either FMS buy-backs or foreign production).

To keep track of some of those possibilities in an orderly way, and to integrate them with the best available cost data for the Apache it was worthwhile to develop a computer model.

## Develop Tradeoff Model

IDA has developed a model (See Appendix B) and a graphical display for assessing and summarizing the quantities and costs of additional attack helicopters that could be produced through various production plans over the remainder of the 1990's. The model projects a potential peacetime production program, and then examines a number of possible alternatives for surging production upon warning. The model calculates two key measures: the total quantity of attack helicopters produced and the costs of producing the attack helicopters for that case. Appendix B provides an overview of the model and the display technique.

The Apache quantity estimates represent the sum of three components: the numbers of Apache produced **for U.S. use** during each of three periods--(1) A peacetime "prewarning" period; (2) a "ramp-up" period; and (3) an "emergency production" period (after "ramp-up").

These three quantity components are calculated as follows:

- Production during prewarning equals the length (in months) of the prewarning period times the peacetime rate per month;

---

1 Percent of Division = Monthly Production Capacity/Number of Apaches in a Division, Percent of a Division = 15/21 = 71.4%.

2 Divisions in a Quarter = Production in Three Months (Monthly Rate x 3)/Number of Apaches in a Division = (15 x 3)/21 = 45/21 = 2.14.

- Production during ramp-up is assumed (in this version) to equal the peacetime monthly rate times the number of months estimated as needed (after warning) to achieve the selected emergency production rate.
- Production during the "emergency production" period is assumed to equal the selected emergency monthly rate times the length (in months) of the emergency production period (i.e., the length of the warning period minus the length of the ramp-up period).

The cost algorithm calculates, for each production plan considered, the relevant production costs (fixed and variable) for each phase of the production plan. Because of the high probability of continuing FMS and the potential loss of the fuselage subcontractor, the monthly production rate is assumed never to drop to zero. Therefore, layaway and restart costs are not elements of the Apache cost equations. Refer to Appendix A for the information obtained about layaway and restart costs for the Apache.

## Develop Alternatives

Because of the assumption for the Apache case study that new aircraft cannot be produced after production has dropped to zero, all alternatives assume that FMS will allow for the continued production of Apache fuselages. (Refer to Appendix A for more details.)

### Thirty Initial Cases and The Display "Cube"

Figure III-4-1 presents results for 30 separate "what-if" planning cases. Along the vertical dimension, the display Cube in the figure shows the number of additional Apaches produced for U. S. use by the end of a 72 month production period (i.e., by the assumed D-day) in each case. The total dollar cost of a given case (in Billions of FY 1992 $) is indicated by the color scheme. (A color legend accompanies the figure.) For orientation, note that the most costly production cases are in the far back corner of the Cube, that they cost about $6 Billion, and are shown in purple. By contrast, the least expensive cases cost less than $1 Billion and may be seen in the light brown/yellow area at the bottom front center of the display.

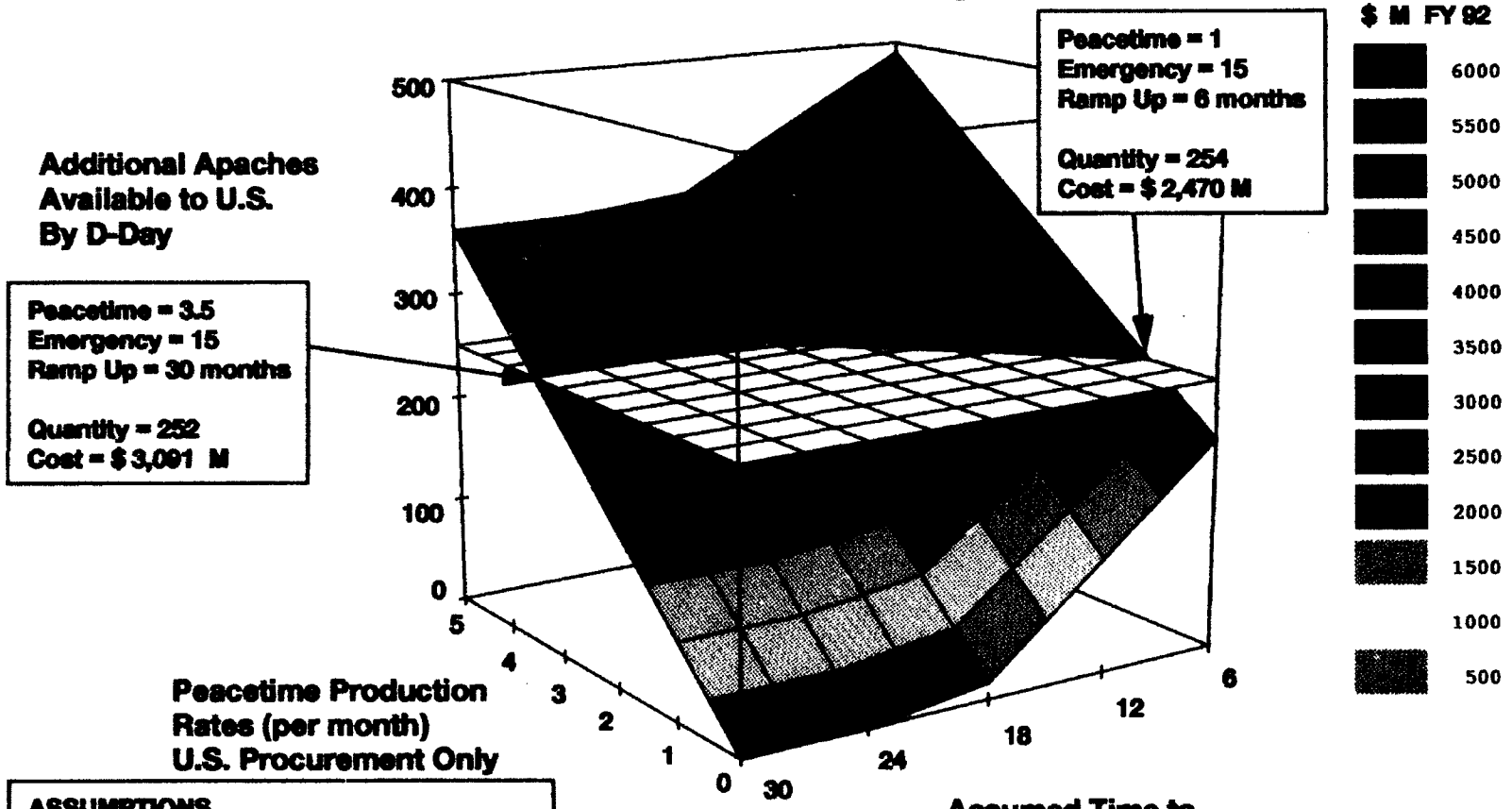
All the cases in Figure III-4-1 share the following principal assumptions. These can be seen in the bottom left corner of the figure:

- First, the overall production period considered here is 72 months long (beginning in October of 1993 and ending September 30, 1999).
- Second, warning is assumed to occur on April 1, 1998, and the warning period is to last for 18 months -- until D-Day on October 1, 1999.

- Third, a variable number of months of "extreme national emergency priority" ramp-up time (after warning) is assumed to be required in these cases in order to achieve the emergency production rate, of 15 units per month.
- Fourth, a non-zero amount of Foreign Military Sales is assumed.
- Fifth, total U.S. costs are included in these estimates, including those costs incurred during the warning/emergency period.

The 30 cases in Figure III-4-1 include five groups of six cases each. Each group of six cases considers differing amounts of peacetime production of Apaches for U. S. use, ranging from zero units per month to five units per month (this is in addition to the units being produced for FMS). For each group of six levels of peacetime production, the assumed time to ramp-up to the emergency rate was varied. The shortest assumed ramp-up time is six months; the longest is 30 months. This range was chosen since the available data indicated that the planned ramp-up time was 28 months, which is a relatively long time. This analysis was constructed, therefore, to highlight the potential value of a shorter ramp-up time.

# SAMPLE OPTIONS FOR POM 94-99
# APACHE Helicopter




**ASSUMPTIONS**
- 6 year production period
- 18 months warning
- Emergency production rate = 15 / month
- Months at emergency rate =
  18 - assumed ramp-up time + 1
  (Positive values only. No emergency rate possible at negative values.)
- Foreign Military Sales = 5 / month
- No Emergency Supplemental Budget

Figure III-4-1

IDA November 24, 1991

Cases 1 and 2, described below, are two of the many notional plans displayed in Figure III-4-1. A focus on these two can help illustrate the technique and demonstrate the value of systematically capturing assessments of contingency production capabilities in planning the POM.

### Case 1: How to Produce Approximately 250 New Apaches if Ramp-up Time is 30 Months (252 Apaches, $3.1 B)

This case illustrates one feasible solution for obtaining approximately 250 new Apaches for U. S. use if the ramp-up time for emergency production, given warning, was 30 months. In this case, the emergency production rate of 15 units per months will not be achieved during the period of the planning (i.e., prior to D-Day). The desired quantity must therefore be produced at the peacetime rate of 3.5 units per month. The total quantity resulting from such a plan is 252 units, calculated as 3.5 per month for 72 months.

The cost calculation, detailed in Table III-4-1, shows the unit costs vary, depending on the monthly production rate. During the prewarning period, there are assumed to be 5 units of additional FMS production. The unit cost is $11.226 M. During the warning period, it is assumed in this analysis that the FMS sales cease; the unit cost during warning is $15.387 M. This is also the unit cost during the post-warning period.

Note that there are no layaway or restart costs for the analysis here, since the assumed level of five units of FMS per month made such actions unnecessary.

### Case 2: Produce Approximately 250 New Apaches if Ramp-up Time is Six Months (254 Apaches, $2.5 B)

This case, illustrated on the right side of Figure III-4-1, serves to show the effect of a short ramp-up time. With a six month ramp-up time, the peacetime production can be as low as one unit per month for U. S. use, and the cost decreases by $621 M, due to the lower unit cost applied to the bulk of the 254 units produced, as shown in Table III-4-2.

The costs in Table III-4-2 may be summarized as follows: during peacetime, there is one unit per month produced for U. S. use at $12.860 M, for 54 months; during warning, there is one unit per month produced at $21.263 M (no FMS units are produced during warning in this analysis); during post-warning, there are 15 units produced per month at $8.562 M per month. the resulting total cost is $2,470 M.

**Table III-4-1. Case 1 Calculations**

| | | | |
|---|---|---|---|
| Quantity | | | |
| Peacetime | 3.5 per month for 54 months | = | 189 |
| Ramp-up period | 3.5 per months for 5 months | = | 17.5 |
| At emergency rates | 3.5 per months for 13 months | = | 45.5 |
| Total | | = | 252 |
| Cost | | | |
| Peacetime | 3.5 per month, $11.226M/unit, for 54 months = | | $2,122M |
| Ramp-up | 3.5 per month, $15.387M/unit, for 18 months = | | 969M |
| Total | | | $3,091M |

**Table III-4-2. Case 2 Calculations**

| | | | |
|---|---|---|---|
| Quantity | | | |
| Peacetime | 1 per month for 54 months | = | 54 |
| Ramp-up period | 1 per months for 5 months | = | 5 |
| At emergency rates | 15 per months for 13 months | = | 195 |
| Total | | | 254 |
| Cost | | | |
| Peacetime | 1 per month, $12.860M/unit, for 54 months = | | $694M |
| Ramp-up | 1 per month, $21.263M/unit, for 5 months = | | 106M |
| Emergency | 15 per month, $8.562M/unit, for 13 months = | | 1,670M |
| Total | | | $2,470M |

## Alternative Ways to Produce Approximately 250 Apaches by D-Day

Figure III-4-1 may be used to identify a range of options for producing approximately 250 Apaches by a given time in the future, depending on the amount of peacetime production and the capability to ramp-up to the emergency production rate. Using the calculus and assumptions illustrated above, one finds there are three basic cases:

1) If ramp-up time is 30 months, produce at 3.5 units per month. Cost is $3.1 B.

2) If ramp-up time can be reduced to approximately 12 months, produce at 2.2 units per months for 65 months, then at emergency rates for the last 7 months of the 72 month period. Cost is $2.8 B.

3) If ramp-up time can be reduced to approximately six months, produce at one unit per months for 59 months, then at emergency rates for the last 13 months of the 72 month period. Cost is $2.5 B.

## Examine Alternative Cases/Scenarios

Sample production plans have been developed and presented in this paper to show a range of ways that the Army could obtain additional U.S. attack helicopters that might be needed by D-Day in a hypothetical European theater (or other major) conflict. Several other kinds of cases and model features are described below.

### Funding Perspectives: Total Dollar Costs or POM Dollar Costs

Figures III-4-1 and III-4-2 have depicted all cases in terms of their total dollar costs in the POM 94-99 period. Figures III-4-3 and III-4-4 take a different funding perspective. They are identical to Figures III-4-1 and III-4-2, respectively, except that Figures III-4-3 and III-4-4 presume that a Supplemental Budget would be available to cover all Apache production costs after Warning Day, i.e., beginning on the 55th month of the 72 month overall production period. Under this assumption, it makes sense for decision makers to review alternatives in view of their relative POM dollar costs. A perspective of this sort thus permits the decision maker to look at POM dollar expenditure patterns in terms of their relative payoffs on "D-Day."

### Other Scenarios, Warning Times, Ramp-Up Times, Etc.

The model and display techniques can be applied to short-warning planning scenarios--such as a Major Regional Contingency (East)--as well. In those cases, which may be more likely than the long warning European contingency, the model (and the underlying data) is expected to show that the Army has no real options other than relying on helicopters already in inventory and, perhaps to a very limited extent, accelerating deliveries of any helicopters which are already on order for either the U.S. or for FMS and which are therefore "in the pipeline."

### Foreign Military Sales (FMS)

The value of FMS is highlighted in Figures III-4-2 and III-4-4 when compared to Figures III-4-1 and III-4-3. In Figures III-4-1 and III-4-3, FMS is estimated to be five aircraft per month during peacetime. In Figures III-4-2 and III-4-4, FMS is estimated to be nine aircraft per month during peacetime.

Comparing Figures III-4-1 and III-4-2 (no emergency supplemental budget), the cost to the U.S. of obtaining 250 aircraft drops by $0.4B to $0.2B (depending on assumed ramp-up time) if FMS can be increased from five to nine aircraft per month. The comparable change with are emergency supplemental budget varies from $0.3B to $0.1B.

The Apache also presents a special case since the industrial production capability may be lost if fuselage production were to drop to zero. FMS thereby provides a "cushion" which would allow U.S. acquisition to drop to zero for some period of time without incurring the potential loss of production capability.

## CONCLUSIONS AND RECOMMENDATIONS

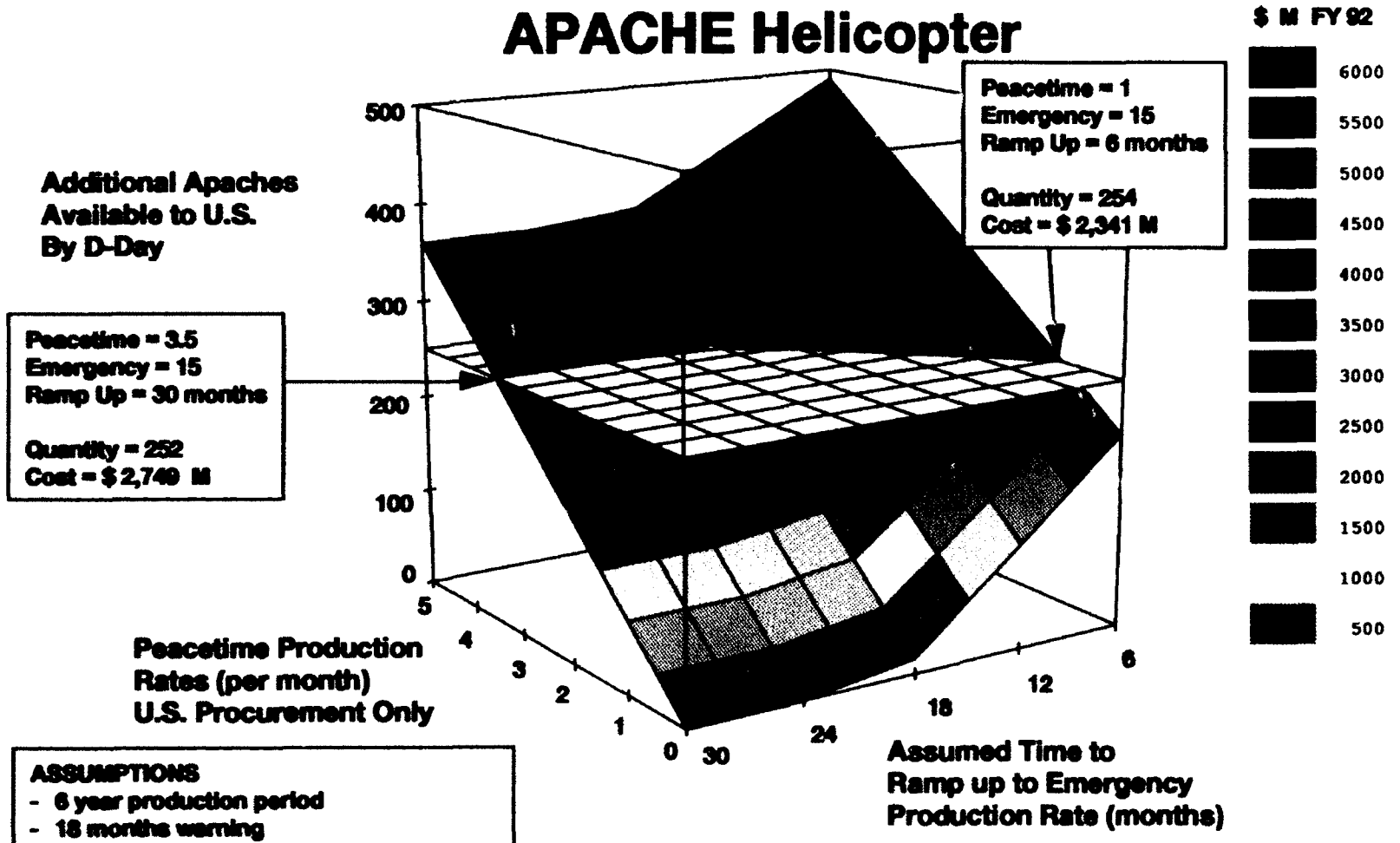
This paper presents an initial set of production options to meet potential demands for additional Apaches in the context of one of the Integrated Army Mobilization Study scenarios--a relatively long-warning European war scenario. The approach can be of use in assessing and depicting production possibilities for a range of planning scenarios in the 1990's. The production tradeoff methods illustrated here may be useful for other systems as well. They may also help provide practical insights concerning the costs and payoffs of various "hedging options" that the President has called for to flesh out a viable Reconstitution component of the National Security Strategy. More specifically, these methods could assist the Army in identifying concrete actions in its 1994-99 POM .

A cautionary note concerning these initial assessments does need to be struck. The relatively low unit costs of production estimated in some of the emergency cases, such as Case Two (which make them look relatively more attractive from a cost standpoint) may be partially offset by rapid price inflation during such periods. A second caution in interpreting these numbers is that there is, unfortunately, still significant uncertainty as to the ramp-up times to emergency production rates. More often than not ramp-up time estimates that have been obtained through "normal" channels significantly underestimate what could be done to speed things up under real mobilization conditions. But when critical sub-tier suppliers start going out of business and when key skilled labor must shift to other jobs, ramp-up times could become quite long.

Good quality information on defense industrial capabilities is no less expensive to obtain than good quality information in many other areas and fields. Given the importance to the nation's security of building a prudent balance between on-hand assets and potential (mobilizable) power, IDA recommends that the Army (1) adopt an assessment and option development scheme of this kind for the upcoming POM, using the best available cost and production data concerning key systems; and (2) accelerate efforts to obtain data on key systems that is at least as good as that

available for the Abrams tank (refer to IDA Working Paper of August 28, 1991, *Sample Tank Options for Army POM 94-99 Decisions*).

# SAMPLE OPTIONS FOR POM 94-99
# APACHE Helicopter

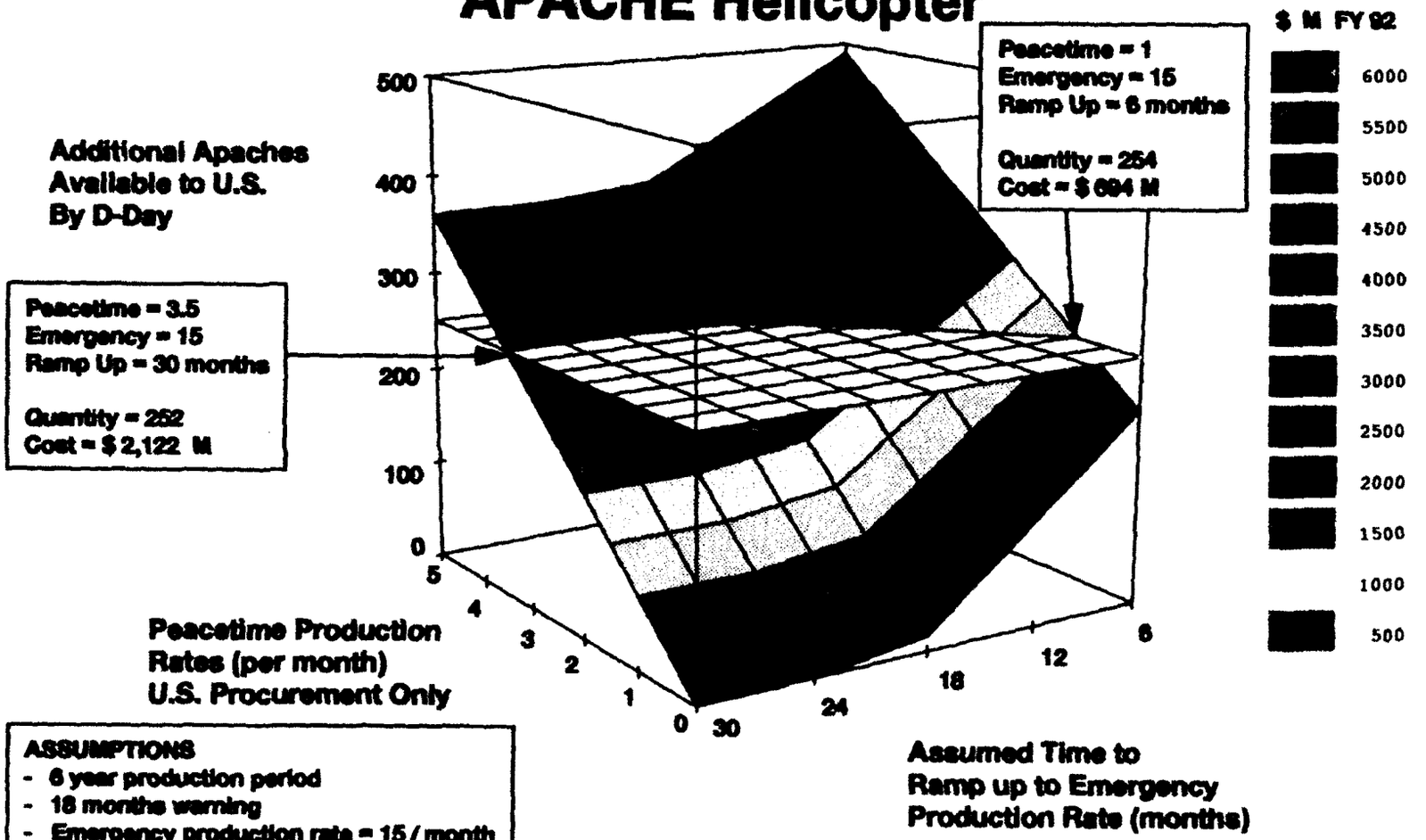



**ASSUMPTIONS**
- 6 year production period
- 18 months warning
- Emergency production rate = 15 / month
- Months at emergency rate = 18 - assumed ramp-up time + 1 (Positive values only. No emergency rate possible at negative values.)
- Foreign Military Sales = 9 / month
- No Emergency Supplemental Budget

Figure III-4-2

IDA November 24, 1991

# SAMPLE OPTIONS FOR POM 94-99
# APACHE Helicopter

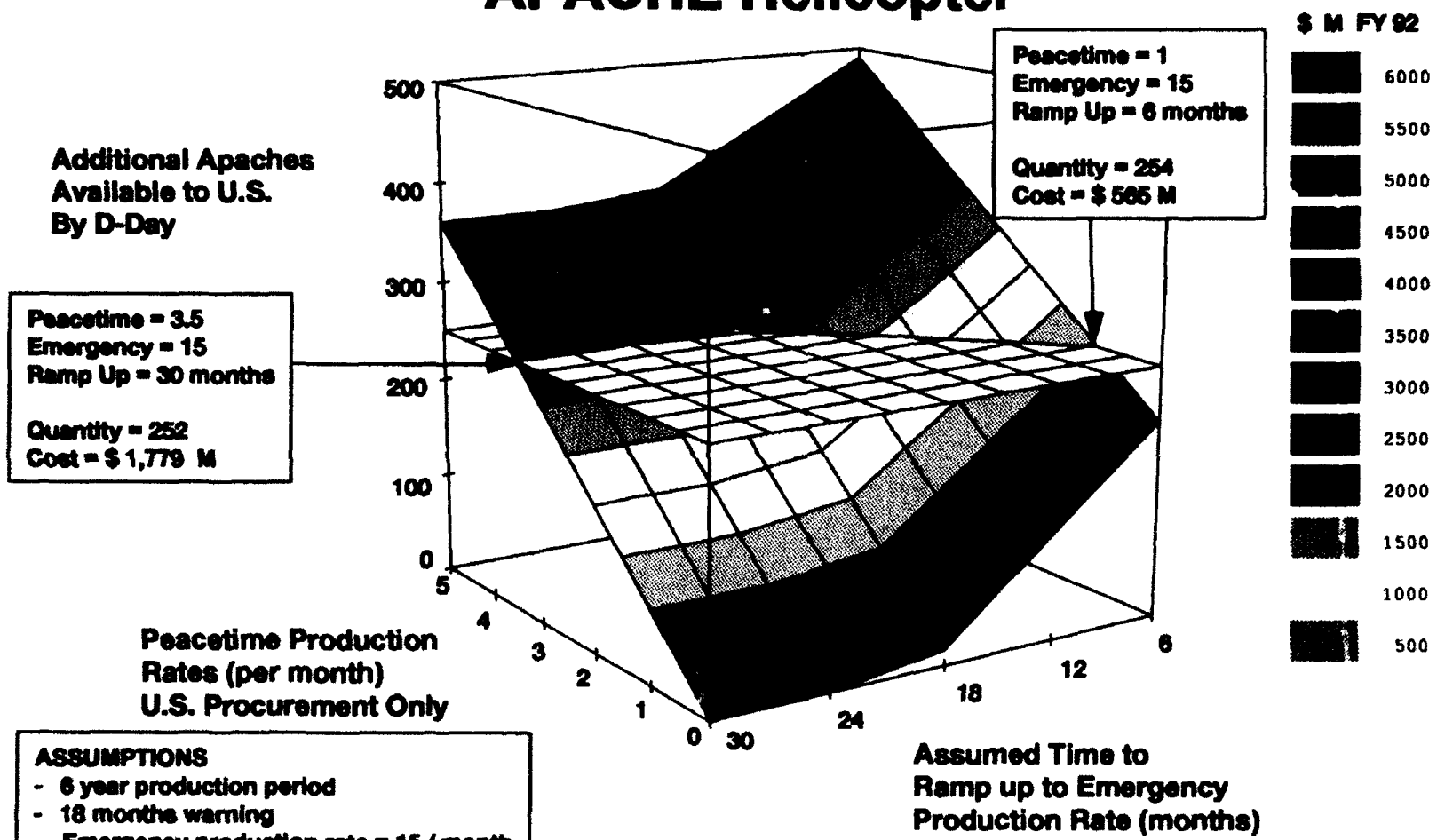



**ASSUMPTIONS**
- 6 year production period
- 18 months warning
- Emergency production rate = 15 / month
- Months at emergency rate =
  18 - assumed ramp-up time + 1
  (Positive values only. No emergency rate possible at negative values.)
- Foreign Military Sales = 5 / month
- Emergency Supplemental Budget

Figure III-4-3

IDA November 24, 1991

# SAMPLE OPTIONS FOR POM 94-99
# APACHE Helicopter




**ASSUMPTIONS**
- 6 year production period
- 18 months warning
- Emergency production rate = 15 / month
- Months at emergency rate =
  18 - assumed ramp-up time + 1
  (Positive values only. No emergency rate possible at negative values.)
- Foreign Military Sales = 9 / month
- Emergency Supplemental Budget

Figure III-4-4

IDA November 24, 1991

# APPENDIX A TO CHAPTER 4

# APACHE COST/CAPACITY INFORMATION

## APPENDIX A TO CHAPTER 4

## APACHE COST/CAPACITY INFORMATION

### SYSTEM DESCRIPTION AND U.S. DELIVERY

McDonnell Douglas Helicopter Company (MDHC) is primarily an assembler although they produce some components and sub-assemblies. The fuselage is constructed by Teledyne Ryan Aeronautical (TRA) in San Diego and shipped to MDHC as a unit. MDHC then installs the various components and sub-assemblies, most of which are purchased or supplied as GFE (Government-Furnished Equipment). The major items of GFE are the:

- Airframe structure (TRA)
- T-701C engine (General Electric (GE))
- Tactical Acquisition Designation Sight/Pilot Night Vision Sensor (TADS/PNVS) (Martin Marietta Electronic Systems (MMES)).

Both GE and MMES GFE are involved in other on-going programs and the production facilities are not expected to shut down if Apache production is stopped. However, the TRA fuselage facility is expected to be either shut down or modified for other products when new Apache production ceases.

The AH-64A is the basic model and all of the currently planned new production are "A" models. A total production of 807 units are planned.

The "B" model configuration is a sub-system modification of some "A" units. The modifications could be made "in the field" and consist of:

- adding the capability to fire Stinger missiles
- use of the new GPS (Global Positioning System)
- installation of air target handover systems
- adding improved optic systems, and
- installation of a laser protective visor.

No new Apache production was involved. Two hundred and fifty-four (254) "A" units are planned for conversion to "B" units.

The AH-64C will be "A" units modified to use the Longbow radar system (but will not include the system). Current plans are to produce "C" units from "A" units and do not include the acquisition of new aircraft. A total of 308 AH-64Cs are planned.

Of the 308 "C" units, 227 are planned for conversion to the "D" configuration. The "D" model is a "C" model with the Longbow actually installed.

If current plans are followed, a summary of AH-64 production for U.S. use is (See Figure III-4-A-1):

| | | |
|---|---|---|
| AH-64A | 245 | |
| AH-64B | 254 | Completed |
| AH-64C | 81 | Planned to start in May, 1994 |
| AH-64D | 227 | Planned to start in May, 1995 |
| Total | 807 | Last delivery in October, 1993 |

Figure III-4-A-1 depicts planned delivery rates and work-in-process (WIP) as of 18 June 1991. The top portion shows the number of aircraft expected to be at various stages of production and assembly through CY 1996. Note especially the expected workload starting in May 1994 as production of AH-64C aircraft begins in anticipation of receipt of the Longbow radar system (LBA) which will then be installed to produce AH-64D aircraft.

The lower portion of Figure III-4-A-1 shows planned deliveries. The Foreign Military Sales (FMS) deliveries occurring after June 1994 were projected based on previous expectations. Those expectations have since been modified to reflect the FMS sales discussed below.

## FOREIGN MILITARY SALES (FMS)

Continued production of new Apache aircraft is expected through September 1994 (Figure III-4-A-1) to complete FMS to Israel, Egypt and Saudi Arabia. Ongoing discussions indicate a probability of additional sales. Informal conversations with program personnel yielded the information shown in Table III-4-A-1 on probable additional FMS through FY 1998.

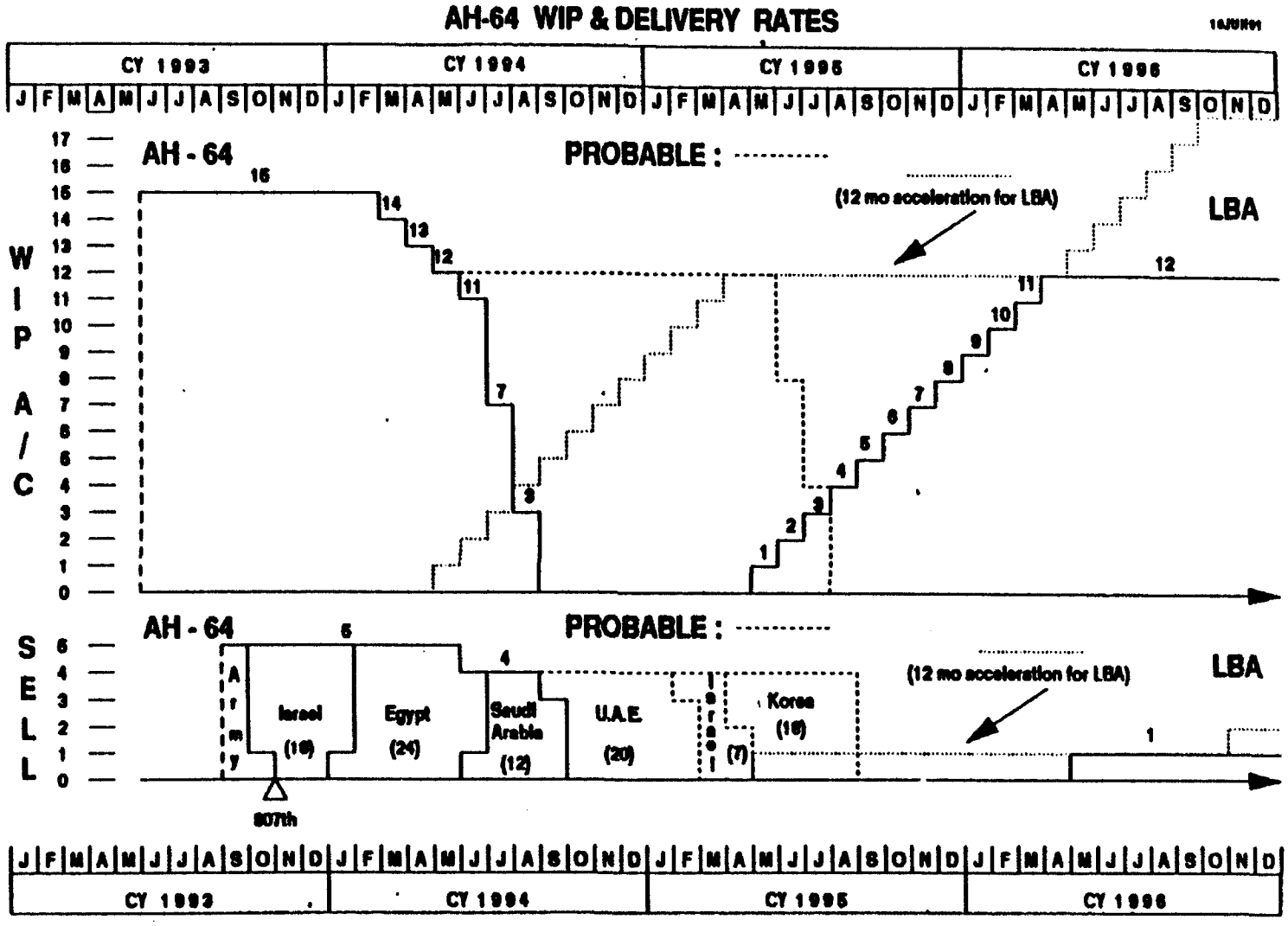



Figure III-4-A-1. AH-64 Work-In-Progress and Delivery Rates

**Table III-4-A-1. Probable Additional FMS Through 1998**

| Country | Quantity | Probability |
|---|---|---|
| UAE | 20 | High |
| Bahrain | 8 | Low |
| Israel | 31 | High |
| Saudi Arabia | 36 | Medium |
| Korea | 37 | High |
| Greece | 12 | High |
| UK | 80+ | High |
| Netherlands | 52 | Low |
| Spain | 18+ | Low |
| Japan | 85+ | Low |
| Kuwait | 60 | Low |

Considering only the FMS with "high" or "medium" probability, a total new production of 216 units could be expected. If some of this potential demand could be met through diversion with actual new production spread over FY 1995 through 1998 (4 years), an actual production rate of about 4 1/2 new aircraft per month could be maintained through FY 1998. The addition of "low" probability FMS adds 223+ aircraft to the production schedule, raising the average 1995-1998 production rate to over 9 new aircraft per month.

## U.S. PRODUCTION CAPACITY

There is general agreement that the capacity for producing new AH-64s is 15 aircraft per month. Some individuals prefer an estimate of 12 aircraft per month because of a presumed need for spares. Still others believe that a surge/mobilization rate of 18 aircraft per month is realistic. All of these rates appear to be sustainable at the major suppliers.

A production capacity of 15 aircraft per month is recommended until additional contractor analyses can be accomplished.

Current production planning at MDHC indicates that, although some inefficiencies may occur during the changeover from the "A" to the "C" model, a total plant shutdown should not be experienced. In fact, if the expected FMS occurs, MDHC may be operating at full, around-the-clock capacity for a significant period.

However, the most significant point of the capacity review is that, when current new production is completed in September 1994, production of fuselages in a contractor-owned/leased facility will cease. Although some of the production equipment is government-owned, there is no incentive for TRA to maintain the capability for future Apache fuselage production. If the Army wishes to maintain the capability to produce new Apaches quickly, the major options are to:

1. Pay TRA to maintain a "cold" plant, or

2. Continue production at a low but efficient rate with the U.S. purchasing any aircraft fuselages not sold through FMS.

Although further review and study seems appropriate, the current analysis is based on the assumption that once TRA has been shut down, no more Apaches can be built. Therefore, the option of restarting from a zero production rate is not available unless special consideration is given to keeping the fuselage line open.

## UNIT PRODUCTION COSTS

Data were provided by the program office for the flyaway cost of the AH-64A (Figure III-4-A-2).

| Production Rate A/C/ mo. | Unit Cost, Millions of 1992 $ |
|---|---|
| 1 | 22.2 |
| 3 | 15.2 |
| 5 | 12.5 |
| 12 | 10.8 |

Point estimates were also provided for the "C" and "D" models at a production rate of 5 aircraft per month if they were produced as new aircraft.

| | |
|---|---|
| AH-64C | $15.5 million 1992 |
| AH-64D | $17.5 million 1992 |

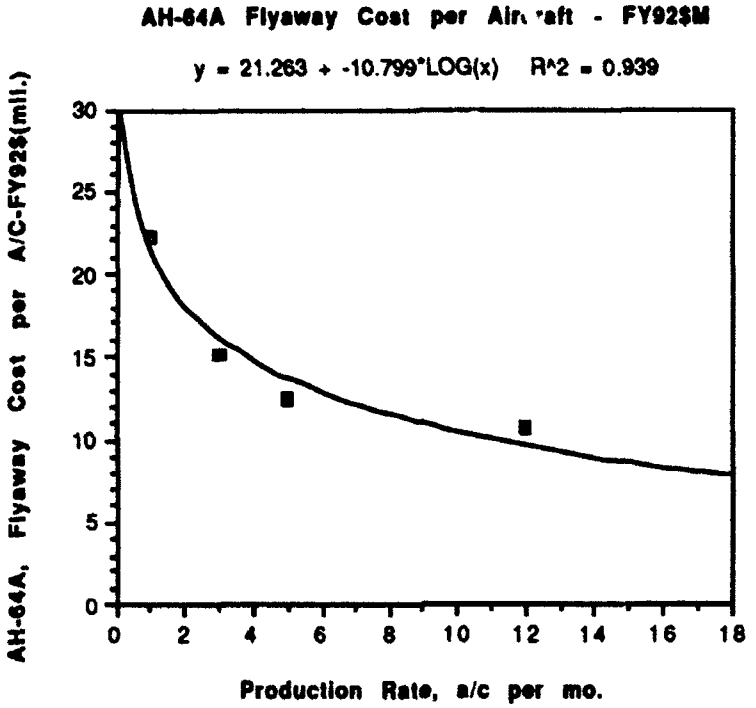



**Figure III-4-A-2. AH-64A Flyaway Cost per Aircraft**

Assuming that the slope of the unit cost curve would be the same for the three models, the unit cost curves are

AH-64A:

$y = 21.263 - 10.799 \log x$

AH-64C:

$y = 23.048 - 10.799 \log x$

AH-64D:

$y = 25.048 - 10.799 \log x$

where

y = unit cost, in millions of 1992 dollars, when produced as new aircraft.

x = monthly production rate, aircraft/month.

IDA was able to obtain some data on fuselage production costs (Figure III-4-A-3) which may be helpful if consideration is given to maintaining the fuselage production base. Although the data were very scant, and additional review is needed for a definitive estimate, the information made available to us indicated that, at a production rate of about 5 or more units per month, a fuselage unit cost of $1,000,000 in 1992 dollars is reasonable with the cost rising to $3,000,000

per fuselage in 1992 dollars at a rate of 1 unit per month. For estimating purposes, it is recommended that the fuselage unit cost used for analysis be

| Units Produced Per Month | Cost per Unit 1992 Dollars |
|---|---|
| 5+ | $1,000,000 |
| 4 | 1,500,000 |
| 3 | 2,000,000 |
| 2 | 2,500,000 |
| 1 | 3,000,000 |

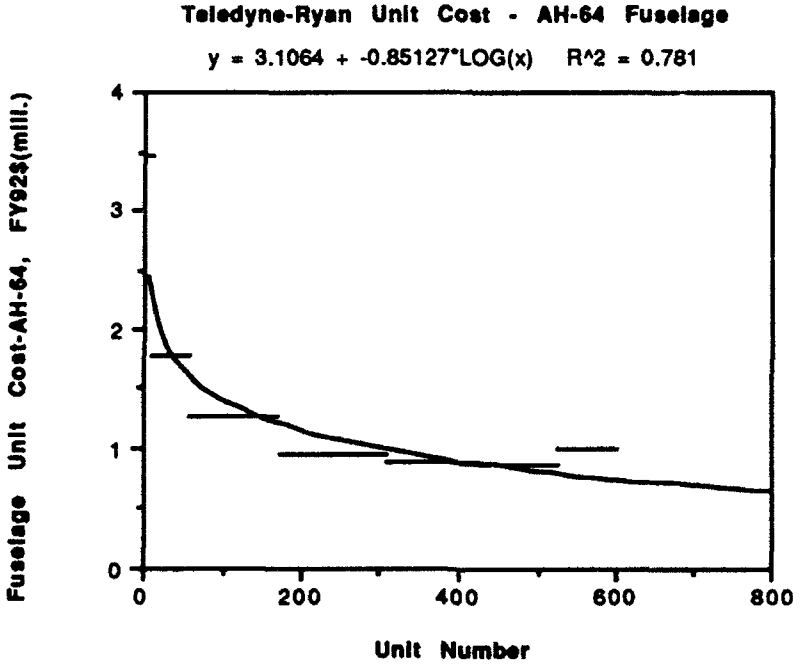



**Figure III-4-A-3. Teledyne-Ryan Unit Cost-AH-64 Fuselage**

## Start-up and Layaway Costs

Start-up and layaway cost estimates were developed through conversations and discussion of previous point estimates rather than referral to a specific report or study. The estimates below refer only to a dropping to (layaway) or rising from (start-up) zero production. The costs of moving from one production rate to another is reflected in the change in unit production costs developed above.

Note that no startup cost has been provided for TRA on the assumption that, once the plant goes to zero production, it will be dismantled.

| | |
|---|---|
| Layaway Costs: | |
| Cost to layaway TRA | $7.0 million, non-recurring |
| Cost to layaway MDHC | 3.0 million, non-recurring |
| Maintenance During Layaway: | |
| MDHC | $0.875 million per month |
| Restart: | |
| MDHC | $25.0 million +$3.4 million per month during the restart process until a total restart cost of $86.2 million is reached. The $3.4 million per month represents "loss of learning" to cover labor inefficiencies. |

# APPENDIX B TO CHAPTER 4

# INVESTMENT TRADEOFF METHODOLOGY

## APPENDIX B TO CHAPTER 4

## INVESTMENT TRADEOFF METHODOLOGY

The investment tradeoff methodology was designed to provide the decision maker a new capability for performing complex assessments involving several factors, where there are several criteria on which the evaluations may be based.

For the case study developed and included in this paper, the problem was framed in terms of factors that the decision maker might possibly control, and factors that are represented as planning estimates but which are not decision options. In the former category are 1) the peacetime production rate for the system, 2) the ultimate surge capacity for the system, and 3) the amount of Foreign Military Sales (FMS). In the latter category are: 4) the amount of warning time before D-Day, 5) the amount of ramp-up time required to achieve the emergency production rates (given warning), and 6) whether the monies expended during the warning period for surging the production are supplied by an emergency supplemental budget.

For both categories of factors, parametric variations over a range of possible values were explored. This approach was thought to be helpful in discovering those situations where one's externally based cost or quantity requirements were satisfied.

For specific values of each of the above factors (e.g., for a given peacetime production rate, with an assumed surge capacity, coupled with a specific warning time, etc.), it is possible to determine how many systems would be produced at various times, and what would be the cumulative costs. The quantity calculation is straightforward. The cost calculation involves several factors, only a few of which have been addressed here.

As discussed above, the following factors enter the cost calculus:

- The cost to layaway the plant. There are both fixed and variable portions of this cost component.
- The cost to surge to the emergency production rate. (Degenerate cases may occur, e.g., do not decrease from the current level, or do not surge at all.)
- The unit production cost. This depends on the number of units produced per month.

A computer model was created to carry out the arithmetic. While the source data were discrete, there were enough data points to allow a cost equation to be developed for each of the above factors. The model is based on these equations. To illustrate the calculations, a specific example is carried out in Appendix C.

The final element of the tradeoff methodology is a new technique for quickly and flexibly depicting the results of varying several decision variables jointly. This display technique, which shows the results for a matrix of options in terms of surfaces, is what generated the figures in the main section of this paper.

The reader or analyst should note that the display technique connects discretely calculated points with a straight line. Thus, the figures show a surface consisting of intersecting flat planes even though the cost equations are non-linear and continuous and investments occur at specific points or along specific lines. As the methodology gains wider use, this discrepancy can be resolved by calculating a larger number of discrete points at shorter intervals, eventually approaching the more correct depiction of a curved surface.

# APPENDIX C TO CHAPTER 4

# SAMPLE RESULTS AH-64 (APACHE)

## APPENDIX C TO CHAPTER 4

## SAMPLE RESULTS AH-64 (APACHE)

### OVERVIEW

The investment tradeoff methodology was used to conduct an initial, illustrative analysis of some key factors being considered in mobilization capability--peacetime production rates, ramp-up times, foreign military sales (FMS), and funding assumptions.

One example of a tradeoff analysis is to determine which investment strategies yield a given quantity of helicopters by a given time. For example, which investment strategies would produce about 250 Apache helicopters by a hypothetical D-Day, where D-Day is assumed to be six years in the future?

Using the cost and capacity assumptions developed in Appendix A and including the assumption of:

- a total period of six years
- 18 months of warning prior to D-Day
- some FMS sales throughout the period,

There are two basic strategies;

- Produce at a constant (regular) rate with no surge after warning.
- Surge to maximum rate after warning with a minimum production level before warning to achieve the desired number of units. Note that the peacetime rate cannot drop to zero if surge capability is to be maintained. FMS would be included to maintain the rate above zero.

On those two strategies, a net increase of about 250 Apaches for U.S. use could be achieved either by

- operating the production facilities at a rate of about 3.5 aircraft per month for U.S. use (252 units total) with no surge at warning
- operating the production facilities at a rate of one aircraft per month ramping up to a production rate of 15 aircraft per month after warning (assuming a capability to ramp-up to maximum rate in six months).

With an FMS base of five aircraft per month, these two options would cost (Figure III-4-1).

- 3.5 aircraft (U.S.) per month constant = $3.1B

- one aircraft (U.S.) per month with surge = 2.5B

With an FMS base of nine aircraft per month, the costs become $2.7B and $2.3B, respectively (Figure III-4-2).

The above estimates for inclusion in POM 94-99 are based on the assumption that a supplemental budget would not become available at warning. If that assumption were changed so that start-up and production costs after warning were funded through a supplemental budget, the estimates shown above would become (Figures III-4-3 and III-4-4)

FMS sales = five aircraft per month

Constant U.S. production at 3.5 aircraft per month = $2.1B

Peacetime U.S. production at one aircraft per month with surge = $0.7B

FMS sales = nine aircraft per month

Constant U.S. production at 3.5 aircraft per month = $1.8B

Peacetime U.S. production at one aircraft per month with surge = $0.6B

## A SAMPLE CALCULATION

A specific example of one investment option is examined in detail to provide a better understanding of the calculation contained in the model. This one case corresponds to one of the points annotated in Figure III-4-1.

This example assumes the peacetime production for U.S. acquisition has been reduced to one unit per month. An FMS rate of five aircraft per month is also assumed bringing the actual production rate to six aircraft per month. A six-year (72 month) period is assumed prior to D-Day, with warning occurring 18 months beforehand. Thus, there are 54 months of peacetime production, an assumed ramp-up period of six months, and 13 months of production at an emergency rate of 15 units per month. It is further assumed that the surge rate is in effect at the end of the ramp-up period, i.e. at month 60. Note that all surge production is available for U.S. use.

The total quantity available to the U.S. by D-Day (month 72) is

| | | |
|---|---|---|
| 54 months at one per month | = | 54 |
| 5 months at one per month | = | 5 |
| 13 months at 15 per month | = | 195 |
| Total | = | 254 |

The cumulative costs through month 72 are

| | | |
|---|---|---|
| Peacetime production cost: | | |
| Unit cost at a rate of 6 per month | $12.86M | |
| Month of U.S. deliveries | 54 | |
| U.S. Peacetime costs | | $694M |
| Plant layaway and startup cost: | | 0 |
| (production did not drop to zero) | | |
| Warning production costs: | | |
| Unit cost at one per month | $21.26M | |
| Months of U.S. deliveries | 5 | |
| U.S. warning time costs | | $106M |
| Surge production cost: | | |
| Unit cost at a rate of 15 per month | $8.56M | |
| Month of U.S. deliveries | 13 | |
| U.S. surge costs | | $1,670M |
| Total U.S. costs | | $2,470M |

## EFFECT OF FMS AND THE USE OF A SUPPLEMENTAL BUDGET

The effect of FMS on U.S. costs is the difference in unit price engendered by higher total production rate. From the data in Appendix A if only one aircraft per month were produced, it would cost $21.26M and the 54 pre-warning aircraft would cost a total of $1,148M. The six-year "savings" in the budget in the case calculated above is $454M with no loss of U.S. availability from the planned quantity.

If a supplemental budget were planned to cover all costs incurred after warning, then the six-year budget would be based on peacetime unit costs and production (one aircraft per month at $12.86M each) and would be $926M (one aircraft per month at $12.86M each for 72 months) for a "savings" of $1,544M over the expected total requirement. Further, as seen in Figure III-4-3, only $694M of the planned $926M would occur prior to warning.

# APPENDIX D TO CHAPTER 4

# PROGRAM HIGHLIGHTS

## APPENDIX D TO CHAPTER 4

## PROGRAM HIGHLIGHTS

**Selected Acquisition Report (RCS:DD-COMP (Q&A)823)**
**December 1990**
**Program: AH-64 (APACHE)**

**Sources: SAR 12/31/90 and ARMY 1990-91 Green Book 10/90**

| | |
|---|---|
| September 1972 | U.S. Army Approved the Advanced Attack Helicopter System. (DSARC I) |
| June 22, 1973 | Competitive Phase I Development Contracts awarded to Hughes Helicopter and Bell Helicopter Textron, Inc. |
| December 7, 1976 | AAH DSARC approved the AAH entry into full scale engineering development (Phase 2) |
| December 7, 1976 | Secretary of the Army selected Hughes as Phase 2 prime aircraft systems contractor. |
| March 10, 1977 | Contracts awarded to Martin Marietta Orlando Aerospace (MMOA) and Northrop Corporation for development of the Target Acquisition Designation Sight/Pilot Night Vision Sensor (TADS/PNVS) subsystem. |
| January 30, 1981 | Army awarded a Long Lead-Time Items (LLTI) contract to MMOA for the TADS/PNVS. |
| February 20, 1981 | Army awarded Hughes a LLTI contract for production of AH-64s. |
| November 18, 1981 | ASARC III was completed. |
| March 26, 1982 | DSARC III initial production of the APACHE approved. |

| | |
|---|---|
| April 1982 | Production contracts for the first production quantity of 11 aircraft and associated equipment were awarded to Hughes, MMOA, and General Electric. |
| Early 1984 | McDonnell Douglas Helicopter Company (MDHC) acquired Hughes Helicopter. |
| January 26, 1984 | MDHC rolled out the first production vehicle. |
| July 22, 1984 | Initial Operation Capability. |
| October 20, 1986 | First production lot of Air Vehicles 11 (ea) completed. |
| May 1989 | APACHE Multi-Stage Improvement Program (MSIP) renamed LONGBOW APACHE. |
| October 1993 | Final Production Delivery. |
| February 1994 | *Last Unit Equipped* |

NOTE: Decreased procurement quantity eliminated Eleventh and Twelfth Production Contraction and Award, changes Final Production Delivery from May 1995 to September 1993 (revision 3 changes to October 1993), and revises the last unit equipped from September 1995 to February 1994.

# APPENDIX E TO CHAPTER 4

# CORRESPONDENCE AND VISIT

## APPENDIX E TO CHAPTER 4

## CORRESPONDENCE AND VISIT

### PROPOSED AGENDA

### Meeting With Program Office Personnel For Advanced Attack Helicopter (Apache) Systems

Note: The following agenda is a general one. It may be modified according to the unique characteristics of a specific system or contractor. The topics are listed for a general discussion rather than a specific presentation.

A. Background and Overall System Information.

1. Purpose of the task
2. System description
   a. Physical characteristics
   b. Subsystem and major components

B. Production Capability Information - Prime Contractor and Major GFE Contractors.

1. Provide a "line-of-balance" diagram
2. Provide the approved production plan
3. Identify each step in the production process and, for each step note
   a. the shift usage (1-8-5, 2-8-5, etc.) to meet current production rate
   b. the standard labor hours per unit produced
   c. the actual labor hours per unit produced
   d. the standard machine hours per unit produced
   e. the actual machine hours per unit produced
   f. the current percent of shift capacity utilized
4. Identify the actual lot size as it may be used at various stages in the production process.
5. Identify the production, test, and quality control process steps which may be eliminated or modified to increase production rate but maintain short term quality standards.

6. For each step noted in B.3. above, estimate the total monthly production capability assuming that materials, components and supplies would be available when needed and that all work stations are manned on a 3-8-7 shift basis.

7. Based on the highest production capability rate noted in B.6. above, estimate the equipment investment cost needed for each other process step noted in B.3. above to raise that process capability to the highest value noted in B.6. If another process step cannot be expanded without exceeding its brick-and mortar capacity, repeat this step using the lower brick-and-mortor capacity as the new maximum capacity and note the change.

C. Subcontractor and GFE Information.

1. Provide the approved procurement plan

2. Procurement characteristics

   a. List foreign-source items and procurement lead times

   b. List critical components and procurement lead times

   c. List single - source components and procurement lead times

   d. List sole - source components and procurement lead times

   e. List long - lead times and their lead times.

3. Procurement history, current operations, and future plans (including production for FMS and all Services).

   a. Total system prime contractors and integration facilities.

      1. List all parts, current and planned prime contractors and system integration facilities.

      2. Provide monthy production for previous 12 months for current contractors and facilities noted in C.3.a.1., above.

   b. GFE

      1. Identify subsystems and components supplied to the prime contractor or integrating facility as GFE. Provide name and address for each.

      2. For each integrator noted in a.1., above, provide the current procurement lead time and the program office's opinion concerning the supplier's capability to

supply the material needed to achieve the highest system production rate noted in B.7., above.

D. Cost Information: The following should be supplied for each Prime contractor, Major Integrating Facility and Major GFE Contractors.

1. Unit costs: Estimate the fixed and variable unit costs at
   a. Current production rates
   b. One-half current production rate
   c. One-third current production rate
   d. One-fourth current production rate
   e. One-tenth current production rate
   f. A production rate of one unit per month
   g. A production rate of the highest value used in B.7., above.
   h. If current production equals 0, provide items a. through f., above, using the highest value used in B.7., above, as the current production rate.
   i. At most efficient current design rate.
2. Layaway costs: Estimate the total one-time and recurring costs incurred in plant layaway to maintain the maximum current production capability at an average on-going production rate of
   a. Zero
   b. One-tenth current production rate
   c. One-fourth current production rate
   d. One-third current production rate
   e. One-half current production rate
3. Restart Costs: Estimate the total fixed costs incurrent for plant restart to increase the production rate from each rate noted in D.2., above to
   a. Current production rate
   b. Current production capability noted in B.7., above.

E. Summary

Review information provided above noting any apparent inconsistencies and adding important observations and information not noted above on prime contractor and lower tiers.

# IDA VISIT TO
# APACHE PROGRAM OFFICE

**13-14 AUGUST 1991**

## IDA VISITORS

Richard Cheslow

Janet Nauta

## PRIMARY CONTACTS

| | |
|---|---|
| Mr. Robert Kennedy, Deputy PM | (314) 263-3836 |
| Mr. Bill Mahen, Point of Contact | (314) 263-1971 |
| Mr. Bennie Young, FMS | (314) 263-3836 |
| Mr. Bob Reynolds, Production | (314) 263-1937 |
| Mr. Victor Burgos, Cost Analysis | (314) 263-1925 |
| Mr. Gary Doty, Longbow Production | (314) 263-1981 |

# APPENDIX F TO CHAPTER 4

# OVERVIEW OF THE IDA CONTRIBUTION TO THE IAMS STUDY

# INTEGRATED ARMY MOBILIZATION STUDY

## OVERVIEW OF CONTRIBUTION BY THE
## Institute for Defense Analyses (IDA)

### OBJECTIVE

- Develop tradeoff methodology and options for Army POM 94-99 (for selected systems) that combine alternative plant status, procurement, ramp-up, capacity and cost elements to best satisfy stated Army requirements.

### CANDIDATE SYSTEMS

- AH-64
- MLRS
- Abrams Main Battle Tank
- TOW2

### APPROACH

- Obtain Information from Program Offices
  - •• Programmatic Policy Options
  - •• Most Current Production Bottleneck/Cost Data
  - •• Major subcontractor information
  - •• Plant closure/restart data
  - •• Key data limitations
- Build Strawman Issue-Option Papers for Each System
- Revise/Refine for POM Assessments with feedback from Key participants

### STATUS

- Methodology Developed and Briefed
- All Program Offices have been visited, available data compiled and data gaps identified
- Tank option paper submitted August 28, 1991
- TOW and other Option packages in preparation to meet overall study schedule

# APPENDIX G TO CHAPTER 4

# PLANNED DELIVERY RATES

## APPENDIX G TO CHAPTER 4

## PLANNED DELIVERY RATES

Figure III-4-G-1 shows planned delivery rates and work-in-process (WIP) inventory. The upper portion of the figure indicates the number of aircraft in the McDonnell Douglas Helicopter Company (MDHC) facility at various stages in the production/modification cycle. Note that aircraft are planned to be brought for modification to the "C" configuration prior to the end of new aircraft production. Approximately one year later, modification to the "D" configuration, by installation of the Longbow radar, is expected to start. Thus, current planning indicates that MDHC would not revert to a "cold base" in the foreseeable future.

If potential Foreign Military Sales (FMS) (See Appendix A) were added beyond the completion of current FMS production, the MDHC plant would probably be operating at a rather high level of activity during the planning period.

The lower portion of the figure shows planned deliveries. The FMS deliveries occurring after June 1994 were projected based on expectation on 18 June 1991. Those expectations have since been modified to reflect the FMS sales discussed in Appendix A.

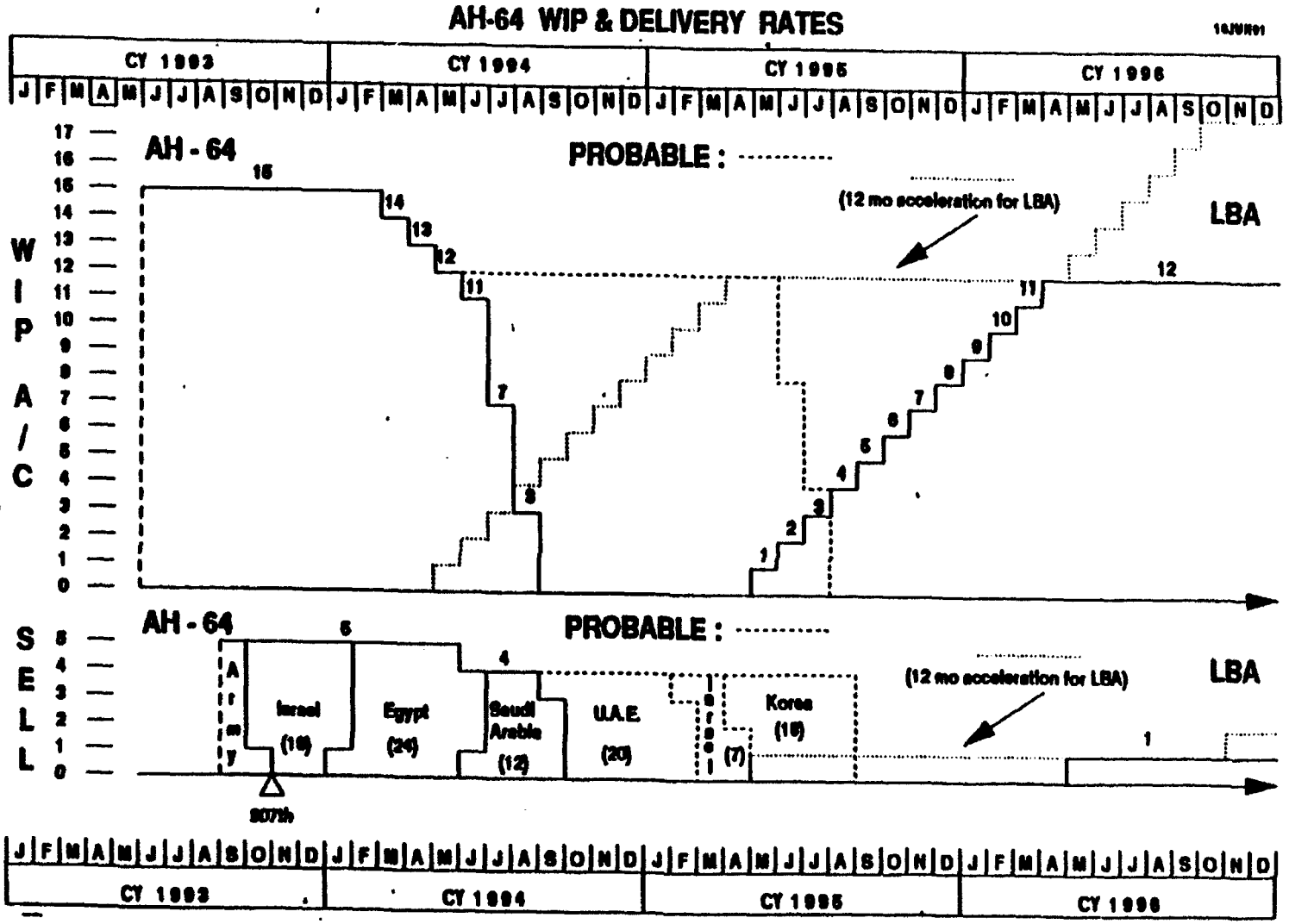



Figure III-4-G-1. AH-64 WIP & Delivery Rates

# CHAPTER 5

# SAMPLE TOW MISSILE OPTIONS FOR ARMY POM 94-99 DECISIONS

## INTRODUCTION

In preparing its FY1994-99 Program Objective Memorandum (POM), the Army is building production plans for a variety of combat systems. The magnitude of impending budget cuts and program terminations puts a premium on identifying innovative ways to maintain/restore the capability to meet potential future U.S. needs for battlefield combat power. President Bush has recently highlighted the importance of such efforts -- by making Reconstitution a key part of *The National Security Strategy of the United States* (August 1991):

> Beyond the crisis response capabilities provided by the active and reserve forces, we must have the ability to generate wholly new forces should the need arise....The ability to reconstitute is what allows us safely and selectively to scale back and restructure our forces in being. This difficult task will require us to invest in hedging options whose future dividends may not always be measurable now. It will require careful attention to the vital elements of our military potential: the industrial base, science and technology, and manpower....We and our allies must be able to reconstitute a credible defense faster than any potential opponent can generate an overwhelming offense.

As a part of the Integrated Army Mobilization Study (IAMS), and to help the Army frame resourcing options for several planning scenarios in the POM 94-99 time frame, the Institute for Defense Analyses (IDA) has developed a means of assessing cost/quantity production tradeoffs for key weapons systems. IDA is compiling data and preparing production tradeoffs for four systems: the Abrams tank, the Apache helicopter, the TOW missile, and the Multiple Launch Rocket System (MLRS). Each program office was visited, and data are now being assessed. This paper describes the basic tradeoff technique and then illustrates it with data for the TOW missile using material that has been reviewed with the Program Manager's (PM) staff. The paper concludes with a recommendation that this approach be used to develop options for the Army's POM 94-99.

## TWO QUESTIONS

Two key IAMS questions are as follows:

- Would currently projected U.S. TOW 2 assets suffice to meet battlefield objectives as stipulated in a long-warning European scenario occurring at the end of the POM 94-99 period?
- If not, what are some of the Army's major alternatives to meet those needs?

IAMS advisors have tasked U.S. Army's Concepts Analysis Agency (CAA) to provide estimates on the first question. The next section provides some initial assessments by IDA that may help address the second.

## APPROACH

### Collect Production, Planning and Inventory Data

The production forecast calls for TOW 2Bs, only, to be produced after 1991. The projected production rate is 1,000 units per month. If the Army should need more TOW 2s than it now has, it can produce them or obtain them from other countries. This analysis focuses on production possibilities. Appendix A summarizes the TOW's production capability and cost data that have been utilized in preparing this paper.

One basic fact is that the current U.S. facilitized monthly TOW 2 production capacity is 1,000 units for TOW 2B; 2,500 units for TOW 2, 2A, and 2B combined, and 3,500 for all TOW missiles.

If more TOW 2 missiles are needed for a particular future scenario, the U.S. may want to consider some combination of the following options:

- more than a year's worth of emergency production time (at 3,500 per month),
- a capability to produce more than 3,500 per month in an emergency,
- some additional production in peacetime, or
- some other source of additional TOW 2s, (either FMS buy-backs or foreign production).

To keep track of some of these possibilities in an orderly way, and to integrate them with the best available cost data for the TOW 2, it was worthwhile to develop a computer model.

## Develop Tradeoff Model

IDA has developed a model (see Appendix B) and a graphical display for assessing and summarizing the quantities and costs of additional TOW 2s that could be produced through various production plans over the remainder of the 1990's. The model projects a potential peacetime production program, and then examines a number of possible alternatives for surging production upon warning. The model calculates two measures: the total quantity of missiles produced (with peacetime and emergency production combined) and the costs of producing the missiles for that case. Appendix B provides an overview of the model and the display technique.

The TOW 2 quantity estimates represent the sum of three components; the quantity of TOW 2s produced **for U.S. use** during (1) a peacetime"prewarning" period; (2) a "ramp-up" period; and (3) an "emergency production" period (after "ramp-up").

These three quantity components are calculated as follows:

- Production during prewarning equals the length (in months) of the prewarning period times the peacetime rate per month;
- Production during ramp-up is assumed (in this version) to equal the peacetime monthly rate times the number of months estimated as needed (after warning) to achieve the selected emergency production rate.
- Production during the "emergency production" period is assumed to equal the selected emergency monthly rate times the length (in months) of the emergency production period ( i.e., the length of the warning period minus the length of the ramp-up period).

The cost algorithm calculates, for each production plan, the sum of three cost elements:

- plant "layaway" costs (both fixed and variable);
- plant "restart" costs; and
- the relevant unit production costs (fixed and variable) for each phase of the production plan.

## Initial Cases and the Display Cube

Figure III-5-1 presents a typical display of the results of a number of planning cases. Along the vertical dimension, the display Cube in the figure shows the number of additional TOW 2Bs produced by the end of a 72 month production period (by D-Day). The total dollar cost (in millions of 1992$) is indicated by the color scheme. (Note the color legend on the upper right side.) For orientation, note that the most costly production cases are in the far back corner of the

cube. The least expensive cases are in a light brown/yellow at the bottom front center of the display.

All the cases in Figure III-5-1 share five principal assumptions. These are listed in the bottom left corner of the figure.

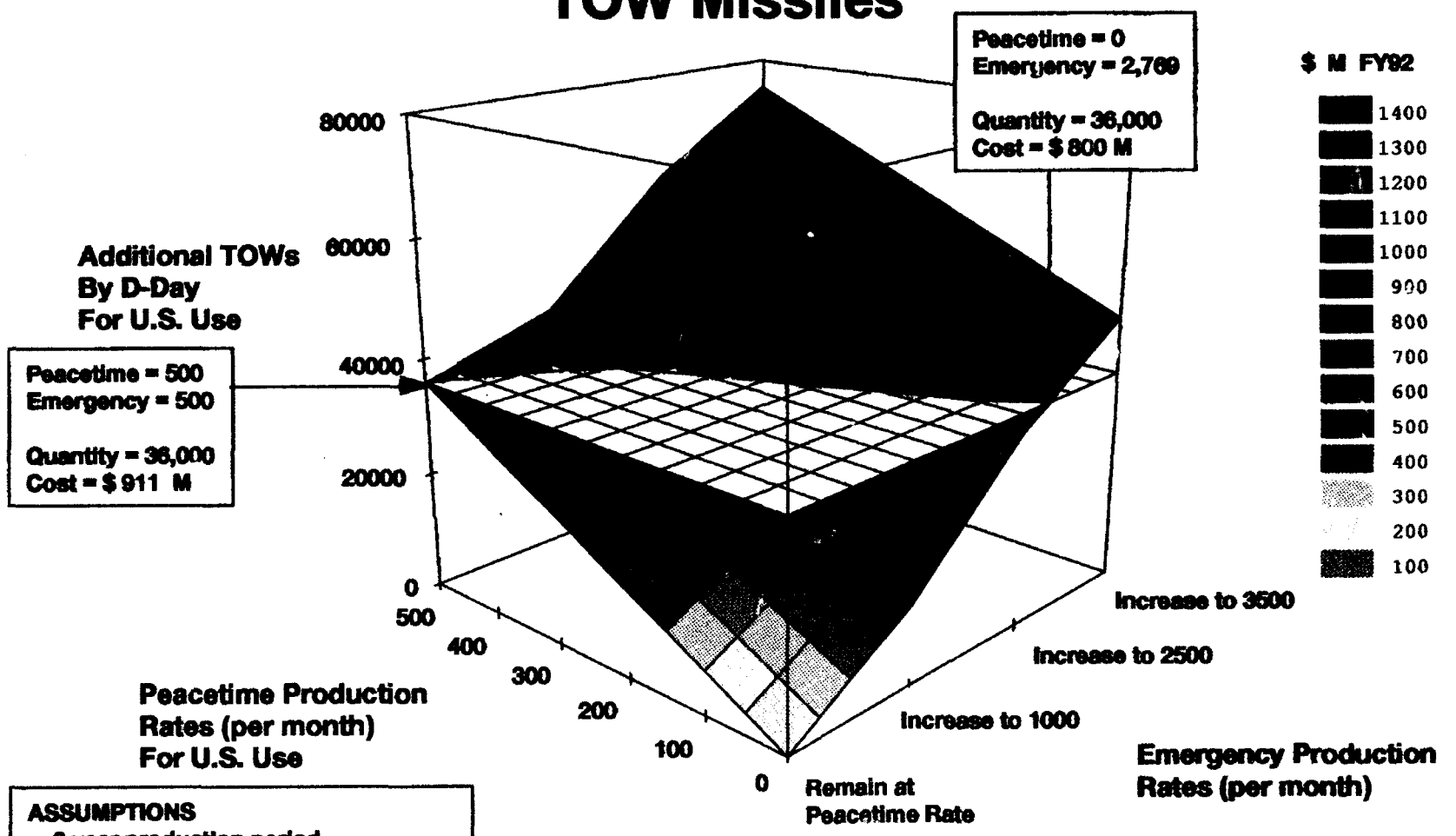
- The overall production period is 72 months long (beginning in October of 1993 and ending September 30, 1999).
- Warning is assumed to occur on April 1, 1998, and the warning period lasts for 18 months--until D-Day on October 1, 1999.
- Five full months of "extreme national emergency priority" ramp-up time (after warning) is assumed to be required in these cases in order to achieve the emergency production rate.
- No FMS is assumed in any of these (Figure III-5-1) cases (more on this later).
- Total costs are included in these estimates, including any restart and production costs during the warning/emergency period.

The 24 cases in Figure III-5-1 include four groups of six: a first six in which one of the six peacetime monthly production rates shown at the bottom left front of the Cube (0, 100, 200, 300, 400, and 500) is maintained through the entire 72 month period, i.e., no production "surge" occurs and production remains at the peacetime rate through the entire warning period; a second six cases in which each peacetime rate is maintained until warning and then production is increased to 1,000 units per month for the last 13 months of warning; six cases in which each peacetime rate is maintained until warning and then increases to 2,500 per month for the last 13 months of warning; and a final six cases in which the peacetime rate is maintained until warning and then a rate of 3,500 per month is achieved for the last 13 months of the 18 month warning period.

The cases displayed in Figure III-5-1 thus range from completely closing down the TOW 2 plants ("total shut down") throughout the period up to a plan to produce 500 missiles per month throughout the peacetime period and then, on warning, to increase to 3,500 per month. The total shut-down case (i.e., 0, 0) may be seen in the front bottom corner of the cube in Figure III-5-1, while the 500 per month in peacetime combined with mobilization up to 3,500 per month (500, 3500) can be seen in the far back upper corner of the Cube.

Cases 1 and 2, described below, are two of the many notional plans displayed in Figure III-5-1. A focus on these two can help illustrate the technique and demonstrate the value of systematically capturing assessments of contingency production capabilities in planning the POM.

# SAMPLE OPTIONS FOR POM 94-99
# TOW Missiles




**ASSUMPTIONS**
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- Foreign Military Sales = 0 / month
- No Emergency Supplemental Budget

Figure III-5-1

IDA November 24, 1991

## Case One: Produce 500 TOW 2s Per Month for 72 Months (36,000 TOW 2s, $911M)

Figure III-5-1 highlights this case (toward the bottom front left in the figure), and indicates (in the box) that such a plan would result in 72 x 500 or 36,000 TOW 2 missiles, at an estimated total cost of $911M (in FY 1992 dollars).

**Case One Calculations:** Table III-5-1 shows the quantity and cost calculations for this case. The TOW 2 quantity calculation is self-evident, i.e., 72 months at 500 missiles per month equals 36,000 additional TOW 2s. The cost calculation warrants some explanation. No data was available to estimate partial shutdown costs (See Appendix A for details). There are no restart costs, since a production rate of 500 per month is maintained over the whole period. Finally, the estimated unit production cost of TOW 2Bs at a production rate of 500 per month is $25,307 per TOW 2. No estimate was available for the fixed cost portion (variable by time (month)). The total production costs are $911M.

**Table III-5-1. TOW 2 Case One Calculations**

| | | | | |
|---|---|---|---|---|
| Quantity | | | | |
| Total Quantity | = 500 TOW 2s/mo x 72 month | | = 36,000 TOW 2s | |
| Cost | | | | |
| Production: | Unit | = $25,307/TOW 2Bs x 36,000 | = | $911M |
| Total | | | | $911M |

**Table III-5-2. Case Two Calculations**

| | | | | | |
|---|---|---|---|---|---|
| Quantity | | | | | |
| Peacetime | = 0 | TOW 2/mo x 54 mo | = | 0 | |
| Ramp Up | = 0 | TOW 2/mo x 5 mo | = | 0 | |
| Emergency | =2,769.2 | TOW 2/mo x 13 mo | = | 36,000 | |
| Total | | | | 36,000 | TOW 2s |
| Cost | | | | | |
| Layaway: | One time | = $52.4M | = | $52.4M | |
| | Monthly | = $1.5M/mo x 54 mo | = | $81.0M | |
| | | | | | $133.4M |
| Restart: | One time | | = | | $ 83.0M |
| Plant Investments | One time | | | | $ 43.0M |
| Production: | Unit | = $15020/TOW2 x 2769.2 x 13 mo | | = | $540.7M |
| Total | | | | | $800.1M |

### Case Two: Produce Zero Tow 2s During Peacetime and 36,000 During Emergency (36,000 TOW 2s, $800M)

By contrast, consider a second TOW 2 production plan (Case 2) where the peacetime (prewarning) monthly rate is 0 per month. On warning, however, the rate is increased to 2,769 as rapidly as possible. Again, assume warning occurs at the start of the 55th month of the production plan and that it is feasible to ramp-up to a production rate of just 2,769 by the start of the sixth month after warning, i.e., by the start of month 60. Figure III-5-1 displays this second case in the highlighted box showing that a total of 36,000 missiles would be produced at an approximate total cost of $800M (FY92$).

Table III-5-2 summarizes the calculations for this case. The additional 36,000 missiles in this case (as compared with Case 1) result from producing at the rate of just over 2,769 per month for the last 13 months of the plan as opposed to 500 missiles per month in each of those 13 months.

The cost of the 36,000 missiles in Case 2 can be explained as follows. Layaway costs include a one time cost of $52.4M and a variable cost for 54 months at $1.5M per month for a variable cost of $81.0M (54 x 1.5M). This makes the total layaway cost $133.4M. The restart cost is estimated as a one time cost of $83M. The production cost estimate only considers variable costs since no fixed monthly production cost estimate was available. There is an additional $43M in plant investment cost to allow the emergency production rate of 2,769 per month to be achieved.

## Examine Alternative Cases/Scenarios

Sample production plans have been developed and presented in this paper to show a range of ways that the Army could obtain additional TOW 2s that might be needed by D-Day in a hypothetical European theater (or other major) conflict. Several other kinds of cases and model features are described below.

### Foreign Military Sales

The TOW 2 cases shown in Figure III-5-1 offer a useful starting point for considering the cost impacts of Foreign Military Sales (FMS). Figures III-5-2 through III-5-4 depict the effects of a range of FMS (from 100, 200, or 300 TOW 2s per month) on the costs (to the U.S. taxpayer) of each of the cases described in Figure III-5-1. To illustrate, Figures III-5-2 through III-5-4 highlight the effects on Cases One and Two (from Figure III-5-1) of FMS sales at various levels per month. The cost of Case One drops from $911M (in Figure III-5-1) with no FMS, down to $834M (in Figure III-5-4) if FMS is maintained at 300 units per month until warning (Note that

FMS is assumed to be discontinued upon warning in all these sample cases). These savings stem from reduced peacetime unit production costs. Case Two's costs are reduced to $584 million (Figure III-5-4) because of the further elimination of layaway and start up costs with any level of FMS; i.e., the U.S. would pay for only the production costs of the missiles received.

### Funding Perspectives: Total Dollar Costs or POM Dollar Costs

Figures III-5-1 through III-5-4 have depicted all cases in terms of their U.S. total dollar costs in the POM 94-99 period. Figures III-5-5 through III-5-8 take a different funding perspective. They are identical to Figures III-5-1 through III-5-4, respectively, except that Figures III-5-5 through III-5-8 presume that a Supplemental Budget would be available to cover all plant restart and production costs after Warning Day. Under this assumption, it makes sense for decision makers to review alternatives in view of their relative POM dollar costs. A perspective of this sort thus permits the decision maker to look at POM dollar expenditure patterns in terms of their relative payoffs on "D-Day."

### Other Scenarios, Warning Times, Ramp-Up Times, Etc.

The model and display techniques can be applied to short-warning planning scenarios--such as a Major Regional Contingency (East)--as well. In those cases, which may be more likely than the long warning European contingency, the model (and the underlying data) is expected to show that the Army has no real options other than relying on TOW 2s already in inventory and, perhaps to a very limited extent, accelerating deliveries of any TOW 2s already on order for either the U.S. or for FMS and therefore "in the pipeline."

## CONCLUSIONS AND RECOMMENDATIONS

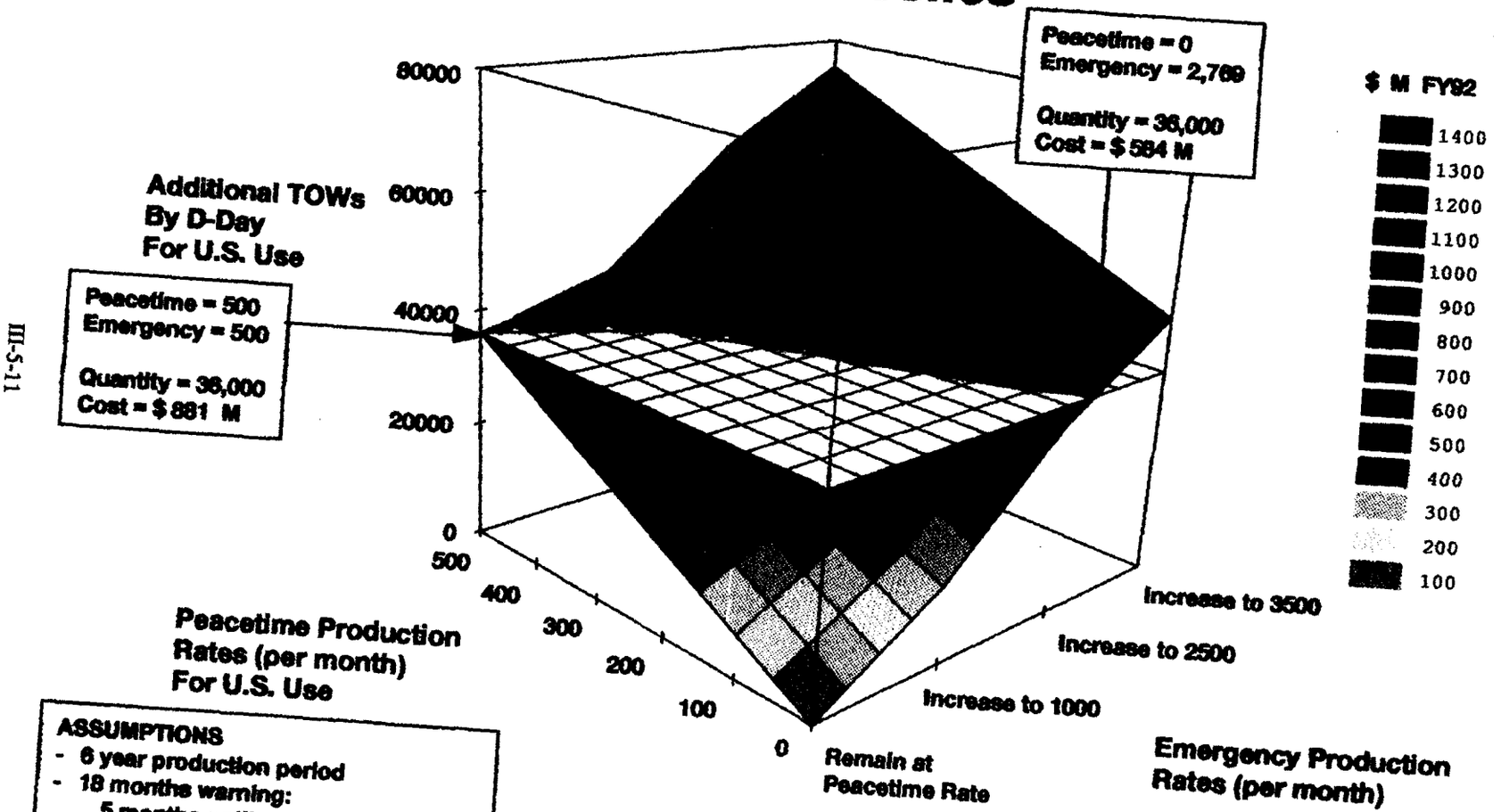
This paper presents an initial set of production options to meet potential demands for additional TOW 2Bs in the context of one of the Integrated Army Mobilization Study scenarios--a relatively long-warning European war scenario. The approach can be of use in assessing and depicting production possibilities for a range of planning scenarios in the 1990's. The production tradeoff methods illustrated here may be useful for other systems as well. They may also help provide practical insights concerning the costs and payoffs of various "hedging options" that the President has called for to flesh out a viable Reconstitution component of the National Security Strategy. More specifically, these methods could assist the Army in identifying concrete actions in its 1994-99 POM .

A cautionary note concerning these initial assessments does need to be struck. The relatively low unit costs of production estimated in some of the emergency cases, such as Case

Two (which make them look relatively more attractive from a cost standpoint) may be partially offset by rapid price inflation during such periods. A second caution in interpreting these numbers is that there is, unfortunately, still significant uncertainty as to the ramp-up times to emergency production rates and the layaway and restart costs. More often than not estimates that have been obtained through "normal" channels significantly underestimate what could be done to speed things up under real mobilization conditions. But when critical sub-tier suppliers start going out of business and when key skilled labor must shift to other jobs, ramp-up times could become quite long.

Good quality information on defense industrial capabilities is no less expensive to obtain than good quality information in many other areas and fields. Given the importance to the nation's security of building a prudent balance between on-hand assets and potential (mobilizable) power, IDA recommends that the Army (1) adopt an assessment and option development scheme of this kind for the upcoming POM, using the best available cost and production data concerning key systems; and (2) accelerate efforts to obtain data on key systems that is at least as good as that available for the Abrams tank (refer to IDA Working Paper of August 28, 1991, *Sample Tank Options for Army POM 94-99 Decisions*).

# SAMPLE OPTIONS FOR POM 94-99
# TOW Missiles

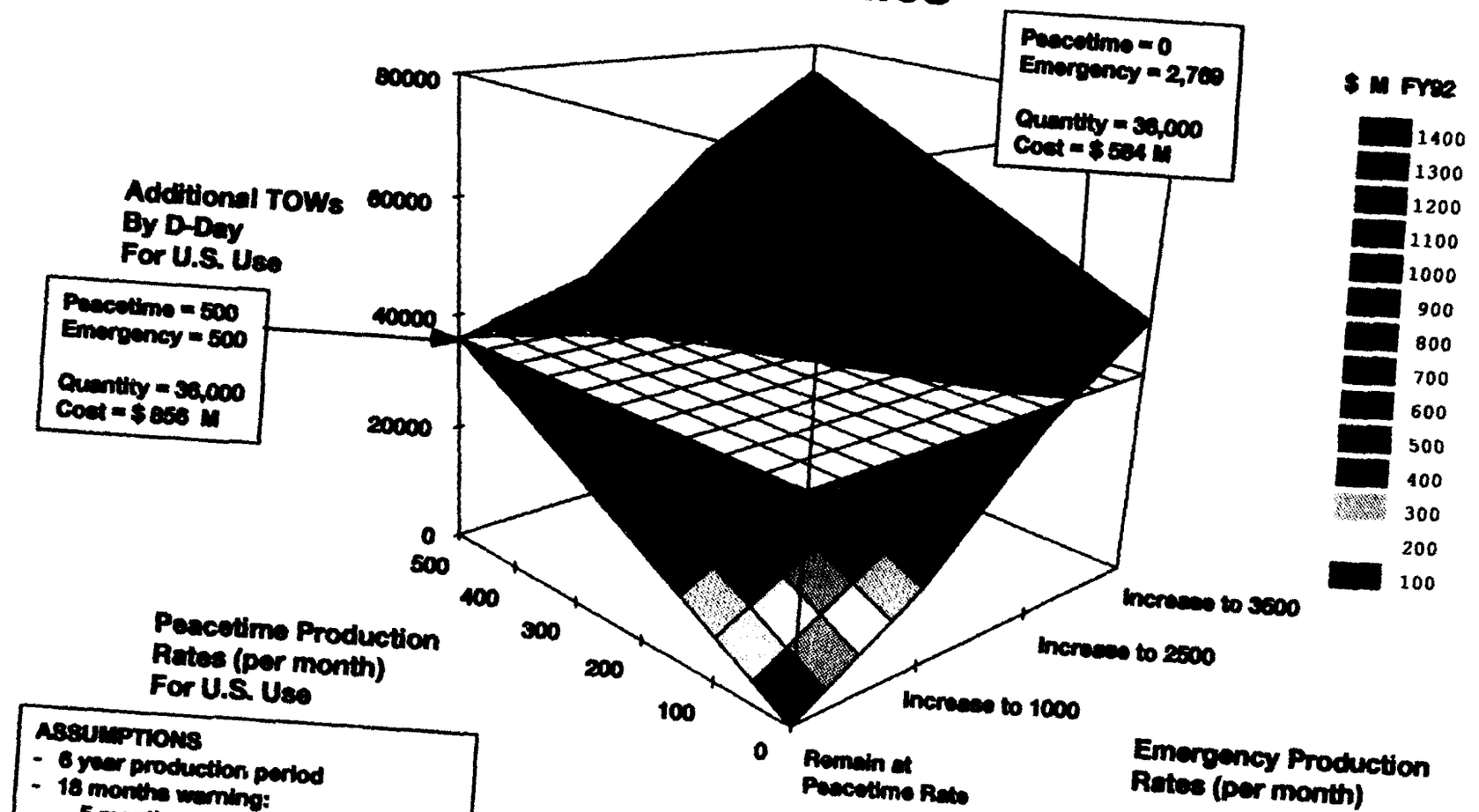



**ASSUMPTIONS**
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- Foreign Military Sales = 100 / month
- No Emergency Supplemental Budget

Figure III-5-2

IDA November 24, 1991

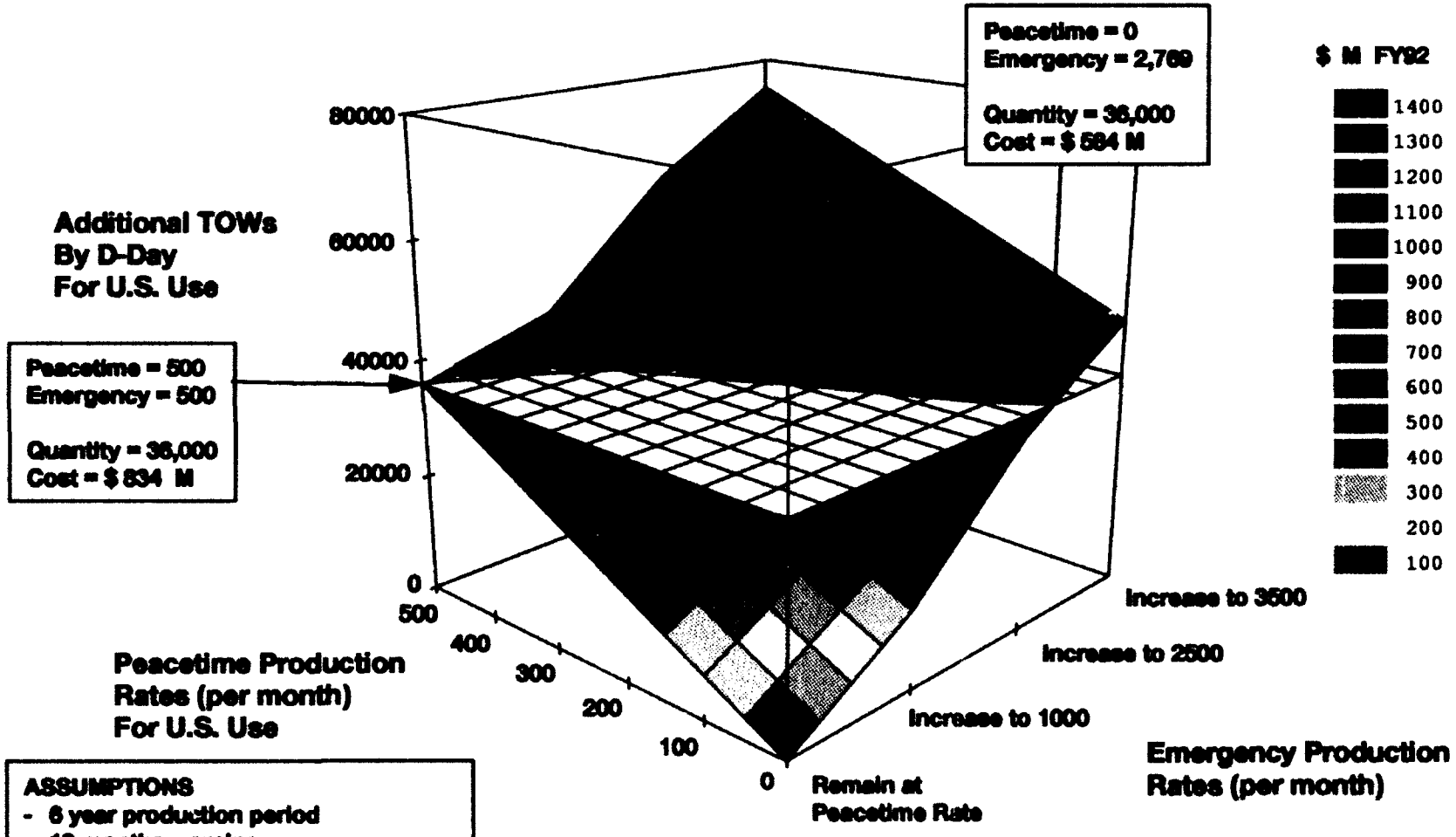
# SAMPLE OPTIONS FOR POM 94-99
# TOW Missiles




**ASSUMPTIONS**
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- Foreign Military Sales = 200 / month
- No Emergency Supplemental Budget

Figure III-5-3

# SAMPLE OPTIONS FOR POM 94-99
# TOW Missiles

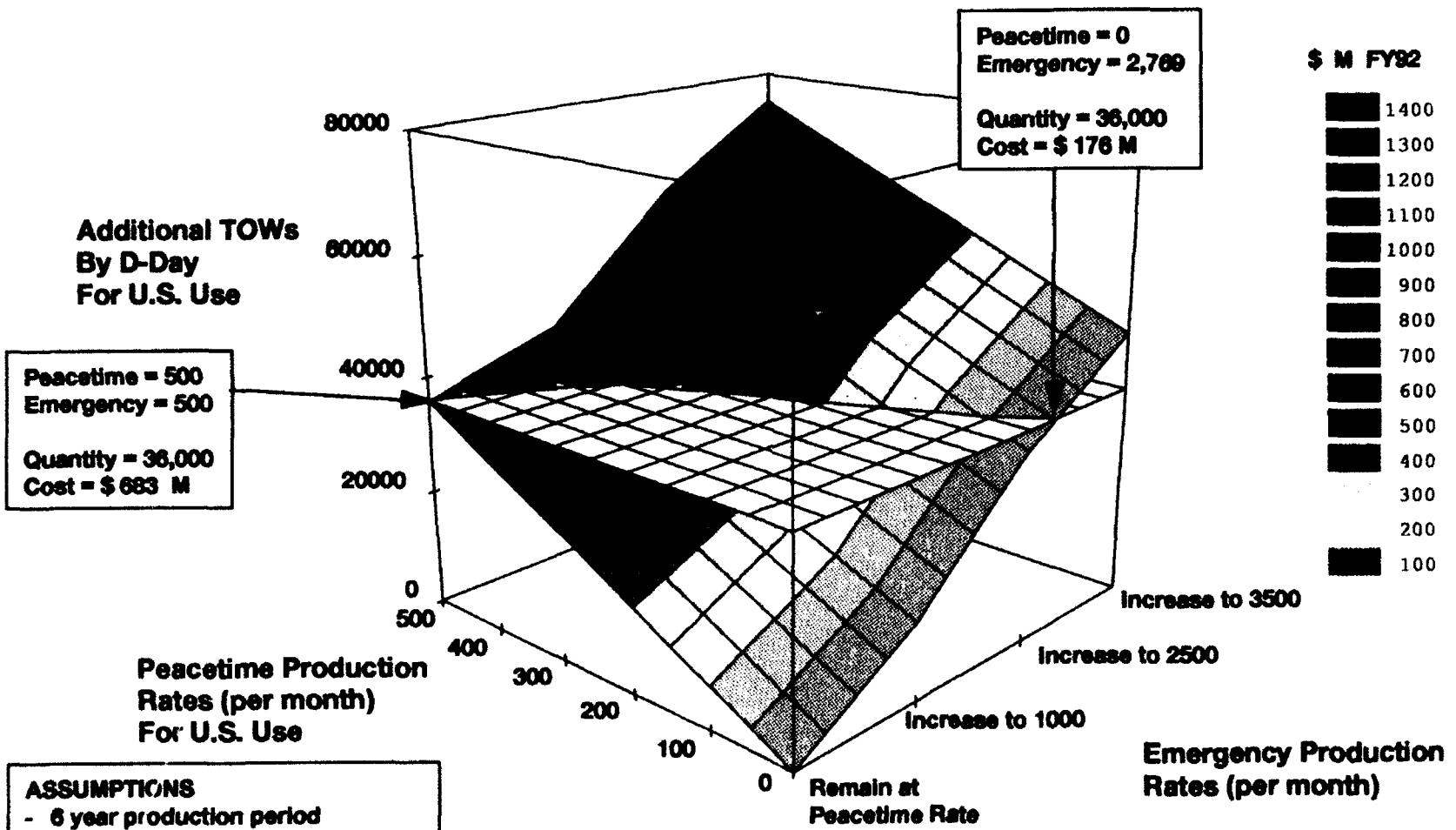



**ASSUMPTIONS**
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- Foreign Military Sales = 300 / month
- No Emergency Supplemental Budget

Figure III-5-4

IDA November 24, 1991

# SAMPLE OPTIONS FOR POM 94-99
# TOW Missiles

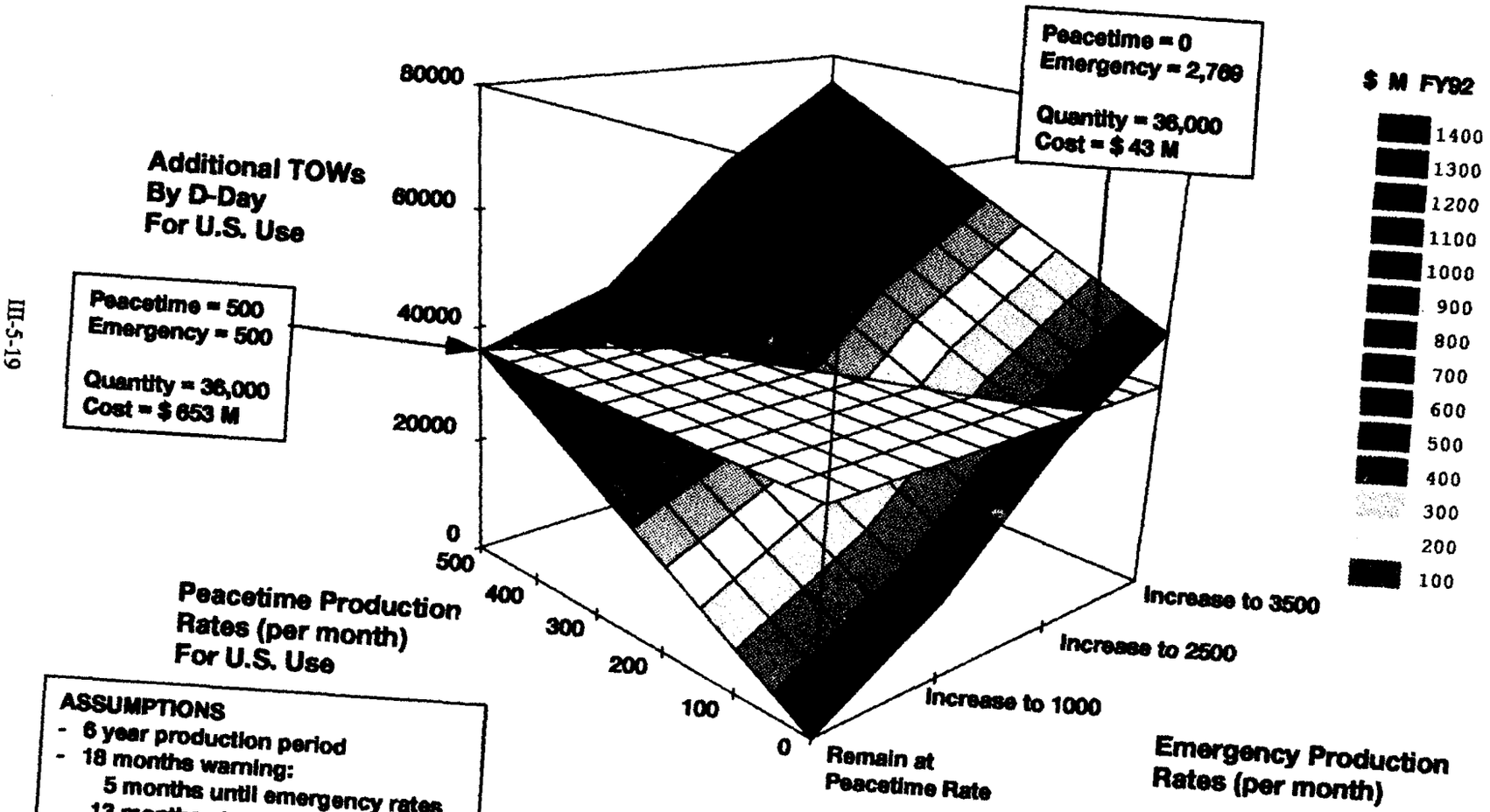



**ASSUMPTIONS**
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- Foreign Military Sales = 0 / month
- Emergency Supplemental Budget

Figure III-5-5

IDA November 24, 1991

# SAMPLE OPTIONS FOR POM 94-99
# TOW Missiles

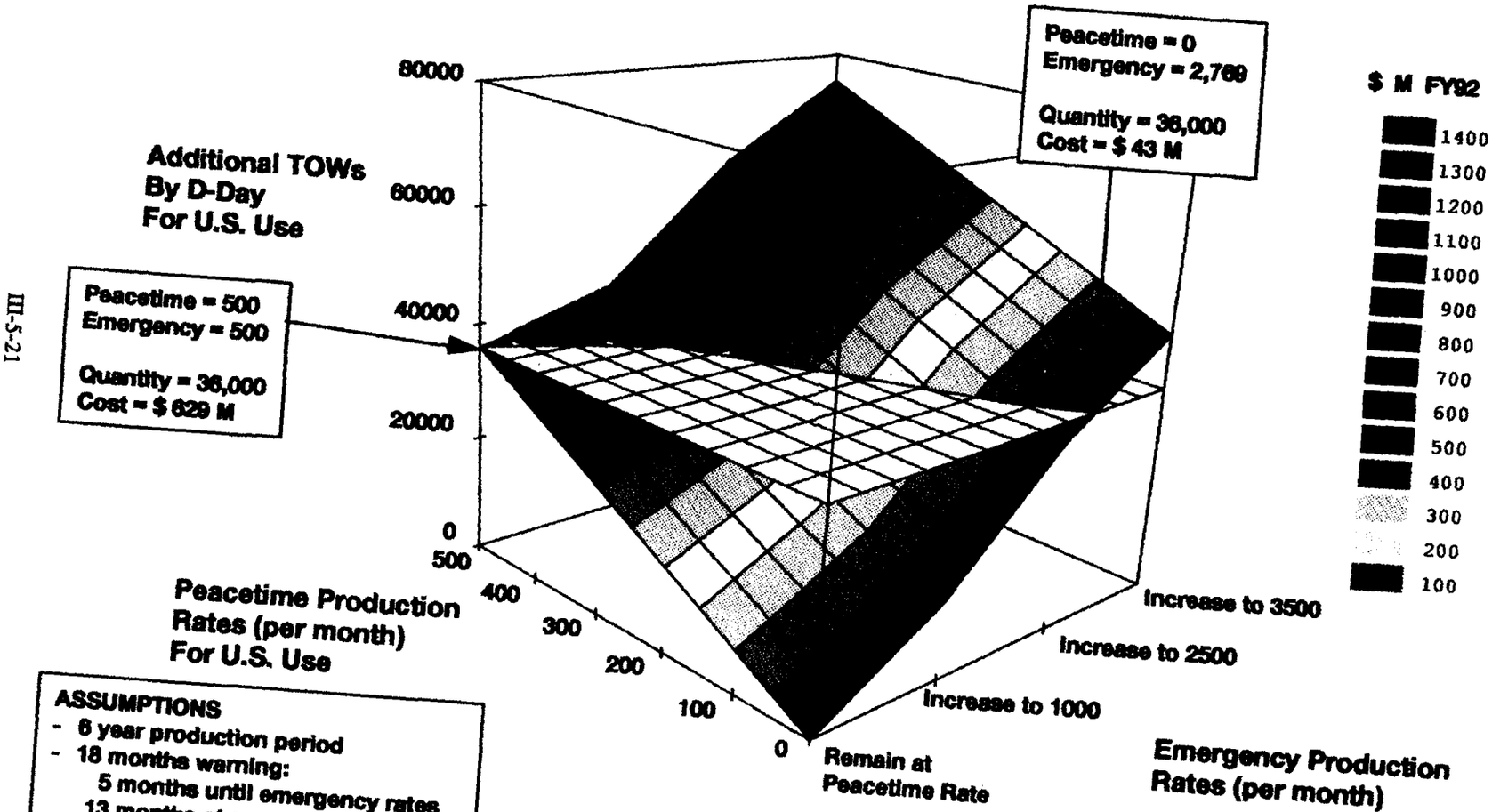



**ASSUMPTIONS**
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- Foreign Military Sales = 100 / month
- Emergency Supplemental Budget

Figure III-5-6

IDA November 24, 1991

# SAMPLE OPTIONS FOR POM 94-99
# TOW Missiles

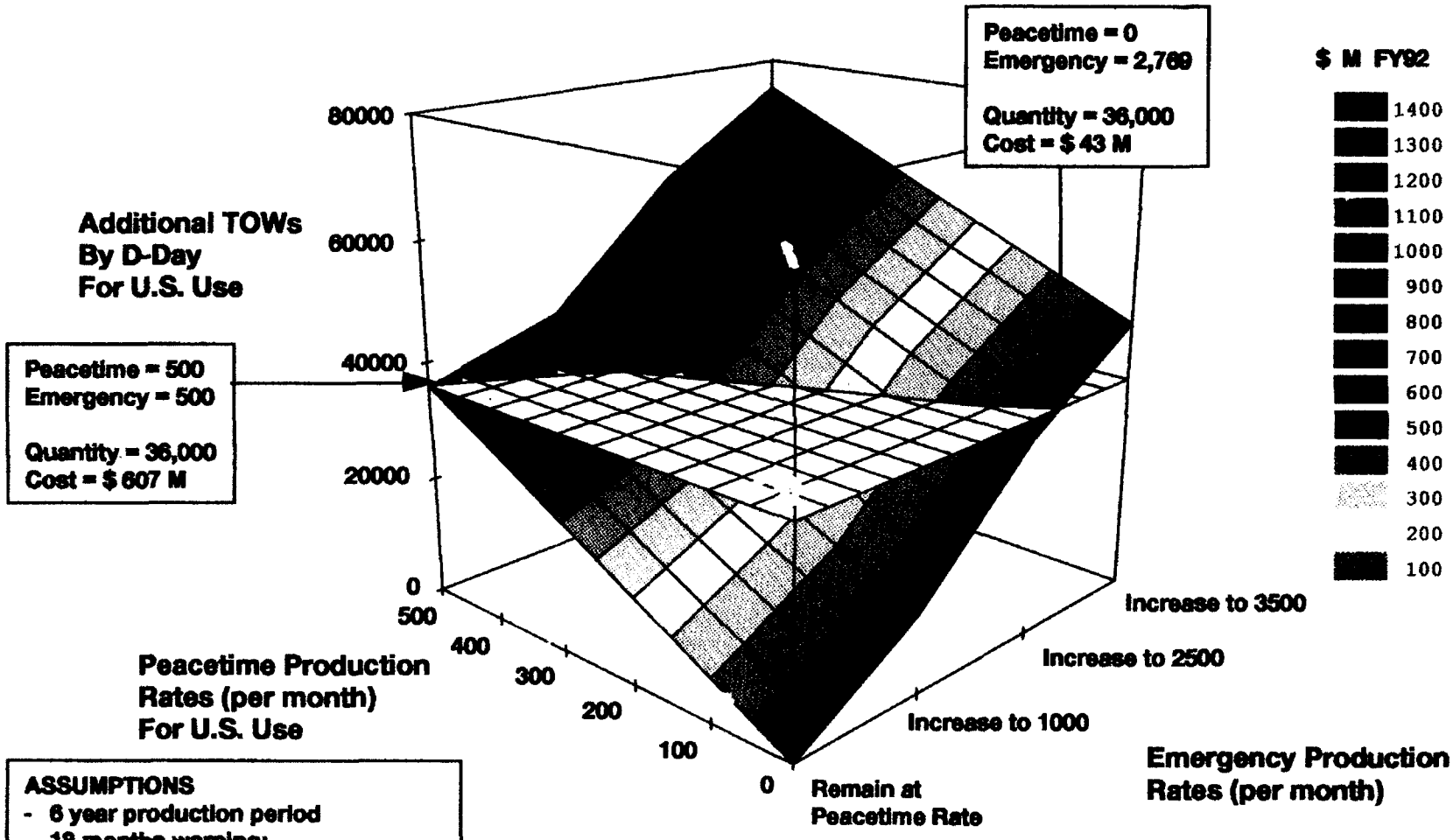



**ASSUMPTIONS**
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- Foreign Military Sales = 200 / month
- Emergency Supplemental Budget

Figure III-5-7

IDA November 24, 1991

# SAMPLE OPTIONS FOR POM 94-99
# TOW Missiles




**ASSUMPTIONS**
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- Foreign Military Sales = 300 / month
- Emergency Supplemental Budget

Figure III-5-8

IDA November 24, 1991

# APPENDIX A TO CHAPTER 5

# CAPACITY AND COST DATA TOW 2

## APPENDIX A TO CHAPTER 5

## CAPACITY AND COST DATA TOW 2

### SYSTEM DESCRIPTION AND BACKGROUND

Air Force Plant 44 in Tucson, AZ, operated by Hughes Aircraft Company (HAC), is the sole source producer of the TOW (Tube-Launched, Optically Tracked, Wire Guided) missile. The TOW consists of a family of anti-armor missiles which have been operational since 1970. The first improvement to the basic TOW was the Improved TOW (ITOW) which had a warhead which provided better performance against armor and featured a telescopic nose probe. The second change resulted in the TOW 2 which had a larger warhead, improved propellant, and improved guidance system. The TOW 2A added a small warhead to the nose probe. The TOW 2B is designed for top attack with two unique warheads. The missile flies over the target and a sensor triggers the system to shoot the two warheads into the top of the target.

### CAPACITY AND PRODUCTION RATE

The TOW is an excellent example of a system where the real capacity is governed by the capacity of sub-system and component suppliers rather than the prime contractor. The production forecast calls for TOW 2Bs, only, to be produced after 1991. The projected production rate is 1000 units per month. HAC's capacity for TOW airframes is 3,500 per month. However, the entire TOW 2 family (TOW 2, 2A, and 2B) use a common battery in the thermal beacon which is produced by Eagle Picher as the single source. The Eagle Picher capacity for that battery is stated to be 2,500 per month. The capacity for TOW 2B sensor assemblies and warheads at Thorn EMI (UK) and Aerojet-Azusa, respectively, is 1,000 per month. Both suppliers are sole sources.

Therefore, for TOW missiles based on limited current information,

- The capacity for TOW 2B is 1,000 units per month
- The capacity for TOW 2, 2A, and 2B, combined, is 2,500 per month.
- The capacity for all TOW missiles is 3,500 per month.

An uncited reference was made to an estimate of $9,600,000 to facilitize Thorn EMI and Aerojet to a capacity of 2,500 units per month for their respective components.

### COSTS

Unit Cost

The unit cost equations for the TOW 2/2A and the TOW 2B are

TOW 2/2A

$y = 101{,}380 - 22{,}819 \log x \quad R^2 = 0.815$

TOW 2B:

$y = 77{,}503 - 13{,}839 \log x \quad R^2 = 0.904$

where

y = unit cost, 1992 dollars

x = annual production rate

These equations, which are depicted in Figures III-5-A-1 and III-5-A-2, were derived from the data shown in Table III-5-A-1.

## SHUT-DOWN AND STARTUP COSTS

The information available in this area is preliminary and known by the program office to be somewhat contradictory. For that reason, the program office is eliciting further information from contractors and plans to update their analyses with these new data. For purposes of these sample options, we have drawn upon the latest available program office estimates at the time of our visit.

Based on memoranda and discussion with program office personnel, we have made the following assumptions concerning shut down and start-up costs. Newer and more complete data will result in improved cost estimates which may be readily incorporated into the analytical model.

It is recommended that, for this study, the following estimates of shut down and start up costs be used.

- The TOW plant is operated only on an "on" or "off" basis, i.e. shut down costs are incurred only when the production rate drops to zero and start up costs are incurred only when production resumes at any rate.
- The shut down cost estimate is $52.4 million non-recurring with a recurring maintenance cost of $1.5 million per month.
- The plant start up costs for a cold base, i.e. production rate is zero, is $83 million.
- We strongly recommend that additional research be made in estimating the shut down and start up costs of this system.

**Table III-5-A-1. TOW Cost/Quantity Data**

| Annual Production Rate | TOW 2/2A Unit Cost, 1989 Dollars | TOW 2/2A Unit Cost, 1992 Dollars 1) | TOW 2B Unit Cost , 1992 Dollars2) |
|---|---|---|---|
| 800 | 42,383 | 47,476 | – |
| 1,600 | 24,149 | 27,051 | – |
| 2,000 | – | – | 35,800 |
| 2,400 | 18,071 | 20,243 | – |
| 3,200 | 15,032 | 16,839 | – |
| 4,000 | 13,209 | 14,796 | 26,800 |
| 4,800 | 11,993 | 13,434 | – |
| 5,600 | 11,125 | 12,462 | – |
| 6,000 | – | – | 23,500 |
| 6,400 | 10,437 | 11,691 | – |
| 7,200 | 9,967 | 11,165 | – |
| 8,000 | 9,562 | 10,711 | 21,800 |
| 8,800 | 9,230 | 10,339 | – |
| 9,600 | 8,954 | 10,030 | – |
| 10,000 | – | – | 20,700 |
| 10,400 | 8,720 | 9,768 | – |
| 11,200 | 8,520 | 9,544 | – |
| 12,000 | 8,346 | 9,349 | 19,900 |
| 12,800 | 8,194 | 9,179 | – |
| 13,600 | 8,060 | 9,029 | – |
| 14,000 | – | – | 19,300 |
| 14,400 | 7,941 | 8,895 | – |
| 15,200 | 7,838 | 8,780 | – |
| 16,000 | 7,742 | 8,672 | 18,900 |
| 16,800 | 7,656 | 8,576 | – |
| 18,000 | – | – | 18,500 |
| 20,000 | – | – | 18,200 |
| 22,000 | – | – | 18,000 |
| 24,000 | – | – | 17,700 |
| 26,000 | – | – | 17,500 |
| 28,000 | – | – | 17,300 |
| 30,000 | – | – | 17,100 |

1) An inflation factor of 89.2716 (1992=100) was used. The calculation was: 1989 dollars x (100/89.2716)=1992 dollars.

The source of the inflation factor is Department of Defense, "Deflators (Purchases)", "Missile Procurement, Army", 17 January 1991.

2) As noted in the text, annual production rates of more than 12,000 units but less than 30,000 units would require an investment of about $9.6 million at the sub-contractor level.

Sources: TOW 2/2A: "TOW Minimum Sustaining Rate Analysis" STD TR89-263, SRS Technologies, Huntsville, AL., 23 May 1989. COMPETITION SENSITIVE

TOW 2B: Based on cost curve provided by TOW program office, 6 Aug 1991.

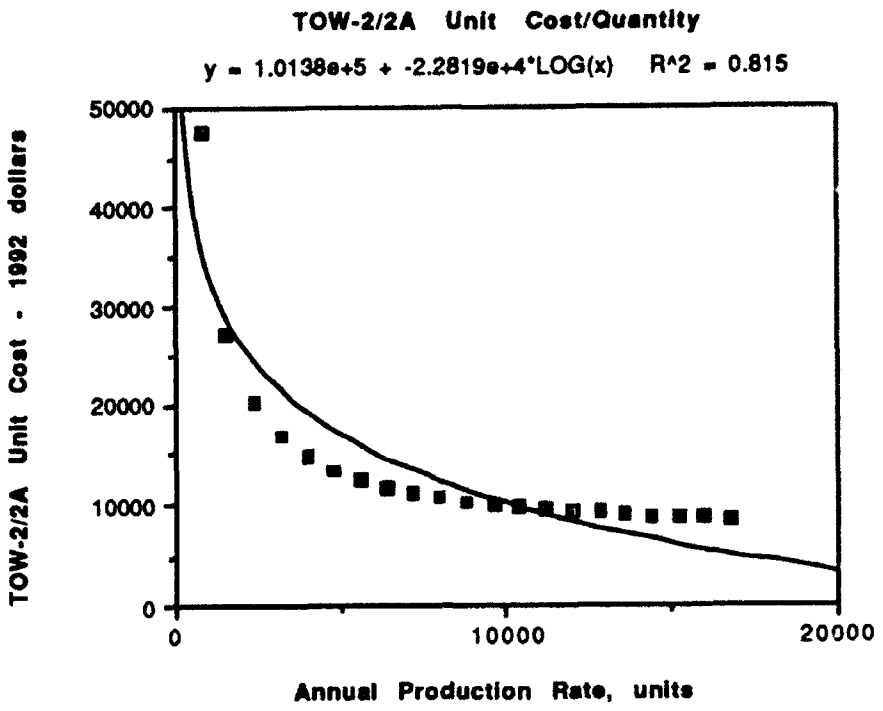



**Figure III-5-A-1. TOW 2/2A Unit Cost/Quantity**

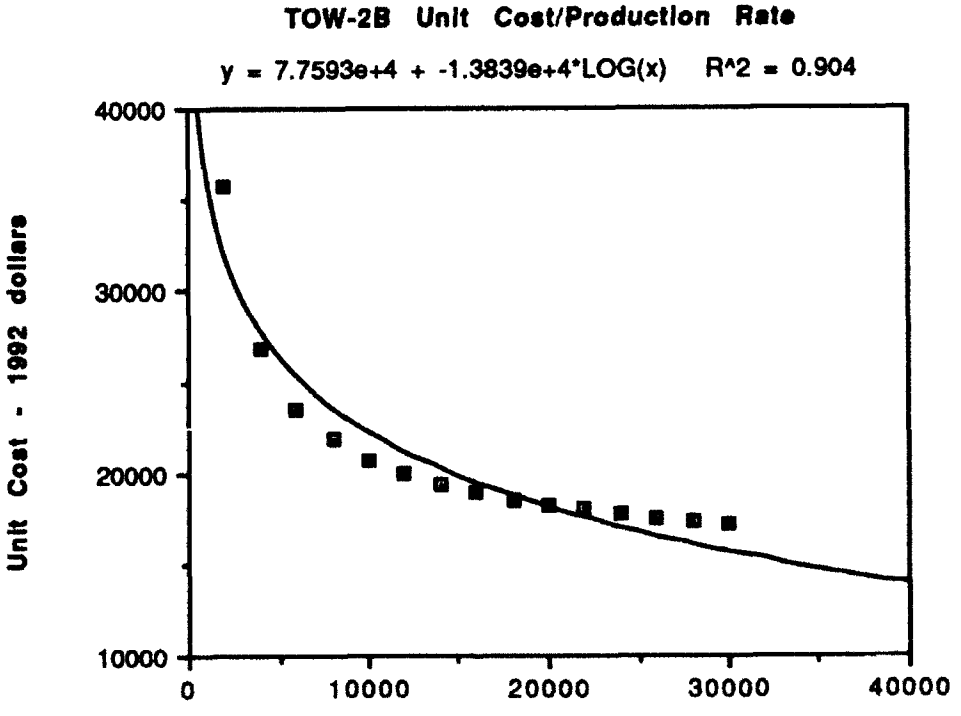



**Figure III-5-A-2. TOW 2B Unit Cost/Production Rate**

## INVENTORY VS. FACILITIZATION COSTS AND TRADEOFFS

Subsequent to our visit with program office personnel, the price of selected parts and sub-assemblies were obtained specifically,

| | |
|---|---|
| Thermal beacon battery (Eagle Picher) | $100 each |
| Sensor assembly (Thorn EMI) | $2,810 each |
| Warhead assembly (Aerojet) | $3,623 each |

This information may be helpful in determining an optimum tradeoff between stockpiling critical parts in anticipation of mobilization versus facilitizing suppliers to meet a higher production rate goal during mobilization.

# APPENDIX B TO CHAPTER 5

# INVESTMENT TRADEOFF METHODOLOGY

## APPENDIX B TO CHAPTER 5

## INVESTMENT TRADEOFF METHODOLOGY

The investment tradeoff methodology was designed to provide the decision maker a new capability for performing complex assessments involving several factors, where there are several criteria on which the evaluations may be based.

For the case study developed for this paper, the problem was framed in terms of factors that the decision maker might possibly control, and factors that are represented as planning estimates but which are not decision options. In the former category are 1) the peacetime production rate for the system, 2) the ultimate surge capacity for the system, and 3) the amount of Foreign Military Sales (FMS). In the latter category are: 4) the amount of warning time before D-Day, 5) the amount of ramp-up time required to achieve the emergency production rates (given warning), and 6) whether the monies expended during the warning period for surging the production are supplied by an emergency supplemental budget.

For both categories of factors, parametric variations over a range of possible values were explored. This approach was thought to be helpful in discovering those situations where one's externally based cost or quantity requirements were satisfied.

For specific values of each of the above factors (e.g., for a given peacetime production rate, with an assumed surge capacity, coupled with a specific warning time, etc.), it is possible to determine how many systems would be produced at various times, and what would be the cumulative costs. The quantity calculation is straightforward. The cost calculation involves several factors, only a few of which have been addressed here.

As discussed above, the following factors enter the cost calculus:

- The cost to layaway the plant. There are both fixed and variable portions of this cost component.
- The cost to surge to the emergency production rate. Degenerate cases may occur, e.g., do not decrease from the current level, or do not surge at all.
- The unit production cost. This depends on the number of units produced per month.

A computer model was created to carry out the arithmetic. While the source data were discrete, there were enough data points to allow a cost equation to be developed for each of the above factors. The model is based on these equations. To illustrate the calculations, a specific example is carried out in Appendix C.

The final element of the tradeoff methodology is a new technique for quickly and flexibly depicting the results of varying several decision variables jointly. This display technique, which shows the results for a matrix of options in terms of surfaces, is what generated the figures in the main section of this paper.

The reader or analyst should note that the display technique connects discretely calculated points with a straight line. Thus, the figures show a surface consisting of intersecting planes even though the cost equations are non-linear and continuous and investments occur at specific points or along specific lines. As the methodology gains wider use, this discrepancy can be resolved by calculating a larger number of discrete points at shorter intervals, eventually approaching the more correct depiction of a curved surface.

# APPENDIX C TO CHAPTER 5

# TOW 2 SAMPLE RESULTS

## APPENDIX C TO CHAPTER 5

## TOW 2 SAMPLE RESULTS

### OVERVIEW

The investment tradeoff methodology was used to conduct an initial illustrative analysis of some key factors being considered by the TOW 2 program. One sample tradeoff analysis is to determine which investment strategies yield a given quantity of TOW 2s by a given time. For example, which strategies of investment would produce 36,000 TOW 2s by a hypothetical D-Day, where D-Day is assumed to be 6 years in the future?

Using the calculus outlined above, one finds there are three basic strategies:

- Produce at approx. 500 per month ; do not surge Cost = $911M
- Produce at approx. 200 per month, surge to 1,860 per month Cost = $795M
- Produce at approx 0 per month, surge to 2,769 per month Cost = $800M

If Foreign Military Sales are assumed, at the level of 300 per month, (where the FMS units are not available to the U.S.), then these three strategies now cost $834, $736, and $584M respectively.

Lastly, the effect of funding the surge actions using an emergency supplemental budget are explored. The effect is to make all actions which occur after warning occurs cost zero. In this case, the strategies cost $683M, $343M, and $176M respectively. A level of FMS of 0 per month is assumed here.

To place these in a broader context, and to allow comparison among cases at different quantity and cost levels, the tradeoff methodology explored parametric variations of several factors. The results are depicted in Figures III-5-1 through III-5-8. To introduce these somewhat complex results, a specific example is given first.

### A SAMPLE CALCULATION

As a basis for understanding the quantities and costs shown in the color plots, a specific example of one investment option will be discussed. This one case corresponds to one of the points annotated in Figure III-5-1 on page III-5-5.

This example assumes the peacetime production rate has been decreased to 0 TOW 2s per year, and that the possible surge capacity is up to 3,500 per month. Furthermore, a 6 year (72

month) period is assumed prior to D-Day, with warning occurring 18 months beforehand. There are thus 54 months of peacetime production, a ramp-up period (assumed to be 6 months long, and in which production remains at 0 units per month) followed by 13 months of production at the emergency rate of 2,769.2 units per month (it is assumed that the surge rate is in effect at the end of the ramp-up period, i.e., at month 60).

The total quantity produced by D-Day (month 72) is 36,010. This calculated by combining:

| | | | | |
|---|---|---|---|---|
| 54 months | x | 0 | = | 0 |
| 5 months | x | 0 | = | 0 |
| 13 months | x | 2,769.2 | = | 36,000 |
| Total | | | = | 36,000 |

The cumulative costs, through month 72 are $800 million. The calculation is as follows: $52.4M plant closure costs, $81M variable layaway costs, $83M restart costs, $43M surge capacity investments and $541M unit production costs.

## THE EFFECT OF FOREIGN MILITARY SALES AND THE USE OF AN EMERGENCY SUPPLEMENTAL BUDGET

To evaluate the effects of varying production rates, FMS, and scenario factors, a computer program first generated the quantity and cost results for each possible combination. Six dimensions were varied: peacetime production rate, emergency production rate, FMS rates, whether there was an emergency supplemental budget, ramp-up time (to the emergency rate), and warning time.

Tradeoffs were assessed by first comparing the tradeoffs among peacetime and emergency production rates. By placing these two factors on the x and y axes, one obtains a matrix of options. Figure III-5-1 shows these factors as the two horizontal axes. For each option (i.e., a combination of the two rates), the model calculates how many TOW 2s were produced, say, by D-Day, and what was the cumulative cost.

To show both the quantity and cost for each option in the matrix, the Graphical Analysis System (developed by IDA) was used. This system can create a surface by connecting 'heights' above a grid of points. Viewing the matrix of options as a horizontal grid, one now has a surface showing the quantities produced for the options shown. In the example above, one would have a height of 36,000 above the case of 0 combined with 2,769. See Figure III-5-1.

The value in this approach is two-fold. First, in Figure III-5-1, one now has four factors easily represented -- x axis, y axis, height and color. Second, one can compare this set of

tradeoffs, which involved no FMS and no emergency supplemental budget, with cases in which both of these assumptions are varied. This is done in Figures III-5-5 through III-5-8.

Figures III-5-1 through III-5-4 depict the cases where FMS varies as 0, 100, 200, and 300 units per month, respectively, and in which there is no emergency supplemental budget. Figures III-5-5 through III-5-8 show the same FMS variations, but with the assumption of an emergency supplemental budget.

## CONCLUDING REMARKS

One may approach these illustrations of the methodology from two other perspectives. First, one may depict an equal quantity curve on one of the surfaces. For example, the curve at height 36,000 in Figure III-5-1 passes through several cost values, depending on whether one has a high surge capacity or not.

Second, these figures may be used to ask: What options would fit within an overall budget ceiling, and under which set of assumptions. Here, one could pick a dollar amount, find the corresponding color, and rapidly determine which options remained at that color (or 'less').

# APPENDIX D TO CHAPTER 5

# OVERVIEW OF THE IDA CONTRIBUTION TO THE IAMS STUDY

# INTEGRATED ARMY MOBILIZATION STUDY

## OVERVIEW OF CONTRIBUTION BY THE

## Institute for Defense Analyses (IDA)

### OBJECTIVE

- Develop tradeoff methodology and options for Army POM 94-99 (for selected systems) that combine alternative plant status, procurement, ramp-up, capacity and cost elements to best satisfy stated Army requirements.

### CANDIDATE SYSTEMS

- AH-64
- MLRS
- Abrams Main Battle Tank
- TOW2

### APPROACH

- Obtain Information from Program Offices
  - Programmatic Policy Options
  - Most Current Production Bottleneck/Cost Data
  - Major subcontractor information
  - Plant closure/restart data
  - Key data limitations
- Build Strawman Issue-Option Papers for Each System
- Revise/Refine for POM Assessments with feedback from Key participants

### STATUS

- Methodology Developed and Briefed
- All Program Offices have been visited, available data compiled and data gaps identified
- Tank option paper submitted August 28, 1991
- TOW and other Option packages in preparation to meet overall study schedule

# APPENDIX E TO CHAPTER 5

# TOW PROCUREMENT PLAN

# APPENDIX E TO CHAPTER 5

# TOW PROCUREMENT PLAN

**Table III-5-E-1. TOW Procurement Plan**

| Year | ITOW | TOW2/2A Retrofit | TOW2A | TOW2B | Total |
|---|---|---|---|---|---|
| 1991 | 671 | 5,315 | 15,478 | 2,406 | 23,870 |
| 1992 | 557 | 7,184 | 1,717 | 8,535 | 17,993 |
| 1993 | – | – | – | 12,000 | 12,000 |
| 1994 | – | – | – | 12,000 | 12,000 |
| 1995 | – | – | – | 12,000 | 12,000 |
| 1996 | – | – | – | 12,000 | 12,000 |

Source: DoD Multi-Service Study Team, "Multi-Service Production Planning Schedule Feasibility Study," May 1991, U.S. Army Industrial Engineering Activity.

Note: 1991-92 data are contract data, 1993 and beyond are forecast data.

# APPENDIX F TO CHAPTER 5

# CORRESPONDENCE AND VISIT

## APPENDIX F TO CHAPTER 5

## CORRESPONDENCE AND VISIT

### PROPOSED AGENDA

### Meeting with Program Office Personnel for TOW-2 Systems

Note: The following agenda is a general one. It may be modified according to the unique characteristics of a specific system or contractor. The topics are listed for a general discussion rather than a specific presentation.

A. Background and Overall System Information

1. Purpose of the task
2. System description
   a. Physical characteristics
   b. Subsystem and major components

B. Production Capability Information - Prime Contractor and Major GFE Contractors.

1. Provide a "line-of-balance" diagram
2. Provide the approved production plan
3. Identify each step in the production process and, for each step note
   a. the shift usage (1-8-5, 2-8-5, etc.) to meet current production rate
   b. the standard labor hours per unit produced
   c. the actual labor hours per unit produced
   d. the standard machine hours per unit produced
   e. the actual machine hours per unit produced
   f. the current percent of shift capacity utilized
4. Identify the actual size as it may be used at various stages in the production process.
5. Identify the production, test, and quality control process steps which may be eliminated or modified to increase production rate but maintain short term quality standards.

6. For each step noted in B.3. above, estimate the total monthly production capability assuming that materials, components and supplies would be available when needed and that all work stations are manned on a 3-8-7 shift basis.

7. Based on the highest production capability rate noted in B.6. above, estimate the equipment investment cost needed for each other process step noted in B.3. above to raise that process capability to the highest value noted in B.6. If another process step cannot be expanded without exceeding its brick-and-mortar capacity, repeat this step using the lower brick-and-mortor capacity as the new maximum capacity and note the change.

C. Subcontractor and GFE Information.

1. Provide the approved procurement plan

2. Procurement characteristics

   a. List foreign-source items and procurement lead times

   b. List critical components and procurement lead times

   c. List single - source components and procurement lead times

   d. List sole - source components and procurement lead times

   e. List long - lead times and their lead times.

3. Procurement history, current operations, and future plans (including production for FMS and all Services).

   a. Total system prime contractors and integration facilities.

      1. List all parts, current and planned prime contractors and system integration facilities.

      2. Provide monthly production for previous 12 months for current contractors and facilities noted in C.3.a.1., above.

   b. GFE

      1. Identify subsystems and components supplied to the prime contractor or integrating facility as GFE. Provide name and address for each.

      2. For each integrator noted in a.1., above, provide the current procurement lead time and the program office's opinion concerning the supplier's capability to supply the material needed to achieve the highest system production rate noted in B.7., above.

D. Cost Information: The following should be supplied for each Prime contractor, Major Integrating Facility and Major GFE Contractors.

1. Unit costs: Estimate the fixed and variable unit costs at

   a. Current production rates

   b. One-half current production rate

   c. One-third current production rate

   d. One-fourth current production rate

   e. One-tenth current production rate

   f. A production rate of one unit per month

   g. A production rate of the highest value used in B.7., above.

   h. If current production equals 0, provide items a. through f., above, using the highest value used in B.7., above, as the current production rate.

   i. At most efficient current design rate.

2. Layaway costs: Estimate the total one-time and recurring costs incurred in plant layaway to maintain the maximum current production capability at an average on-going production rate of

   a. Zero

   b. One-tenth current production rate

   c. One-fourth current production rate

   d. One-third current production rate

   e. One-half current production rate

3. Restart Costs: Estimate the total fixed costs in current for plant restart to increase the production rate from each rate noted in D.2., above to

   a. Current production rate

   b. Current production capability noted in B.7., above.

E. Summary

Review information provided above noting any apparent inconsistencies and adding important observations and information not noted above on prime contractor and lower tiers.

# IDA VISIT TO
# TOW PROGRAM OFFICE

**6-7 AUGUST 1991**

## IDA VISITORS

James Thomason

Richard Cheslow

## PRIMARY CONTACTS

| | |
|---|---|
| Bourque, Betty, J. | SFAE-TO-M-F |
| Cruce, James | AMSMI-RD-SE-IO-IS |
| Guttensohn, Arthur | SFAE-FS-TO-M-P |
| Lawson, Gary | TOW-P |
| Olson, Robert | AMSMI-RD-SE-IO-IS |
| Smallwood, Gary | SFAE-TO-M-F |

# APPENDIX G TO CHAPTER 5

# PROGRAM HIGHLIGHTS

## APPENDIX G TO CHAPTER 5

## PROGRAM HIGHLIGHTS

**Selected Acquisition Report (RCS: DD-COMP (Q&A)823)**

**December 1990**

**Program: TOW 2**

| | |
|---|---|
| September 1978 | TOW 2 Program Go Ahead |
| 1979 | TOW 2 missile contract developed under a product improvement program |
| September 1983 | TOW 2 Initial Operational Capability |
| December 1984 | TOW 2A, enhancement to the TOW 2 missile, to counter the reactive applique armor threat. This added a tip charge to the probe, a redesigned safe and arming device and an electronic timing device to provide delay between the tip and main charge functions. Additional ballast was added to the aft end of the missile to accommodate the extra weight resulting from the probe improvements. |
| FY 86 Buy | Acquisition of TOW 2A accomplished as an Engineering Change Proposal to the missile production line. |
| September 1987 | TOW 2A Initial Operational Capability |
| September 24, 1987 | TOW 2B fly-over shoot-down missile version development contract awarded. |
| July 1989 | Second Source Educational Buy Contract Awarded. Second source effort terminated by direction of the Office of the Secretary of Defense. |
| February 16, 1990 | FY 90 TOW 2A missile contract awarded for 7,297 Army missiles. |

| | |
|---|---|
| August 1990-Jan 1992 | Deliveries scheduled for FY 90 TOW 2A contract |
| October 3, 1990 | TOW 2B development test/operational test completed. |
| November 16, 1990 | TOW 2B production in-process review held. Approval was given for Type Classification limited production for 2,406 missiles for FY and 10,946 for FY 91. |
| December 21, 1990 | An Engineering Change Proposal to the FY 90 contract added 2,406 TOW 2Bs. Initial delivery will be March 1991 with 800 per month beginning August 1991. |
| Classified | TOW 2B Initial Operational Capability |
| March 1991 | TOW 2 Retrofit Phase I Missile Deliveries |
| Classified | TOW 2 Retrofit Phase II Missile Deliveries Begin |
| May 1989 | TOW Sight Improvement Program (TSIP) Program Go-Ahead |
| May 1991 | TSIP FSD Contract Award. |

# THE TOW WEAPON SYSTEM

## FIVE MISSILES (525,000 PRODUCED; 237,000 FOR INTERNATIONAL CUSTOMERS)

- BASIC TOW _ _ _ _ _ _ _ _ _ _ FIELDED 1970
- ITOW _ _ _ _ _ _ _ _ _ _ _ _ _ FIELDED 1981
- TOW 2 _ _ _ _ _ _ _ _ _ _ _ _ FIELDED 1983
- TOW 2A _ _ _ _ _ _ _ _ _ _ _ _ FIELDED 1987
- TOW 2B _ _ _ _ _ _ _ _ _ _ _ _ EARLY PRODUCTION

## LAUNCH PLATFORMS

- 14,164 USA AND USMC
  - 388 M113/TRIPOD
  - 3139 HMMWV (1,117 USMC)
  - 2,758 ITV/LAV (96 USMC)
  - 6724 BRADLEY
  - 1,155 M65 (78 USMC)

- 7,343 INTERNATIONAL (40+ COUNTRIES)
  - 6,931 GROUND LAUNCHERS ON VARIETY OF VEHICLES
  - 412 M65 SYSTEMS:
    - AH COBRA
    - 500 MD
    - LYNX
    - AUGUSTA

NOTE: 2300 BASIC BRADLEY

[redacted]TSIP[redacted]TOW PO[redacted]

0890-02/11

# CHAPTER 6

# SAMPLE MLRS OPTIONS FOR ARMY POM 94-99 DECISIONS

## INTRODUCTION

In preparing its FY1994-99 Program Objective Memorandum (POM), the Army is building production plans for a variety of combat systems. The magnitude of impending budget cuts and program terminations puts a premium on identifying innovative ways to maintain/restore the capability to meet potential future U.S. needs for battlefield combat power. President Bush has recently highlighted the importance of such efforts -- by making Reconstitution a key part of *The National Security Strategy of the United States* (August 1991):

> Beyond the crisis response capabilities provided by the active and reserve forces, we must have the ability to generate wholly new forces should the need arise....The ability to reconstitute is what allows us safely and selectively to scale back and restructure our forces in being. This difficult task will require us to invest in hedging options whose future dividends may not always be measurable now. It will require careful attention to the vital elements of our military potential: the industrial base, science and technology, and manpower....We and our allies must be able to reconstitute a credible defense faster than any potential opponent can generate an overwhelming offense.

As a part of the Integrated Army Mobilization Study (IAMS), and to help the Army frame resourcing options for several planning scenarios in the POM 94-99 time frame, the Institute for Defense Analyses (IDA) has developed a means of assessing cost/quantity production tradeoffs for key weapons systems. IDA is compiling data and preparing production tradeoffs for four systems: the Abrams tank, the Apache helicopter, the TOW missile, and the Multiple Launch Rocket System (MLRS). Each program office was visited, and data are now being assessed. This paper describes the basic tradeoff technique and then illustrates it with data for the MLRS rocket using material that has been reviewed with the MLRS Program Manager (PM), and his staff. The paper concludes with a recommendation that this approach be used to develop options for the Army's POM 94-99.

## TWO QUESTIONS

Two key IAMS questions are as follows:

- Would currently projected U.S. MLRS rocket assets suffice to meet battlefield objectives as stipulated in a long-warning European scenario occurring at the end of the POM 94-99 period?
- If not, what are some of the Army's major alternatives to meet these needs?

IAMS advisors have tasked U.S. Army's Concepts Analysis Agency (CAA) to provide estimates on the first question. The next section provides some initial assessments by IDA that may help address the second.

## APPROACH

### Collect Production, Planning and Inventory Data

MLRS supplements cannon weapons available to division and corps commanders for the delivery of large volumes of firepower over a very short time. The system consists of an MLRS launcher produced by LTV Corp. at Camden, AR and Dallas, TX, two disposable pods containing six M77 rockets each, all produced by LTV at Camden, and a Bradley Fighting Vehicle (BFV)-derived carrier produced by FMC Corp. at the San Jose, CA plant. The future plans are described in Appendix A.

Table III-6-A-1 of Appendix A shows the procurement plans (U.S. only) as of 1 July 1991. The FY 1992 procurement will result in the Army Acquisition Objective (AAO) being achieved in FY 1994.

The inventory of MLRS rockets is a significant military asset for conflicts in the 1990s. The shelf life of the existing inventory of MLRS rockets is a consideration. (Refer to Appendix A for a further discussion.)

The production capacity for the launcher is estimated by LTV to be seven per month, under the current firm fixed price contract.

The rocket production capacity is estimated by LTV to be 86,000 per year, under the current firm fixed price contract. However, two additional bits of information were:

- A sustained rate of 72,000 (12,000 pods) rockets was actually achieved on a 2-8-5 shift basis, and
- The automated portion of the rocket production line is set to produce at a rate of 1,200 rockets per week on a 2-8-5 basis.

Based on this information, it is recommended that the M77 rocket capacity at Camden be considered to be 86,000 per year at current price levels and 93,600+ per year (1,800 rockets per week on a 3-8-5 shift basis times 52 weeks) with price adjustments to cover shift and weekend labor costs. (Refer to Appendix A for further discussion.)

The LTV-owned rocket and launcher plant at Camden, AR would probably be closed if rocket production were to cease and the launcher production facilities would be consolidated in Dallas. Since the Camden plant is the only Army artillery rocket plant in the U.S., there is concern over the loss of production capability if the plant were shut down and converted to other uses. In spite of that concern, there was little cost and capacity data available. Much of the information in the following sections are point estimates based on similar systems. No information was available on the capability of major sub-systems suppliers.

Due to limited availability of cost data (see Appendix A for discussion) only the MLRS rocket is considered in this analysis.

If the Army should need more MLRS rockets than it now has, it can produce them or obtain them from other countries. This analysis focuses on the production possibilities. Appendix A summarizes the MLRS rocket production capability and cost data that has been utilized in preparing this paper.

If the U.S. determines it needs to produce more than 86,000 MLRS rockets per year to meet a particular future scenario, it will want to have either:

- more than a year's worth of emergency production time (at 86,000 per year),
- a capability to produce more than 86,000 per year in an emergency,
- some additional production in peacetime, or
- some other source of additional MLRS rockets (either FMS buy-backs or foreign production).

## Develop Tradeoff Model

IDA has developed a model (See Appendix B) and a graphical display for assessing and summarizing the quantities and costs of additional MLRS rockets that could be produced through various production plans over the remainder of the 1990's. The model projects a potential peacetime production program, and then examines a number of possible alternatives for surging production upon warning. The model calculates two measures: the total quantity of rockets produced (with peacetime and emergency production combined), and the costs of producing the

MLRS rockets for that case. Appendix B provides an overview of the model and the display technique.

The MLRS rocket quantity estimates represent the sum of the numbers of MLRS rockets produced for U.S. use during each of three periods--(1) A peacetime "prewarning" period; (2) a "ramp-up" period; and (3) an "emergency production" period (after "ramp-up").

These three quantity components are calculated as follows:

- Production during prewarning equals the length (in months) of the prewarning period times the peacetime rate per month;
- Production during ramp-up is assumed (in this version) to equal the peacetime monthly rate times the number of months estimated as needed (after warning) to achieve the selected emergency production rate.
- Production during the "emergency production" period is assumed to equal the selected emergency monthly rate times the length (in months) of the emergency production period ( i.e., the length of the warning period minus the length of the ramp-up period).

The cost algorithm calculates, for each production plan, the sum of three cost elements:

- plant "layaway" costs (both fixed and variable);
- plant "restart" costs; and
- the relevant production costs (fixed and variable) for each phase of the production plan.

## Develop Alternatives

### Eighteen Cases and the Display "Cube"

Figure III-6-1 presents results for each of 18 separate "what-if" planning cases. Along the vertical dimension, the display Cube in the Figure shows the number of additional MLRS rockets produced by the end of a 72 month production period (by D-Day) in each case. The total dollar cost of a given case (in Millions of 1992$) is indicated by the color scheme. (Note the color legend on the right side of Figure III-6-1.)

All the cases in Figure III-6-1 share five principal assumptions. These are stated in the bottom left corner of the Figure.

- First, the overall production period considered here is 72 months long (beginning in October of 1993 and ending September 30, 1999).
- Second, warning is assumed to occur on April 1, 1998, and the warning period to last for 18 months--until D-Day on October 1, 1999.

- Third, five full months of "extreme national emergency priority" ramp-up time (after warning) is assumed in these cases in order to achieve the emergency production rate.
- Fourth, no FMS is assumed in any of these cases.
- Fifth, total costs are included in these estimates, including any restart and production costs during the warning/emergency period.

The 18 cases in Figure III-6-1 include three groups of six: a first six in which one of the six peacetime production rates shown at the bottom left front of the Cube (0, 10, 20, 30, 40, and 50 thousand per year) is maintained through the entire 72 month period, i.e., no production "surge" occurs and production remains at the peacetime rate through the entire warning period; a second six cases in which each peacetime rate is maintained until warning and then production is increased to 86 thousand per year for the last 13 months of warning; and a final six cases in which the peacetime rate is maintained until warning and then a rate of 93,600 per year is achieved for the last 13 months of the 18 month warning period.

The cases displayed in Figure III-6-1 thus range from completely closing down the rockets plants ("total shut down") throughout the period up to a plan to produce 50 thousand rockets per year throughout the peacetime period and then, on warning, to increase to 93,600 per year. The total shut-down case (i.e., 0,0) may be seen in the front bottom corner of the Cube in Figure III-6-1, while the 50 thousand per year in peacetime combined with mobilization up to 93,600 per year can be seen in the far back upper corner of the Cube.

Cases 1 and 2, described below, are two of the many notional plans displayed in Figure III-6-1. A focus on these two can help illustrate the technique and demonstrate the value of systematically capturing assessments of contingency production capabilities in planning the POM.

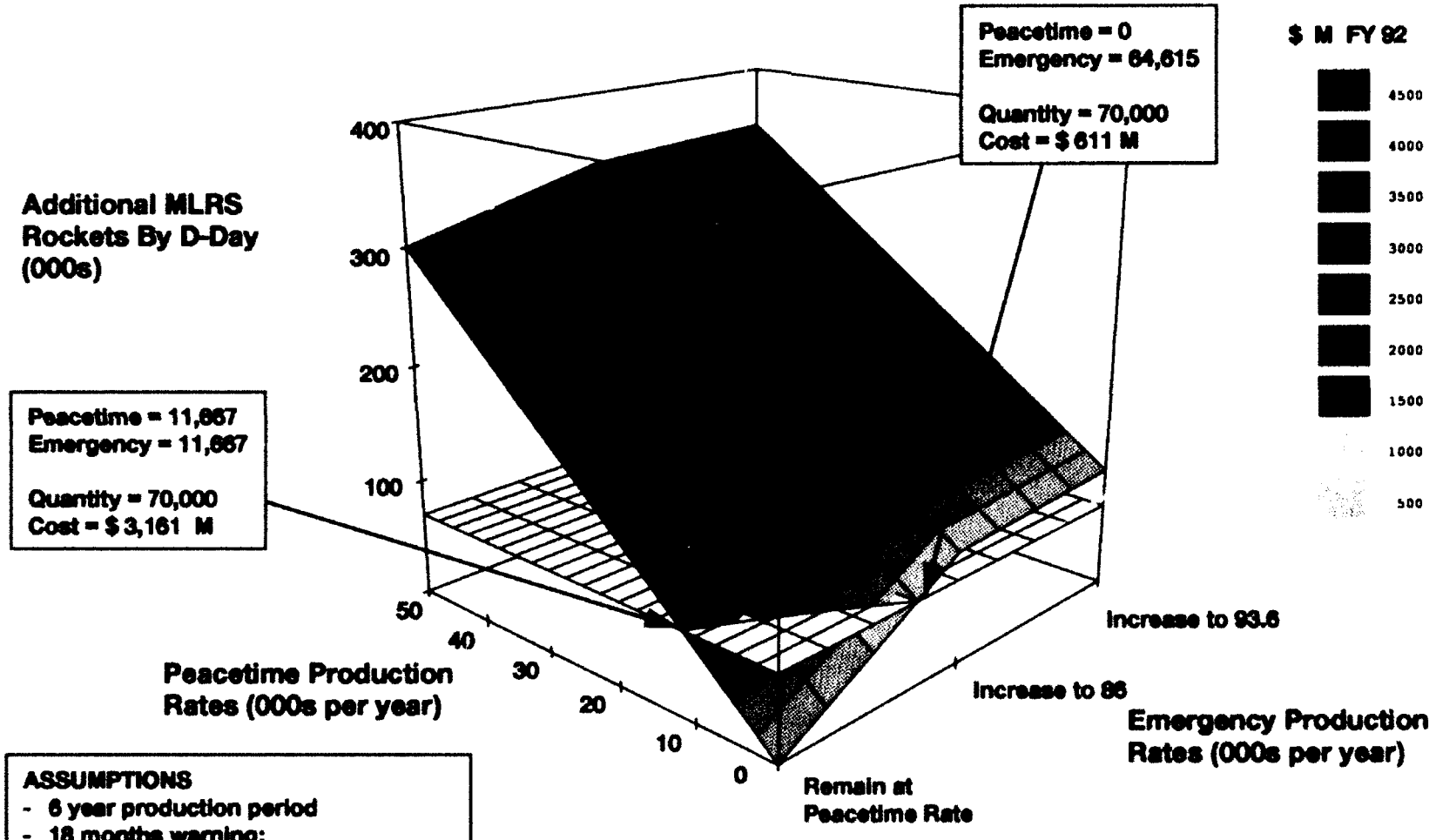
### Case 1: Produce 11,667 per Year, 6 Years, Do Not Surge (70,000 Rockets, $3,161M)

The quantity calculation is 11,667 rockets per year for 6 years; 70,000 total. At this rate, the unit cost is $45,163 per rocket. There are no shutdown or restart costs in this case, so the total cost is $3,161M, calculated as 70,000 times $45,163.

### Case 2: Produce at 0 per year During Peacetime, Surge to 64,615 Per Year During Emergency (70,000 Rockets, $611M)

In this case, the quantity is calculated as 5,384 rockets per month (i.e., 64,615 per year) times 13 months of emergency production. The costs include: $8M shutdown, $0.375M per month for layaway (times 54 months), $37M restart costs and $546M production costs (70,000

# SAMPLE OPTIONS FOR POM 94-99
# MLRS Rockets




**ASSUMPTIONS**
- 6 year production period
- 18 months warning:
  - 5 months until emergency rates
  - 13 months at emergency rates
- Foreign Military Sales = 0 / month
- No Emergency Supplemental Budget

Figure III-6-1

IDA November 24, 1991

units at $7,800 per unit). Note that Case 2 is considerably less costly than Case 1. This is due to the unit cost equation developed in Appendix A and our interpretation of the underlying production cost data, also given in that appendix.

### Alternative Ways To Produce 70,000 Additional MLRS Rockets By D-Day

Cost tradeoffs can be examined in Figure III-6-1 by identifying alternative ways to obtain a given number of rockets. Consider, for instance, a demand for an extra 70,000 rockets over this period. Using the calculus and assumptions illustrated above, one finds there are two basic strategies:

1) Produce at approximately 11,700 per year; do not surge: Cost =$3,161M
2) Do not produce during peacetime, surge to approximately 64,600 per year: Cost = $611M

## CONCLUSIONS AND RECOMMENDATIONS

This paper presents an initial set of production options to meet potential demands for additional MLRS rockets in the context of one of the Integrated Army Mobilization Study scenarios--a relatively long-warning European war scenario The approach can be of use in assessing and depicting production possibilities for a range of planning scenarios in the 1990's. The production tradeoff methods illustrated here may be useful for other systems as well. They may also help provide practical insights concerning the costs and payoffs of various "hedging options" that the President has called for to flesh out a viable Reconstitution component of the National Security Strategy. More specifically, these methods could assist the Army in identifying concrete actions in its 1994-99 POM .

A cautionary note concerning these initial assessments does need to be struck. The relatively low unit costs of production estimated in some of the emergency cases, such as Case Two (which make them look relatively more attractive from a cost standpoint) may be partially offset by rapid price inflation during such periods. A second caution in interpreting these numbers is that there is, unfortunately, still significant uncertainty as to the ramp-up times to emergency production rates and the true unit production costs. More often than not, estimates that have been obtained through "normal" channels significantly underestimate the costs and what could be done to speed things up under real mobilization conditions. But when critical sub-tier suppliers start going out of business and when key skilled labor must shift to other jobs, ramp-up times could become quite long.

Good quality information on defense industrial capabilities is no less expensive to obtain than good quality information in many other areas and fields. Given the importance to the nation's security of building a prudent balance between on-hand assets and potential (mobilizable) power, IDA recommends that the Army (1) adopt an assessment and option development scheme of this kind for the upcoming POM, using the best available cost and production data concerning key systems; and (2) accelerate efforts to obtain data on key systems that is at least as good as that available for the Abrams tank (refer to IDA Working Paper of August 28, 1991, *Sample Tank Options for Army POM 94-99 Decisions*).

# APPENDIX A TO CHAPTER 6

# CAPACITY AND COST DATA MLRS

## APPENDIX A TO CHAPTER 6

## CAPACITY AND COST DATA MLRS

### SYSTEM DESCRIPTION AND BACKGROUND

The Multiple Launch Rocket System (MLRS) is designed to supplement cannon weapons available to division and corps commanders for the delivery of large volumes of firepower over a very short time. The system consists of an MLRS Launcher produced by LTV Corp. at Camden, AR and Dallas, TX, two disposable pods containing six M77 rockets each, all produced by LTV at Camden, and a Bradley Fighting Vehicle (BFV)-derived carrier produced by FMC Corp at the San Jose, CA plant. Fire control (Norden), position reference systems (Bendix), and other guidance, control and communications systems are produced by various suppliers. The sub-munitions in the M77 rocket are supplied by AMCCOM as Government Furnished Equipment (GFE).

The current M77 rocket contains 644 small, grenade-like, explosive sub-munitions. Current plans are to develop a Terminal Guidance Warhead (TGW) and a Sense and Destroy Armor (SADARM) bomblet, both of which would be carried by the M77 rocket. The TGW consists of a dispenser and three terminally-guided sub-munitions (TGSMs). The SADARM bomblets are parachute-stabilized, armor-sensing sub-munitions designed to attack armored vehicles through their presently more vulnerable upper surfaces.

In addition, the Army Tactical Missile System (ATACMS) is under development as a surface-to-surface guided missile which would utilize the MLRS launcher and carrier.

As of 1 July 1991, the procurement plan (U.S. only) was as shown in Table III-6-A-1. In addition, ATACMS was scheduled for production delivery in 1991, full-scale production of the SADARM sub-munition was scheduled for mid-1994 and full-scale production of the TGW sub-munition was scheduled for end-1997. There has been some discussion and planning to introduce a reduced-range practice rocket in FY 92 and an extended range rocket in FY 95.

The LTV-owned rocket and launcher plant at Camden, AR would probably be closed if rocket production were to cease and the launcher production facilities would be consolidated in Dallas.

**Table III-6-A-1. MLRS U.S. Procurement Plan**

| FY | Launchers | Tactical Rocket Pods | Practice Rocket Pods |
|---|---|---|---|
| 80 | 12 | 229 | - |
| 81 | 32 | 390 | - |
| 82 | 68 | 416 | - |
| 83 | 72 | 3,940 | 631 |
| 84 | 76 | 6,000 | 658 |
| 85 | 44 | 8,412 | 658 |
| 86 | 44 | 12,000 | 658 |
| 87 | 44 | 12,000 | 658 |
| 88 | 24 | 12,000 | 658 |
| 89 | 62 | 8,000 | 755 |
| 90 | 68 | 4,000 | 646 |
| 91 | 66 | 8,000 | 313 |
| 92* | 43 | 4,000 | 932 |
| 93 | 34 | - | - |
| 94 | 22 | - | - |
| 95 | 44 | - | - |
| 96 | 34 | - | - |
| 97 | 44 | - | - |
| 98 | 44 | - | - |
| 99 | 44 | - | - |

Source: Undated program office view graphs

Note: Each pod contains six M77 rockets

*The 1992 procurement would result in the Army Acquisition Objective (AAO) being achieved in FY 1994.

The current storage plan specifies a shelf-life of 10 years. Thus, the rockets produced at the start of the program are reaching the end of their projected storage life and are ready for renewal or replacement. Since shelf life criteria are statistically developed based on quality and reliability standards, there is some apparent uncertainty whether the current inventory needs replacement or whether the shelf life criteria can be lengthened without significant degradation to reliability.

Since the Camden plant is the only Army artillery rocket plant in the U.S., there is concern over the loss of production capability if the plant were shut down and converted to other uses. In spite of that concern, there was little cost and capacity data available. Much of the information in

the following sections are point estimates based on similar systems. No information was available on the capability of major sub-system suppliers.

## CAPACITY AND PRODUCTION RATE

The launcher capacity is estimated by LTV to be seven per month, under the current firm fixed price contract.

The rocket capacity is estimated by LTV to be 86,000 per year, under the current firm fixed price contract. However, two additional bits of information were

- A sustained rate of 72,000 (12,000 pods) rockets was actually achieved on a 2-8-5 shift basis, and
- The automated portion of the rocket production line is set to produce at a rate of 1,200 rockets per week on a 2-8-5 basis.

Based on this information, it is recommended that the M77 rocket capacity at Camden be considered to be 86,000 per year at current price levels and 93,600+ per year (1,800 rockets per week on a 3-8-5 shift basis times 52 weeks) with price adjustments to cover shift and weekend labor costs.

No data were available for the capacity of the carrier, the launcher, (except for the comment noted above) sub-munitions, or electronic subsystems. Discussions with program office personnel indicated that the primary capacity constraint would be at Norden Systems supplying the fire control systems. Additional research is needed to determine a realistic capacity for the MLRS.

## COST

No extensive studies of shut down and start-up costs have been made. Therefore, the following information and estimates are based on individual comments, estimates and anecdotes obtained during the visit to the program office.

## SHUT DOWN AND START UP

Shut down to a "cold base" is estimated to be $8 million with an on-going maintenance cost of $0.375 million per month. Start-up costs were variously estimated to be $23 million or $30-50 million. The $23 million estimate consisted of $13 million in contractor costs and $10 million in government costs (for requalification). The $30-50 million estimate was based on MICOM estimates for similar systems. For this analysis a start-up cost of $37 million (as a mid-point between $23 and $50 million) is used.

Shut down to a "warm base" would cost substantially less but this "savings" would be offset by a very high unit cost for the 144 rockets which would be produced in maintaining a warm base. Specifically, maintaining a warm base was estimated to cost $1 million for layaway and $1 million for restart. However from the unit cost data below, each of the 144 M77 rockets would cost about $141,000. The apparent trade-off is approximately 33 months, i.e. if the plant will be shut for less than 33 months, it would be cheaper to maintain a warm base producing a minimum of rockets. However, if the plant were to be shut for more than 33 months it would be less expensive to shut to a cold base and restart when needed.

## UNIT PRODUCTION COST

Unit production data were not available from the PM office. Therefore, the data in Table III-6-A-2 were obtained from "U.S. Missile Data Book", by T. Nicholas and R. Rossi, Data Search Associates, 1989.

**Table III-6-A-2. M77 Rocket Production Cost**

| FY | Quantity | Then Year $, millions |
|---|---|---|
| 80 | 1,374 | 61.9 |
| 81 | 2,340 | 112.8 |
| 82 | 2,496 | 178.4 |
| 83 | 23,640 | 422.1 |
| 84 | 36,000 | 525.9 |
| 85 | 50,472 | 509.0 |
| 86 | 72,000 | 469.1 |
| 87 | 72,000 | 442.8 |
| 88 | 72,000 | 404.7 |
| 89 | 48,000 | 406.8 |

After applying the 1992 DoD Deflator for "Missile Procurement, Army", the unit cost curve (Figure III-6-A-1) is

$$y = 249{,}520\text{-}50{,}248 \log x \qquad R^2 = 0.923$$

where

y = M77 rocket unit cost, 1992$

x = annual production rate, units/yr.

Note that the dividing line between "production" and "maintaining a warm base" is undefined. It would be the point where production goes from a continuous to a batch process using a minimum number of operators.

Note also that these costs refer to rocket production. Carrier, launcher, and electronic system costs are not addressed.

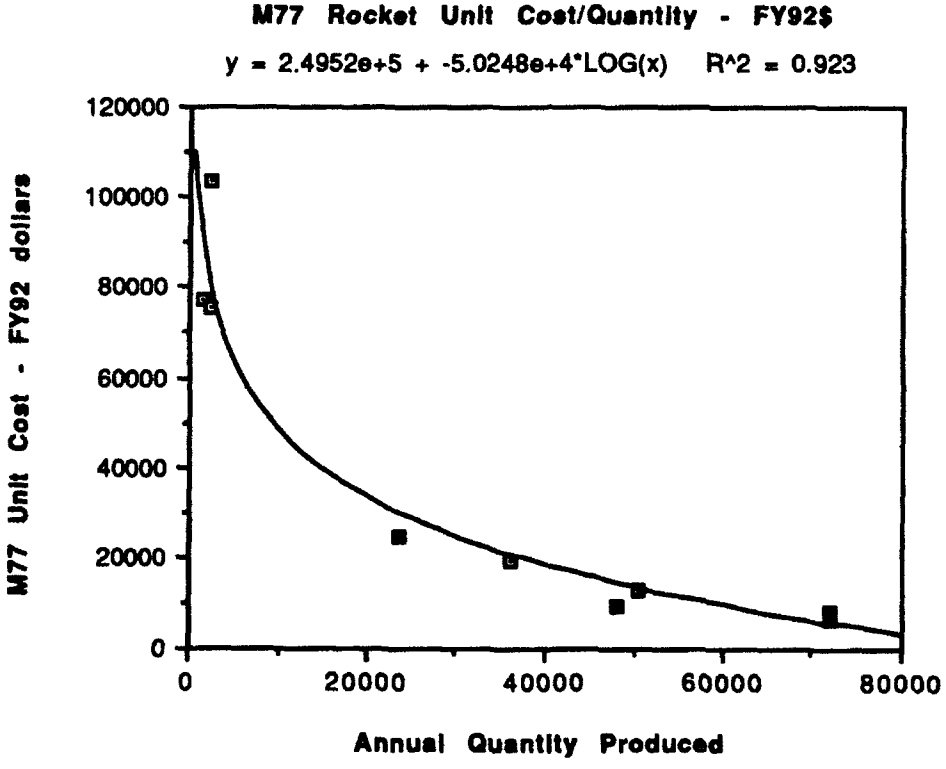



**Figure III-6-A-1. M77 Rocket Unit Cost**

# APPENDIX B TO CHAPTER 6

# INVESTMENT TRADEOFF METHODOLOGY

## APPENDIX B TO CHAPTER 6

## INVESTMENT TRADEOFF METHODOLOGY

The investment tradeoff methodology was designed to provide the decision maker a new capability for performing complex assessments involving several factors, where there are several criteria on which the evaluations may be based.

For the case study developed for this paper, the problem was framed in terms of factors that the decision maker might possibly control, and factors that are represented as planning estimates but which are not decision options. In the former category are 1) the peacetime production rate for the system, 2) the ultimate surge capacity for the system, and 3) the amount of Foreign Military Sales (FMS). In the latter category are: 4) the amount of warning time before D-Day, 5) the amount of ramp-up time required to achieve the emergency production rates (given warning), and 6) whether the monies expended during the warning period for surging the production are supplied by an emergency supplemental budget.

For both categories of factors, parametric variations over a range of possible values were explored. This approach was thought to be helpful in discovering those situations where one's externally based cost or quantity requirements were satisfied.

For specific values of each of the above factors (e.g., for a given peacetime production rate, with an assumed surge capacity, coupled with a specific warning time, etc.), it is possible to determine how many systems would be produced at various times, and what would be the cumulative costs. The quantity calculation is straightforward. The cost calculation involves several factors, only a few of which have been addressed here.

As discussed above, the following factors enter the cost calculus:

- The cost to layaway the plant. There are both fixed and variable portions of this cost component.
- The cost to surge to the emergency production rate. Degenerate cases may occur, e.g., do not decrease from the current level, or do not surge at all.
- The unit production cost. This depends on the number of units produced per month.

A computer model was created to carry out the arithmetic. While the source data were discrete, there were enough data points to allow a cost equation to be developed for each of the above factors. The model is based on these equations. To illustrate the calculations, a specific example is carried out in Appendix C.

The final element of the tradeoff methodology is a new technique for quickly and flexibly depicting the results of varying several decision variables jointly. This display technique, which shows the results for a matrix of options in terms of surfaces, is what generated the figures in the main section of this paper.

The reader or analyst should note that the display technique connects discretely calculated points with a straight line. Thus, the figures show a surface consisting of intersecting planes even though the cost equations are non-linear and continuous and investments occur at specific points or along specific lines. As the methodology gains wider use, this discrepancy can be resolved by calculating a larger number of discrete points at shorter intervals, eventually approaching the more correct depiction of a curved surface.

# APPENDIX C TO CHAPTER 6

# MLRS ROCKET SAMPLE RESULTS

## APPENDIX C TO CHAPTER 6

## MLRS ROCKET SAMPLE RESULTS

### OVERVIEW

The investment tradeoff methodology was used to conduct an initial illustrative analysis of some key factors being considered by the MLRS rocket plant closure discussions. One example tradeoff analysis is to determine which investment strategies yield a given quantity of rockets by a given time. For example, which strategies of investment would produce 70,000 MLRS rockets by a hypothetical D-Day, where D-Day is assumed to be 6 years in the future?

Using the calculus outlined above, one finds there are two basic strategies:

1. Produce at approx. 11,667 per year; do not surge Cost = $3,161M
2. Produce at approx. 0 per year, surge to 64,615 per year Cost = $611M

### A SAMPLE CALCULATION

As a basis for understanding the quantities and costs shown in Figure III-6-1, a specific example of one investment option will be discussed. This one case corresponds to one of the points annotated in Figure III-6-1.

This example assumes the peacetime production rate has been decreased to 0 MLRS rockets per year, and that the intended surge rate is 64,615 rockets per year. Furthermore, a six year (72 month) period is assumed prior to D-Day, with warning occurring 18 months beforehand. There are thus 54 months of peacetime production, a ramp-up period (assumed to be six months long, and in which production remains at zero units per month followed by 13 months of production at the emergency rate of 64,615 per year (it is assumed that the surge rate is in effect at the end of the ramp-up period, i.e., at month 60).

The total quantity produced by D-Day (month 72) is 70,000. This calculated by combining:

| | | | | |
|---|---|---|---|---|
| 54 months | x | 0 | = | 0 |
| 5 months | x | 0 | = | 0 |
| 13 months | x | 64,615/12 | = | 70,000 |
| Total | | | = | 70,000 |

The cumulative costs, through month 72 are $611 million. The calculation is as follows:

| | |
|---|---|
| Fixed cost to layaway -- from present rate to 0 | = $ 8.0 M |
| Variable cost to maintain plant -- ($0.375M per month for 54 months) | = $ 20.2 M |
| Fixed cost to start-up (surge) | = $ 37.0 M |
| Unit production costs | |
| ($7,800 per unit x 64,616/12 units x 13 months) | = $546.0 M |
| Total | = $611.2 M |

## CONCLUDING REMARKS

One may approach these illustrations of the methodology from two perspectives. First, one may depict an equal quantity curve on one of the surfaces. Fo example, the curve at height 70,000 in Figure III-6-1 passes through a range of cost values, depending on whether one has a high surge capacity or not.

Second, this figure may be used to ask: What options would fit within an overall budget ceiling, and under which set of assumptions. Here, one could pick a dollar amount, find the corresponding color, and rapidly determine which options remained at that color (or 'less').

# APPENDIX D TO CHAPTER 6

# OVERVIEW OF THE IDA CONTRIBUTION TO THE IAMS STUDY

# INTEGRATED ARMY MOBILIZATION STUDY

## OVERVIEW OF CONTRIBUTION BY THE
## Institute for Defense Analyses (IDA)

### OBJECTIVE

- Develop tradeoff methodology and options for Army POM 94-99 (for selected systems) that combine alternative plant status, procurement, ramp-up, capacity and cost elements to best satisfy stated Army requirements.

### CANDIDATE SYSTEMS

- AH-64
- MLRS
- Abrams Main Battle Tank
- TOW2

### APPROACH

- Obtain Information from Program Offices
  - Programmatic Policy Options
  - Most Current Production Bottleneck/Cost Data
  - Major subcontractor information
  - Plant closure/restart data
  - Key data limitations
- Build Strawman Issue-Option Papers for Each System
- Revise/Refine for POM Assessments with feedback from Key participants

### STATUS

- Methodology Developed and Briefed
- All Program Offices have been visited, available data compiled and data gaps identified
- Tank option paper submitted August 28, 1991
- TOW and other Option packages in preparation to meet overall study schedule

# APPENDIX E TO CHAPTER 6

# MLRS PROCUREMENT HISTORY AND PLANS

# APPENDIX E TO CHAPTER 6

# MLRS PROCUREMENT HISTORY AND PLANS

**Table III-6-E-1. MLRS Procurement Plan and History as of 1 July 1991**

| FY | Launchers | Tactical Pods | Practice Pods |
|---|---|---|---|
| 79 | – | – | – |
| 80 | 12 | 229 | – |
| 81 | 32 | 390 | – |
| 82 | 68 | 416 | – |
| 83 | 72 | 3940 | 631 |
| 84 | 76 | 6000 | 658 |
| 85 | 44 | 8412 | 658 |
| 86 | 44 | 12000 | 658 |
| 87 | 44 | 12000 | 658 |
| 88 | 24 | 12000 | 658 |
| 89 | 62 | 12000 | 755 |
| 90 | 68 | 8000 | 646 |
| 91 | 66 | 4000 | 313 |
| 92 | 43 | 8000 | 932 |
| 93 | 34 | 4000 | – |
| 94 | 22 | – | – |
| 95 | 44 | – | – |
| 96 | 34 | – | – |
| 97 | 44 | – | – |
| 98 | 44 | – | – |
| 99 | 44 | – | – |

Source: Briefing slides provided by MLRS Program Office.

Note: One Pod Contains 6 Rockets

**Table III-6-E-2. MLRS Recommended Rocket Procurement as of 7 July 1991***

| FY | Tactical Rockets | Practice Rockets | New Extended Range Rockets |
|---|---|---|---|
| 91 | 36,000 | – | – |
| 92 | 24,000 | 6,000 | – |
| 93 | 6,000 | 24,000 | – |
| 94 | 6,000 | 6,000 | – |
| 95 | – | 7,000 | 6,000 |
| 96 | – | 7,000 | 12,000 |
| 97 | – | 8,000 | 16,000 |
| 98 | – | 9,000 | 15,000 |
| 99 | – | 10,000 | 14,000 |
| 00 | – | 10,000 | 14,000 |
| 01 | – | 11,000 | 13,000 |
| 02 | - | 12,000 | 12,000 |

Source: Briefing slides provided by MLRS Program Office.

Note: One Pod Contains 6 Rockets

* Program Office Recommendations.

# APPENDIX F TO CHAPTER 6

# PROGRAM HIGHLIGHTS

## APPENDIX F TO CHAPTER 6

## PROGRAM HIGHLIGHTS

**Selected Acquisition Report (RCS: DD-COMP (Q&A) 823)**

**December 1990**

***Program:* MLRS (ROCKET SYSTEM)**

| | |
|---|---|
| September 1975 | Department of the Army approved a letter of agreement (LOA) for MLRS. |
| January 1977 | DSARC I approved MLRS for validation with two competitive contractors. |
| September 1977 | Boeing and Vought awarded competitive validation contracts. |
| July 1979 | MOU on a cooperative program was signed by France, Germany, United Kingdom, and the United States. |
| May 1980 | DSARC III approval. |
| October 1980 | Terminal Guidance Warhead initiated by approval of an LOA. |
| 1982 | Italy admitted as an associate member of the basic MLRS program. |
| March 1983 | General Officer Program Review (GOPR). |
| March 1983 | Initial Operational Capability (IOC) MLRS battery fielded. |
| April 1983 | Full-scale development decision. |
| September 1983 | First multi-year procurement contract awarded to LTV Aerospace and Defense Company (LTVAD) 5-years with a negotiated two year option (FY88/89). |

| | |
|---|---|
| June 30, 1989 | Second multi-year procurement contract for a 5-year period (FY89/FY93). |

# APPENDIX G TO CHAPTER 6

# CONTACTS AND VISIT

## APPENDIX G TO CHAPTER 6

## CONTACTS AND VISIT

### PROPOSED AGENDA

### Meeting With Program Office Personnel For MLRS Systems

Note: The following agenda is a general one. It may be modified according to the unique characteristics of a specific system or contractor. The topics are listed for a general discussion rather than a specific presentation.

A. Background and Overall System Information.

1. Purpose of the task
2. System description
   a. Physical characteristics
   b. Subsystem and major components

B. Production Capability Information - Prime Contractor and Major GFE Contractors.

1. Provide a "line-of-balance" diagram
2. Provide the approved production plan
3. Identify each step in the production process and, for each step note
   a. the shift usage (1-8-5, 2-8-5, etc.) to meet current production rate
   b. the standard labor hours per unit produced
   c. the actual labor hours per unit produced
   d. the standard machine hours per unit produced
   e. the actual machine hours per unit produced
   f. the current percent of shift capacity utilized
4. Identify the actual lot size as it may be used at various stages in the production process.
5. Identify the production, test, and quality control process steps which may be eliminated or modified to increase production rate but maintain short term quality standards.

6. For each step noted in B.3. above, estimate the total monthly production capability assuming that materials, components and supplies would be available when needed and that all work stations are manned on a 3-8-7 shift basis.

7. Based on the highest production capability rate noted in B.6. above, estimate the equipment investment cost needed for each other process step noted in B.3. above to raise that process capability to the highest value noted in B.6. If another process step cannot be expanded without exceeding its brick-and mortar capacity, repeat this step using the lower brick-and-mortor capacity as the new maximum capacity and note the change.

C. Subcontractor and GFE Information.

1. Provide the approved procurement plan

2. Procurement characteristics

   a. List foreign-source items and procurement lead times

   b. List critical components and procurement lead times

   c. List single - source components and procurement lead times

   d. List sole - source components and procurement lead times

   e. List long - lead times and their lead times.

3. Procurement history, current operations, and future plans (including production for FMS and all Services).

   a. Total system prime contractors and integration facilities.

      1. List all parts, current and planned prime contractors and system integration facilities.

      2. Provide monthly production for previous 12 months for current contractors and facilities noted in C.3.a.1., above.

   b. GFE

      1. Identify subsystems and components supplied to the prime contractor or integrating facility as GFE. Provide name and address for each.

2. For each integrator noted in a.1., above, provide the current procurement lead time and the program office's opinion concerning the supplier's capability to supply the material needed to achieve the highest system production rate noted in B.7., above.

D. Cost Information: The following should be supplied for each Prime contractor, Major Integrating Facility and Major GFE Contractors.

1. Unit costs: Estimate the fixed and variable unit costs at
   a. Current production rates
   b. One-half current production rate
   c. One-third current production rate
   d. One-fourth current production rate
   e. One-tenth current production rate
   f. A production rate of one unit per month
   g. A production rate of the highest value used in B.7., above.
   h. If current production equals 0, provide items a. through f., above, using the highest value used in B.7., above, as the current production rate.
   i. At most efficient current design rate.
2. Layaway costs: Estimate the total one-time and recurring costs incurred in plant layaway to maintain the maximum current production capability at an average on-going production rate of
   a. Zero
   b. One-tenth current production rate
   c. One-fourth current production rate
   d. One-third current production rate
   e. One-half current production rate
3. Restart Costs: Estimate the total fixed costs in current for plant restart to increase the production rate from each rate noted in D.2., above to
   a. Current production rate
   b. Current production capability noted in B.7., above.

E. Summary

Review information provided above noting any apparent inconsistencies and adding important observations and information not noted above on prime contractor and lower tiers.

# IDA VISIT TO
# MLRS PROGRAM OFFICE

**6-8 AUGUST 1991**

**IDA VISITORS**

James Thomason

Richard Cheslow

**PRIMARY CONTACTS**

Col. William S. Taylor, PM

Mr. Bob Luttrell, Chief, PM Office

Eugene Edwards

Charles Fitts

Eugene Hatcher

Ricky Holder

Robert Ryland

# GLOSSARY

| | | |
|---|---|---|
| AAH DSARC | = | Advanced Attack Helicopter Defense System Acquisition Review Council |
| AAO | = | Army Acquisition Objective |
| AMC | = | U.S. Army Materiel Command |
| ATACMS | = | Army Tactical Missile System |
| BFV | = | Bradley Fighting Vehicle |
| CAA | = | U.S. Army Concepts Analysis Agency |
| CY | = | Calendar Year |
| DCSLOG | = | Deputy Chief of Staff, Logistics |
| DoD | = | Department of Defense |
| FMS | = | Foreign Military Sales |
| FY | = | Fiscal Year |
| GE | = | General Electric |
| GFE | = | Government Furnished Equipment |
| GOPR | = | General Officer Program Review |
| GPS | = | Global Positioning System |
| HAC | = | Hughes Aircraft Company |
| IAMS | = | Integrated Army Mobilization Study |
| IDA | = | Institute for Defense Analyses |
| IOC | = | Initial Operational Capability |
| IPM | = | Industrial Preparedness Measures |
| ITOW | = | Improved TOW |
| JCS | = | Joint Chiefs of Staff |
| LBA | = | Longbow version of Apache Helicopter |
| LLTI | = | Long Lead-Time Items |
| LOA | = | Letter of Agreement |
| MDHC | = | McDonnell Douglas Helicopter Company |
| MICOM | = | Missile Command |
| MLRS | = | Multiple Launch Rocket System |
| MMES | = | Martin Marietta Electronic Systems |
| MMOA | = | Martin Marietta Orlando Aerospace |

| | | |
|---|---|---|
| MOB | = | Mobilization |
| PM | = | Program Manager |
| POM | = | Program Objective Memorandum |
| SADARM | = | Sense and Destroy Armor |
| SARDA | = | Assistant Secretary of the Army (Research, Development and Acquisition) |
| TACOM | = | Tank and Automotive Command |
| TADS/PNVS | = | Tactical Acquisition Designation Sight/Pilot Night Vision Sensor |
| TGSM | = | Terminally-guided Sub-munition |
| TGW | = | Terminal Guidance Warhead |
| TOW | = | Tube-Launched Optically-Tracked Wire-Guided |
| TRA | = | Teledyne Ryan Aeronautical |
| WIP | = | Work in Progress |

# Part IV

# *A Logistics Management Plan for Graduated Mobilization Response*

John F. Starns
Paul W. Edwards

The Analytic Sciences Corporation

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# CHAPTER 1

## GRADUATED MOBILIZATION RESPONSE OVERVIEW

Graduated Mobilization Response (GMR) is a mechanism for planning for, preparing for, and reacting to national security emergencies. The GMR approach is based on perceptions of the possible severity of a potential or ongoing national security crisis. These perceptions, in turn, are based on warning--often ambiguous warning--filtered through formal intelligence gathering mechanisms and informal individual observations. Through GMR, decisionmakers can be armed with reasonable assessments of the "costs" of action or nonaction and the timing of suggested actions designed to head-off, defuse, or counter a potential or actual threat to national security. GMR is a useful tool for dealing with a variety of emergencies including a destabilizing technological breakthrough, a client war, a demonstration of national will, a regional conflict, or global war.

GMR addresses mechanisms for:

- maintaining a flexible response capability through development of comprehensive plans and programs;
- conducting more detailed planning, targeted on specific problems and objectives, when it becomes apparent that a crisis is likely to occur or is occurring;
- implementing preparatory actions and investments to improve responsiveness, as required, for a specific crisis; and
- proceeding with appropriate levels of response to match the nature of the crisis.

The framework of Graduated Mobilization Response (Figure IV-1-1) has three stages: planning and preparation, crisis management, and national emergency/war.

Stage 3 is the peacetime planning and preparation stage, during which the U.S. is in a monitoring mode, observing national and international developments for signals of rising tensions and potential crisis or conflict. Two different types of activities are conducted within Stage 3: **general planning** and **programming, preparing, and testing**.

- **General planning** actions form the baseline for all other actions in the GMR process. The operative words for actions in this substage are **plan, identify,** and **develop**. Because specific dimensions of a future national security

| GMR Stage 3 | | GMR Stage 2 | | | GMR Stage 1 |
|---|---|---|---|---|---|
| **Planning and preparation** | | **Crisis management** | | | **National emergency/war** |
| General planning | Programming, preparing, and testing | Specific crisis assessment & planning | Specific crisis preparation | Specific crisis actions | Mobilization actions |

**FIG. IV-1-1. GMR FRAMEWORK**

emergency cannot be defined, the government must ensure that generic (scenario-independent) processes and procedures are in place to permit a rapid industrial base response whenever a national security emergency occurs. Planning and programming targets are established to provide a credible and consistent yardstick for measuring the response capability.

- **Programming, preparing,** and **testing** actions follow general planning. In this substage, principal emphasis is given to maintaining an effective responsiveness baseline. The testing of crisis response procedures is necessary to ensure that rapid and flexible response is possible. Testing will be accomplished through periodic exercises, conferences, or workshops by developing response options to selected illustrative threat scenarios. When testing reveals policy or planning shortfalls, the general planning will be revised and then retested. This plan-test-revise-retest cycle is a continuing activity.

A fundamental assumption of GMR is that national crises other than natural disasters are likely to be preceded by a period of rising tensions, adversarial preparation, client war, or perhaps even low intensity conflict involving U.S. forces. GMR Stage 3 activities are intended to maintain a preparedness posture sufficient to meet any likely future crisis.

**Stage 2** activities, in contrast, are focused on a specific crisis situation that has already begun to emerge. During this stage, DoD will undertake preparatory actions that were not possible during Stage 3, either because of resource constraints or because the absence of a specific crisis prevented development of specific plans and preparations. GMR Stage 2 is divided into three substages: **specific crisis assessment and planning, specific crisis preparation,** and **specific crisis actions.**

- **Specific crisis assessment and planning** represents the "staging area" for the execution of crisis and mobilization activities. The movement from Stage 3 to this level of activity is expected to be extremely fluid. In a rapidly-developing crisis, the time allotted for assessment and planning may be very brief,

requiring planners and decisionmakers to focus on a specific event deemed to be outside of "business as usual;" to assess the scope of the event; the likelihood of undesirable impact on national security; the time available to respond; and alternative response options.

- **Specific crisis preparation** (the degree, focus, and nature of government involvement) depends on the intensity of the crisis and the anticipated degree of disruption to government and economic activities necessary to resolve it. Minimal disruptions may be satisfied without taking any extraordinary actions, while moderate disruptions will require shifts in defense programs and budgets and some short term inconvenience to parts of the civil sector. GMR Stage 2 activities are especially designed to maximize response potential with minimal disturbance to the economy. GMR Stage 1 activities are only warranted if the intensity of the crisis is sufficient to require severe national disruption in order to preserve U.S. national interests. Specific crisis preparation actions may signal intent (i.e. demonstration of national will) or serve to improve the capability to achieve the level of response indicated by the specific crisis or emergency under consideration. In signaling intent, DoD would use preparatory activities as an end rather than a means to an end. Once preparation actions are completed, DoD would reassess the situation to determine if additional actions were needed.

- **Specific crisis actions** are indicated whenever the event does not require intense Government regulation and control. The GMR concept is designed to permit policymakers to select the least disruptive actions to resolve the crisis. GMR Stage 2 crisis actions will always be less disruptive to Government operations and the economy than Stage 1 actions.

**Stage 1** assumes that the United States has begun a mobilization of the economy for a possible crisis or war. A move to GMR Stage 1 most likely will be preceded or accompanied by a declaration of national emergency. However, many Stage 1 activities can be initiated without a declaration of national emergency. The principal feature distinguishing Stage 1 from Stage 2 is the substantial increase in the magnitude and urgency of national defense activities. Expansion of the defense industrial base will be necessary by expanding output from existing facilities, building new facilities, or converting nondefense producers or output to meet national defense needs. Some critical resources may be diverted from nonessential production. The increased demand for resources will increase the importance of coordinating Federal policy and program activities. While industrial **surge** may be predominantly a DoD activity, industrial **mobilization** activities are affected in key ways by non-defense agencies, which have responsibility for many of the critical resources, policy decisions, and programs that impact the effectiveness of mobilization efforts.

The intensity and timing of a crisis may also require a move from assessment directly into Stage 1 mobilization activities. Such a decision would not preclude the execution of

necessary Stage 2 actions but it would **compress the response time** and **limit the benefit** that would be derived if more time were available.

# CHAPTER 2

## DESERT SHIELD/DESERT STORM CHRONOLOGY

In order to assess the sequence, flow, and interrelationships of the actions, events, and activities of Operation Desert Shield/Desert Storm (ODS), it is important to lay out the chronology of this action. Table IV-2-1 expresses the major ODS events based on the official Office of the Assistant Secretary of Defense for Public Affairs (OASD(PA)) chronology through March 14, 1991. The ODS chronology is supplemented by a special report of the Army War College Strategic Studies Institute ("Desert Shield/Desert Storm: A Chronology and Troop List for the '90-'91 Persian Gulf Crisis") and the official 22nd Support Command chronology. The project team edited the combined chronology to represent the perspective of Army ODS participants at the "echelons-above-Corps" levels. In particular, this perspective portrays the vantage point of Army staff as ODS events (and GMR-equivalent actions) occurred.

## TABLE IV-2-1
## OPERATION DESERT SHIELD/DESERT STORM (ODS) CHRONOLOGY

| Date | Action or event |
|---|---|
| 1990 | |
| June 15 | U.S. acknowledges increasing tension in Gulf region. State Department "Watch Team" formed |
| June 22 | General Powell, CJCS, refers to threatening nature of Iraq in public statement |
| July 21 | Iraq moves Republican Guard units toward Kuwait border. USCINCCENT increases regional alert status |
| August 2 | Iraq invades Kuwait at 0200L (1900 EST) |
| August 6 | King Fahd invites friendly forces to Saudi Arabia to reinforce its defenses |
| August 7 | C-Day – first U.S. units begin deploying to Saudi Arabia |
| August 10 | USCENTCOM (Forward) is established in Riyadh |
| August 12 | U.S. Army units (101st Airborne Division and 11th Air Defense Artillery Brigade) begin to deploy |
| August 22 | 48,800 members of the Selected Reserves (SELRES) authorized for call-up |
| September 14 | "Soldier's Guide to Saudi Arabia" published; more than 100,000 U.S. forces in area |
| September 23 | Last ship with 24th Infantry Division equipment arrives in AOR |
| October 23 | More than 210,000 U.S. troops in theater |
| November 8 | Forces designated for deployment increased: 7th Corps HQ; 1st Armored Division; 3rd Armored Division; 2nd Armored Cavalry Division (Forward); 2nd Corps Support Command; 1st Infantry Division (Mechanized) |
| November 14 | Call-up of SELRES extended from 90 to 180 days |
| November 29 | U.N. Security Council Resolution #678 adopted; authorizing all necessary means to uphold and implement previous resolutions if Iraq does not comply on or before January 15, 1991 |
| 1991 | |
| January 9 | Baker-Aziz talks in Geneva fail |
| January 16 | 1900 EST (0300, 17 January, Riyadh) Operation Desert Storm begins with massive air interdiction campaign |
| January 18 | Approximately 450,000 U.S. troops in theater |
| January 26 | Air campaign shifts from strategic interdiction to battlefield preparation |
| February 12 | SECDEF invokes Feed and Forage Act to permit spending beyond appropriated limits for clothing, subsistence, forage, fuel, quarters, transportation, medical and hospital supplies |
| February 23 | G-Day (24 February, Riyadh time); Coalition forces begin a major ground, naval, and air offensive |
| February 27 | 2400 EST (0800, 28 February, Riyadh) Coalition forces suspend combat operations and assume defensive positions |
| March 10 | R-Day; Redeployment begins |

# CHAPTER 3

# ASSESSMENT OF GRADUATED MOBILIZATION RESPONSE ACTIVITIES

## INTRODUCTION

This chapter examines and assesses GMR-equivalent actions which occurred between July 1990 and March 1991 in support of ODS. It documents Army logistics and industrial base efforts which contributed to the successful outcome of the Gulf conflict.

This study is straightforward in its approach. The TASC study team made a thorough review of existing Army ODS lessons-learned files and selected those actual ODS logistics and industrial base actions most equivalent to "ideal" GMR actions. These selected actions were placed in chronological order of occurrence in accordance with the official chronology of ODS events. TASC analysts then examined each selected GMR-equivalent action and made a determination when that action, if executed in a GMR framework, should have been initiated.

This exercise is of benefit to the Army and to the GMR process for a variety of reasons: providing a mechanism for planning for, preparing for, and reacting to national security emergencies—validating the basic intent of GMR; providing guidance to planners—resulting in better Army GMR plans; and providing insights into preparing and conducting contingency operations more effectively and more efficiently.

The basic lesson learned from Phase I of this project is that—on an *ad hoc* basis—individual Army planners, operators, and logisticians made many timely and intelligent "GMR-equivalent" decisions. During ODS, complicated by the "joint" nature of the operation (CINCENT reporting to JCS and OSD), there was no overarching Army guidance, plan, or direction that provided a GMR focus, a GMR bias, or a GMR matrix to assist Army planners, operators, and logisticians cope with the complexities of the ODS conflict.

To assist Army leadership in relating ODS decisions and actions to the GMR process, the following sections provide detail on the **data collection and assessment** portion of TASC's review of Army GMR-equivalent actions during ODS.

## DATA COLLECTION

Data collection activities were divided between efforts to develop a compendium of existing GMR documents and efforts to identify those actual Army GMR-equivalent actions useful for the GMR Management/Action Plan product required in Phase II of this contract. Research sources for the compendium included: legislative and executive authorities for the concept of GMR; early, seminal writings about GMR; analyses of GMR applications; and GMR textbooks, directives, and manuals. Research to identify the GMR-equivalent actions focused on three major sources:

- **Unclassified Army files**
  - ▶ Operation Desert Shield/Desert Storm After Action Report (per AR 11-33)
  - ▶ ODS Logistics Planning Cell File Index (current as of 4/23/91)
  - ▶ Desert Shield/Storm Logistics Repository
  - ▶ Army Joint Uniform Lessons Learned System (JULLS)
  - ▶ Army Materiel Command Production Surge Study, 22 March 1991
- **U.S. Government materials**
  - ▶ U.S. General Accounting Office report to the Chairman, House Armed Services Committee, "The Services' Efforts to Provide Logistics Support to Selected Weapons Systems."
- **Miscellaneous sources**
  - ▶ Logistics Management Institute briefing, "Linking the Industrial Base to Warfighting Requirements," 15 November 1991
  - ▶ TASC archives
  - ▶ Published accounts in the national media.

From the volume of data recording the logistics build-up in the Gulf region between August 1990 and March 1991, the TASC team selected 70 representative actions. Criteria used to select GMR equivalents were:

- Existence of a "trigger" (i.e. a person taking action at a specific point in time);
- An identifiable linking event (i.e. a required industrial base or logistic support response to the "trigger"); and

- An intended result of the "trigger" (i.e. a requirement — real or perceived — satisfied).

The selected actions ranged from specific instances (e.g. diversion of commercial food products from domestic distribution to the Gulf region) to broad-ranging decisions (e.g. designation of the Army as executive agent for all Chemical Defensive Equipment (CDE) in theater). Many additional Army oriented logistical and industrial base actions taken during ODS could have been incorporated in the list of selected actions. However, the study team decided, after reviewing the archival materials, that only marginal gains would be achieved by an exhaustive "re-fighting" of ODS in a GMR framework. The goal of this report is not to relive the past, but to gain practical insights of a more general nature which will allow future decisionmakers to reap the benefits from GMR thinking, the GMR structure, and the GMR process.

## EVALUATION OF ODS ACTIONS

From the earliest indications in June 1990 that Iraq was increasing an already tense situation in the Gulf region until Republican Guard forces actually entered Kuwait on August 2nd, the U.S. military response was muted and not publicly detectable. In a GMR context, the rapid U.S. military response after the August 2nd invasion (the President chose the military option on August 4th) clearly delineated a movement from Stage 3 planning and preparation to Stage 2 crisis response. The level of U.S. commitment was, at its peak, well within the planning boundaries of **partial mobilization**, not the full mobilization normally associated with GMR Stage 1 activities. That certain GMR actions during ODS were indeed carried out at Stage 1 level of intensity is illustrative of the underlying concept: individual GMR actions operate independently. They are reactions to specific events, triggered by individuals, and executed at levels appropriate to the specific crisis.

The team reviewed ODS-related logistics and industrial base actions found in Army archival material and other historical sources as the first step in assessing **if** and **how** these actions enhanced, in a timely manner, the outcome of Desert Shield/Desert Storm. The GMR-equivalent actions selected follow a consistent pattern: each had an identifiable trigger, occurred at a specified point in time, caused a specific action; and completed actions satisfied a real or perceived military need. To prepare for the assessment, the team refined the selected data by grouping the GMR-equivalent actions into five functional categories, linked to the Army organizational structures actually responsible for those actions. Each GMR-equivalent action was also assigned to the GMR stage most appropriate to that action.

Finally, each action item tagged to a GMR stage was compared to its actual time of occurrence during ODS.

An underlying tenet of the doctrine of Graduated Mobilization Response is planning and preparing for logistics and industrial base requirements **well in advance of crisis**. This focus on the management principles of "planning , organizing, controlling, measuring...etc." suggests a useful grouping of the selected GMR-equivalent actions into categories that make sense to those involved in thinking about the logistics of war-fighting. Thus, the five categories selected by the study team reflect the range of logistics issues which routinely confront Army industrial base planners at all levels of the conflict spectrum. These logistically oriented Army functional categories are suitable both for historical analyses of completed military operations and for planning for future contingencies.

The five categories are:

- Plans and Operations
- Security Assistance*
- Transportation, Energy, and Troop Support
- Supply and Maintenance
- Resources and Management.

Within each of the five functional categories, the GMR-equivalent actions associated with that category were allocated to action area sub-groups in order to more effectively analyze the actions in the GMR context. An action area sub-group assignment clearly links a specific action to the particular agency or group associated with that activity. Sub-grouping also provides an additional "echelon" for cataloging GMR actions for future crisis contingency planning.

In addition to functionally categorizing the 70 selected GMR-equivalent actions, the team also assigned the actions to the most logically related stage within the accepted GMR framework. This GMR stage designation indicates, in the GMR spectrum, where the action is most likely to (or should) occur. GMR stages establish a framework for planning and executing preparedness actions across the full range of the crisis spectrum from peacetime planning through crisis and war. GMR stages are tied to specific actions, rather than some pre-ordained, rigid event timeline. Implicit in the concept of GMR is the premise that

*Although the study team, for purposes of analysis of data, identified Security Assistance (SA) as a functional area, SA is a program to itself which overlays and coordinates with **all** the "functional areas" listed.

people, based on their assessment of the situation, trigger individual GMR actions. Individual GMR actions, peculiar to a specific GMR stage, can be initiated without large scale execution of other GMR actions in that stage.

The final concern in analysis of the selected GMR-equivalent actions is the time of occurrence—permitting those actions to be placed in context with the unfolding of Operation Desert Shield/Desert Storm. The TASC team placed GMR-equivalent actions chronologically, using the most reasonable date available—in the following order of preference:

- Actual date the action was triggered, as determined by logbook entry, message date-time group, or other authoritative document;
- Date the action was initiated, as reconstructed from after-action reports, JULLS, file copies, etc.;
- Best recollection of when the action first occurred, based on interviews with Army personnel or other involved "experts."

For this study, TASC applied non-rigid, subjective criteria in assigning GMR stage designations to GMR-equivalent actions, asking the question: "If Army decisionmakers had possessed adequate GMR training and understanding, in which GMR stage was it most likely for the GMR-equivalent action to have occurred?"

Each of the five functional areas, action area sub-groups, and GMR-equivalent actions is addressed in more detail in the following sections. For simplicity and ease of reference for the reader, the text associated with each functional area is summarized by a one page table displaying the GMR-equivalent actions associated with that functional area; and a one page graphical display of the action areas, aligned to a schematic timeline of the most critical milestones in ODS chronology.

## Plans and Operations (See Table IV-3-1 and Figure IV-3-1)

### *Planning - Stage 3*

Early in the Desert Shield portion of the crisis, as force structure was rapidly evolving, ODCSLOG moved to develop a PC-based method for quickly calculating Combat Service Support (CSS) requirements for additional (above-the-line) forces. Existing standard processes were too slow or too complicated to provide planners with rapid assessments to support decisionmakers. **Stage 2a.** An August 1990 review of Critical Items List/Master Urgency List (CIL/MUL) items revealed that many of the items requested for acceleration

by the Services were not on the CINC CIL list; and post-ODS analysis noted a lack of industrial planning data for a number of these same items. AMC initiated a GMR-equivalent Stage 2a action to obtain troop support items (combat rations, clothing and supplies) from DLA and other sources. Although these troop support requirements were foreseeable once the specific crisis became clear (and should have been foreseeable in a planning sense), **none** of the items were in the pre-conflict CINC CIL. AMC's office of Technology Planning and Management (AMCLD) conducted a series of technology-base war games, using actual ODS information (finding that improvements in C3I would yield the greatest near-term increase in war-fighting capability). This war gaming experience led to establishment of the ODS Tech Base Task Force, chartered to revise the Technology Base Master Plan (TBMP), based on ODS experience. Testifying before Congress on June 12, 1991, and both reviewing the past and looking toward the next conflict, General Schwarzkopf stated his concerns for surge and mobilization were in the areas of strategic lift, mine counter measures, IFF equipment, reconnaissance assets, and bomb damage assessment capability. All the items mentioned above are valid GMR action candidates. Sustainment planning for non-major end items did not exist in early ODS operational planning guidance. The Logistics Planning Cell, however, did initiate assessments and recommended requests, at different times during the crisis, for items such as radios, generators, support vehicles, and selected munitions. **Stage 2b.** The U.S. Army Support Group concept was formalized during ODS. At its height, over 1000 people, representing 67 contractors, were in the theater. U.S. Army Support Group set as its goal, under this concept, a 70% turn-around in-theater of major assemblies.

### *Interservice Relationships - Stage 2a*

As the scale of the ODS deployment became apparent, JCS convened the Joint Production Committee (JPC) to review Service requirements and to set priorities for industrial resources. JPC first met in mid-August 1990 and continued to meet twice weekly throughout the crisis. **Stage 2b.** Throughout Desert Shield, Common Item Support (CIS) issues were handled by the ODS Logistics Planning Cell, which imposed makeshift priority of support criteria on requests from other Services.

### *Procurement - Stage 2a*

AMC reacted to Army's resource demands by forming its own surge committee in September 1990. In January 1991, Army Materiel Command began a surge study of relevant defense industry capabilities which—with the onset of conflict on January 16, 1991—became an adequacy review for sustaining the force in case of a long conflict. **Stage 2b.** In

September 1990 the OSARDA Information Management Division (SARD-IMO) began an upgrade of automation hardware designed to enable deployed forces to connect, from their forward locations, with the Army automated supply systems. **Stage 2c.** Throughout ODS, procurement agencies were in a reactive mode. This unfortunate stance was compounded by a **false** general expectation by deployed units that the industrial base would be "turned on" early in the crisis. DLA procedures routinely require Service requisition authority prior to surging items in DLA's wholesale system—standard "pull" methodology. ODS pointed up delays among Service requirements definition, item requisition, and DLA procurement that can stretch to months unless, as happened, *ad hoc* procedures are established. The Logistics Planning Cell noted that most items were accelerated to levels short of surge rates (i.e. twice normal production). This was probably a result of expediting the flow of parts to theater via Desert Express, etc. (thus reducing the number of items needed to fill the pipeline) and the effects of better asset visibility as improvements in logistics management were implemented.

### *Authorities - Stage 2b*

In January 1991, the President signed Executive Order 12742 which, by invoking Section 468 of the Selective Service Act, filled a gap in authorities caused by expiration of the Defense Production Act. E.O. 12742 enabled the Department of Commerce (DoC) to use the Defense Priorities and Allocation System (DPAS) for DoD requests for certain industrial resources. (USD(A) had delegated rating authority to Commerce during the early stages of the ODS buildup.) DoC worked 135 DPAS cases: 91 U.S. and 44 Allied. 50% of the 135 cases were initiated after January 1, 1991, when it appeared hostilities were imminent.

## TABLE IV-3-1
## A. PLANS & OPERATIONS GMR-EQUIVALENT ACTIONS

| | |
|---|---|
| A1 | Develop CSS force structure planning for above-the-line forces (Stage 3) |
| A2 | Review of CIL/MUL for critical items (Stage 2a) |
| A3 | Monitor joint production committee (JPC) actions (Stage 2a) |
| A4 | Monitor establishment of the AMC surge committee (Stage 2a) |
| A5 | Observe AMC tech base wargames (Stage 2a) |
| A6 | Activate AMC ODS tech base task force (Stage 2a) |
| A7 | Assess concern areas for surge/mobilization: LIFT, MCM, IFF RECON, BDA (Stage 2a) |
| A8 | Initiate early-on sustainment planning for nonmajor end items (Stage 2a) |
| A9 | Adequacy review for force sustainment (Stage 2a) |
| A10 | Monitor enactment of E.O. 12742, impacting DPAS (Stage 2b) |
| A11 | Request USD(A) delegate rating authority to DoC (Stage 2b) |
| A12 | Coordinate, through JMPAB, priority of support for sister services (Stage 2b) |
| A13 | Monitor DPAS implementation (Stage 2b) |
| A14 | Upgraded automation hardware allows deployed forces to directly access automated Army supply systems (Stage 2b) |
| A15 | Formalized U.S. Army Support Group (USASG) (Stage 2b) |
| A16 | Monitor DLA surge to fill service requisitions (Stage 2c) |
| A17 | Accelerate items short of surge rates (Stage 2c) |

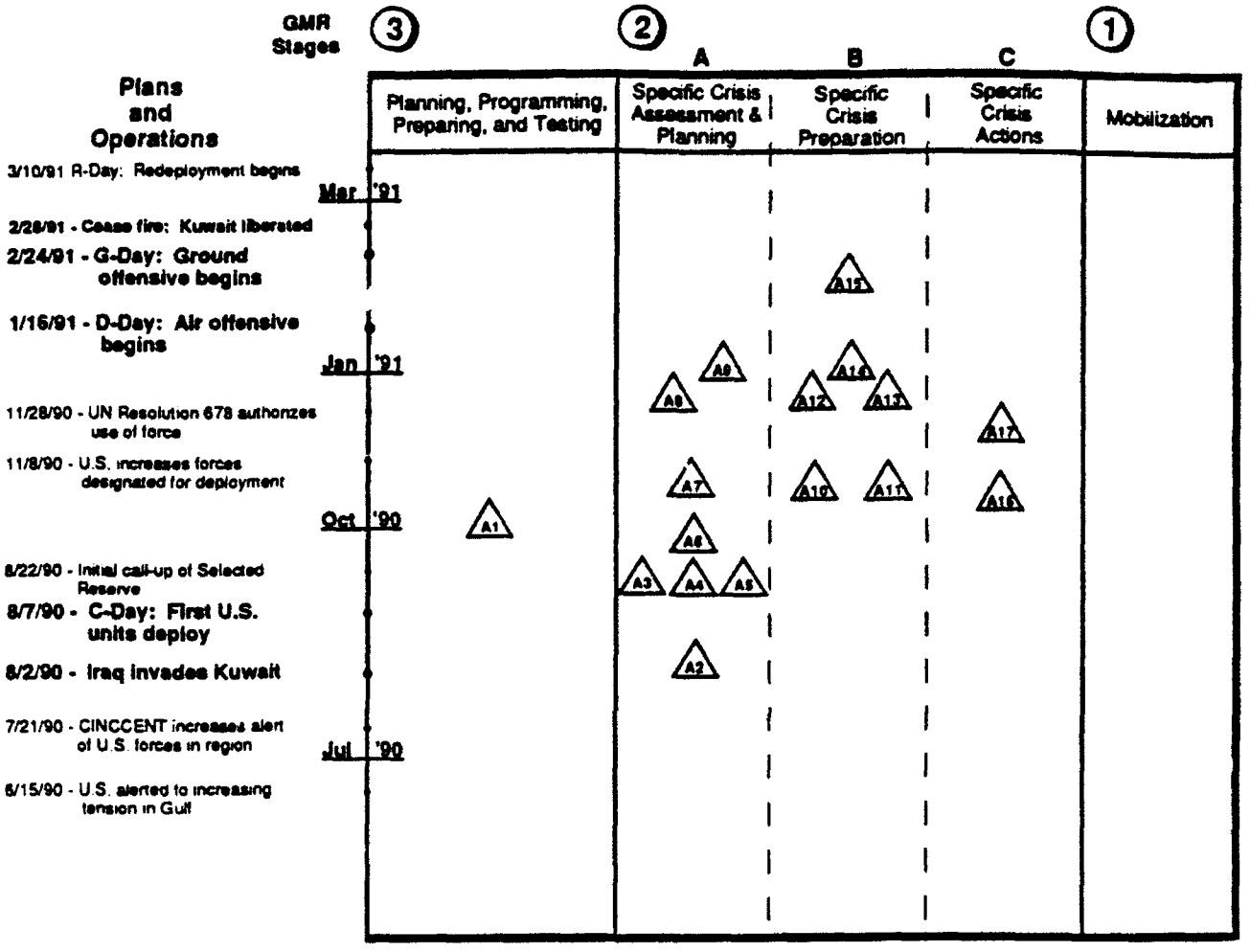


**FIG. IV-3-1. A. PLANS & OPERATIONS GMR-EQUIVALENT ACTIONS CHRONOLOGY**

## Security Assistance (See Table IV-3-2 and Figure IV-3-2)

### *Planning - Stage 3*

Unresolved GMR Stage 3 topics created the need, in early October 1990, to develop a Diversion Decision Coordination (DDC) process which ultimately handled over 240 individual requests. **Stage 2b**. AMC alone processed 122 priority cases for previously authorized foreign military sales (FMS) under the DDC procedure.

### *Procurement - Stage 3*

A number of ODS coalition partners stressed the Foreign Military Assistance (FMA) program with multiple requests for end items and spare parts. This competition with U.S. requirements necessitated implementing special management procedures to manage the demands for finite resources. By Legislative mandate and Executive Order, the ODCSLOG Directorate for Security Assistance is a **peacetime** program to support, within the national interest, allied defense capabilities. SA has no pre-planned capability for acceleration.

### *International Agreements - Stage 2a*

On November 5, 1990 Saudi Arabia and the United States concluded a Host Nation Support (HNS) agreement designed to increase the capability of deployed units.

**TABLE IV-3-2**
**B. SECURITY ASSISTANCE GMR-EQUIVALENT ACTIONS**

| | |
|---|---|
| B1 | • Develop Diversion Decision Consideration (DDC) process (Stage 3) |
| B2 | • Establish special management procedures for dealing with multiple requests for high-demand end items and spare parts (Stage 3) |
| B3 | • Evaluate security assistance programs for emergency acceleration capacity (Stage 3) |
| B4 | • Capability of deployed units increased with U.S.-Saudi agreement (Stage 2a) |
| B5 | • Evaluate special priorities assistance cases (FMS) (Stage 2b) |

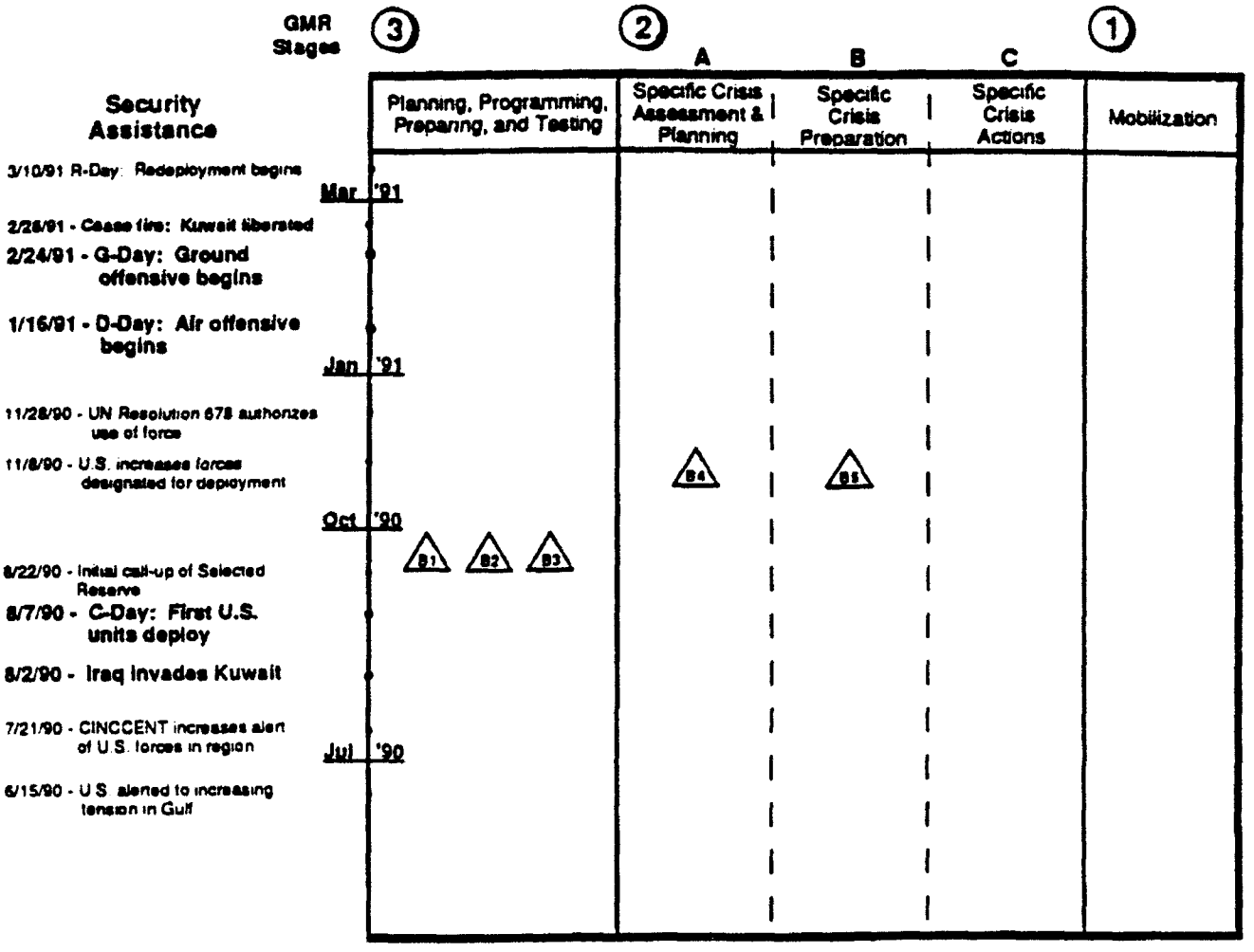


**FIG. IV-3-2. B. SECURITY ASSISTANCE GMR-EQUIVALENT ACTIONS CHRONOLOGY**

## Transportation, Energy, and Troop Support (See Table IV-3-3 and Figure IV-3-3)

### *Planning - Stage 3*

In early September 1990, the ODCSLOG recommended Industrial Preparedness Planning (IPP) for troop support items (particularly Class I, subsistence and Class II, personal demand). Although early subsistence shortages were gradually overcome, according to the Logistics Management Institute (LMI) no Industrial Preparedness Measures (IPMs) were developed or funded during ODS. Logisticians concerned with pre-conflict actions and operations leaders with a post-conflict 20/20 perspective have differing views on what items should have been surged for the most recent conflict and what items should be of interest for future conflicts. As early as August 20, 1990, the ODS Logistics Planning Cell reported that the surge capabilities of three manufacturers of MREs and T-rations, POL, and Desert BDUs could meet or exceed anticipated demand—this before the full scope of U.S. and coalition commitments was known. Based on surge estimates ODCSLOG recommended the Army prepare surge programs for related Class I, and II materials, with particular attention to tentage, clothing, barrier materials, and rations. During ODS, such secondary items were the pacing commodities.

### *Policy - Stage 3*

Programming actions executed by ODCSLOG were adequate, but lacked the flexibility for a quick response to rapidly-changing contingency requirements. In-Theater Class I subsistence responsibilities were both fragmented among numerous Army commands and geared to peacetime surge rates—perhaps because the lack of a Joint Theater MMC Cell, as recommended by ODCSLOG. Although the problems were overcome by December 1990, some early Stage 3 level planning could have made a considerable difference by C-day. **Stage 2a**. Some extraordinary *ad hoc* programming efforts did occur. When the requirement for provision of sundry packs was hampered by their absence—due to perishability concerns—from pre-positioned WRS, the Defense Personnel Support Center (DPSC) cut the anticipated 120 day lead time and began providing sundry packs at C+50.

### *Authorities - Stage 3*

The November 1990 alert of additional forces highlighted a shortfall of Class V munition transportation equipment and caused AMCCOM to call for standby certification of additional Class A & B carriers. Uncommitted National Guard and Reserve transportation detachments were identified for potential use, once certified and trained.

### *Interservice Relationships - Stage 2a*

JCS approved USCINCCENT's request designating Army as executive agent for all inland surface transportation, port operations, and joint service support for all Class I-V and Class VIII materials. No other command relationship issue during ODS had as much impact on Army logisticians. The designation required Army to assume full responsibility between C+30 and C+60. Responsibility for transportation, port operations and fuel was achieved on C-day; however, Army responsibility for some classes of supply was not assumed until C+90.

### *Procurement - Stage 2c*

The ODS Logistics Planning Cell initiated acceleration for fielding Army water purification systems. Growing experience with the desert environment and changing estimates of the Iraqi military threat determined most new procurement. By September 1990, DLA had begun new procurement of desert camouflage material and desert footwear. Early DLA acquisition demands were for rations, which led to the procurement of additional traypack tooling. Other initial demands included clothing, medical supplies, and Class IV barrier materials. **Stage 1.** DLA responded to a critical subsistence issue by obtaining diversion of certain prepared civilian food stocks from domestic sales to Gulf stocks—a conscious decision made to avoid drawing down USAREUR was reserve stocks to support the contingency. This latter action helped support the unanticipated subsistence needs of thousands of Enemy Prisoners of War (EPWs), following the G-day invasion of Kuwait and Iraq.

### *Logistics Support - Stage 2c*

The availability of secondary items in theater was partially a result of expediting their flow via Desert Express, etc. (thus reducing the number of items needed to fill the pipeline) and the effects of better asset visibility as improvements in logistics management were implemented.

## TABLE IV-3-3
## C. TRANSPORTATION, ENERGY, AND TROOP SUPPORT GMR-EQUIVALENT ACTIONS

| | |
|---|---|
| C1 | Conduct IPP for troop support issues (CL I, II) (Stage 3) |
| C2 | Identified lack of capacity to provide Class I subsistence above peacetime rates (Stage 3) |
| C3 | Reidentified absence of programmatic actions for maintaining Class I and II WRS levels (Stage 3) |
| C4 | Establish standby carrier certification for additional Class A and B explosives carriers (Stage 3) |
| C5 | Army designated executive agent for inland surface transportation, port operations, and joint support of Classes I-V and VIII (Stage 2a) |
| C6 | Provide Sundry packs as WRS; needed until PX system established (Stage 2a) |
| C7 | Acclerate fielding Army water purification systems (Stage 2c) |
| C8 | Monitor DLA new procurement of camouflage material and desert footwear (Stage 2c) |
| C9 | Procure traypack tooling (Stage 2c) |
| C10 | Expedite flow of parts to theater via Desert Express (Stage 2c) |
| C11 | Early demands on DLA for rations, clothing, medical supplies, and barrier materials (Stage 2c) |
| C12 | Divert MORES (Stage 1) |

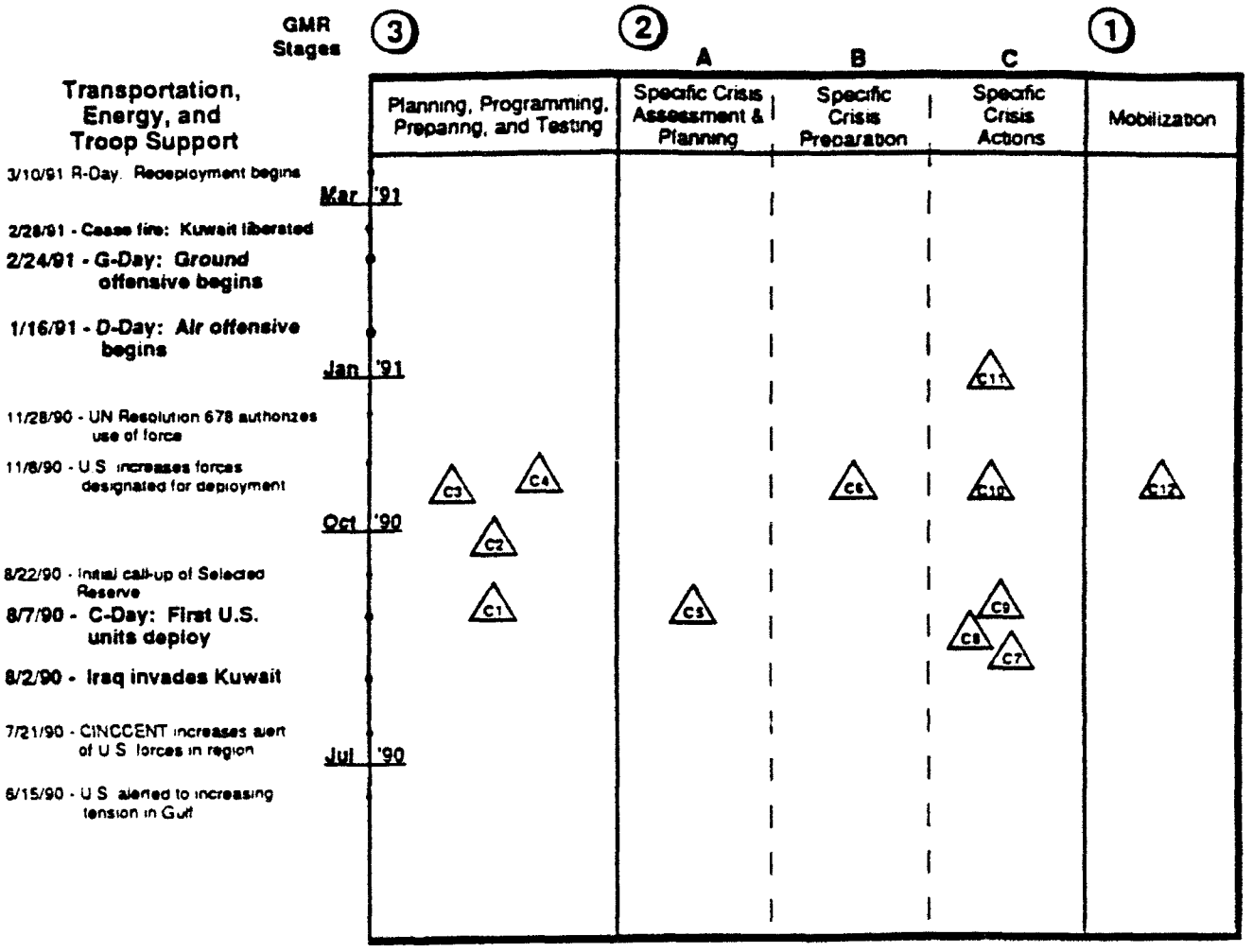


**FIG. IV–3–3. C. TRANSPORTATION, ENERGY, AND TROOP SUPPORT GMR–EQUIVALENT ACTIONS CHRONOLOGY**

## Supply and Maintenance (See Table IV-3-4 and Figure IV-3-4)

### *Planning - Stage 3*

ODCSLOG recommended the Army prepare surge programs for related Class IV, V, & IX materials, with particular attention to key munitions.

### *Policy - Stage 2a*

There were no ongoing programmatic actions for maintaining War Reserve Stocks (WRS) of individual equipment. The DoD decision to reprogram existing funds, rather than present a special funding relief request to Congress, signaled the Services to rely on existing WRS rather than on replenishment contracts with private sector suppliers. As soon as the scope of the deployment became obvious, all Services took action to reduce production lead times for pacing items and components. GAO reported an AVSCOM example where lead time was cut from 25 to 12 months by eliminating production inefficiencies. **Stage 2b.** One result of the DoD funding decision was a bar, absent any new funding, on replenishment of War Reserve and Operational Project Stocks.

### *Interservice Relationships - Stage 2a*

ODCSLOG called for development of common service planning factors for use by executive agents in future contingencies.

### *Logistics Support - Stage 2a*

Once contingency requirements focused on the Gulf region, AMC revised production targets for its major subordinate commands. By November 1990, AMC had fielded the first revised technical publications for desert climatic conditions. DCSLOG formed the Chemical Division to deal with Army's designation as the executive agent for all Chemical Defensive Equipment (CDE) logistics, except medical items. **Stage 2b.** Maintaining asset visibility (item tracking) upon arrival in theater was identified as a serious problem early in the deployment phase of ODS. By August 1990, AMC FAST (Field Assistance in Science and Technology) was collecting on-site data on specific operational equipment problems. In September 1990 ODCSLOG enacted a worldwide redistribution plan to fill out munitions reserves and theater stockpiles. By the end of September 1990, the lack of adequate computer software in place to track both wholesale and retail inventories forced ODCSLOG to request the status of supplies and equipment from the most reliable sources (AMC—wholesale levels, and SWA—in theater equipment status). During October and

November 1990, ODCSLOG reduced unit requirements to maintain multi-vehicle types by "pure fleeting" tactical wheeled vehicles and heavy lift equipment. The decrease in world tensions during this period allowed a redistribution of weapon systems from European and Pacific War Reserve Materiel (WRM) stockpiles to forces in the Gulf. In October 1990 ODCSLOG received OSD permission to withdraw first-line equipment from non-deploying Reserve Component (RC) units, IAW DoDD 1225.6, in order to fill critical equipment shortages in deploying Active Component (AC) Divisions and Regiments. These actions and the establishment of the Saudi Arabia Redistribution Facility (SARF) in November 1990 insured deployed forces had early access to the newest U.S. military equipment. All Services increased their military depot activity during ODS. AVSCOM expanded over 1200 depot repair programs and established 589 new programs, according to one GAO report. This type of surge activity is a hidden Service asset, quickly available in contingencies. In fact, the Air Force relied almost exclusively on depot acceleration to build and repair 1760 exchangeable items, in lieu of initiating surge production from its industrial base suppliers. **Stage 2c**. The ODS Logistics Planning Cell initiated acceleration for ODS-required equipment ranging from missiles (Copperhead, Hellfire, TOW II-A, Stinger) to water purification systems, and GPS receivers. JCS elected to deploy J-STARS while still in its 6-year R&D test and evaluation. This accelerated deployment of major end items was driven entirely by the events of ODS. Along with major ground force increases in November 1990, the Army also selected the Patriot missile system for deployment, in order to counter emerging threats to deployed forces. Recognizing the wear and tear on Army aviation assets of the harsh desert environment and the long haul between CONUS resupply and in-theater users, ODCSLOG supported the establishment of dedicated airlift for high priority parts and sub-assemblies. "Desert Express" began on October 30, 1990 with daily flights from CONUS direct to South West Asia (SWA). The Army and Air Force were prime beneficiaries of the service, although the Army reported some problems with cargo being bumped due to Army unfamiliarity with Air Force-specific packing and documentation requirements. ODCSLOG began equipping CONUS Replacement Centers (CRCs) and the early fielding of Multiple Launch Rocket System (MLRS) in November 1990 and ATACMS in early January 1991. In December 1990, the HET requirement was satisfied by procurement of MACK commercial HETS and Czech Tatra HETS, loans of Egyptian and Italian HETS, German donated HETS, and Host Nation Support (HNS). In January 1991, in support of the ARCENT campaign,

## TABLE IV-3-4
## D. SUPPLY AND MAINTENANCE GMR-EQUIVALENT ACTIONS

| | |
|---|---|
| D1 | Prepare surge programs for Class IV, V, IX (Stage 3) |
| D2 | Lack of programmatic support of industrial base in maintaining theater-specific clothing, individual equipment, and subsistence WRS (Stage 2a) |
| D3 | Reprogramming decision caused services to rely on WRS, rather than contract with suppliers (Stage 2a0 |
| D4 | Allocate joint and combined support responsibilities (Stage 2a) |
| D5 | Explore reducing production leadtimes for pacing items and components (Stage 2a) |
| D6 | Update technical publications for unique climatic conditions experienced in the theater (Stage 2a) |
| D7 | Production breaks and bottlenecks assessed across major subordinate command (MSC) lines (Stage 2a) |
| D8 | Review anti-armor munitions production limit (Stage 2a) |
| D9 | Establish Army as executive agent for all chemical defense equipment (CDE) logistics—except medical items (STAGE 2A) |
| D10 | Tasking to SWA to increase ability to track items in-theater (Stage 2b) |
| D11 | Monitor activation of AMC fast (Stage 2b) |
| D12 | Enact munitions worldwide redistribution plan (Stage 2b) |
| D13 | Tasking to AMC to increase visibility of wholesale and retail inventories (Stage 2b) |
| D14 | Conduct in-theater enhancement of M1-A1 and M1/M3A2 (Stage 2b) |
| D15 | Supply GFE directly from production lines to field units (Stage 2b) |
| D16 | Implement "pure fleeting" of tactical wheeled vehicles and heavy lift equipment (Stage 2b) |
| D17 | Transfer end items from other theaters (Stage 2b) |
| D18 | Withdraw first-line equipment from non-deploying RC units IAW DoDD 1225.6 in order to fill critical equipment shortages in deploying AC units (Stage 2b) |
| D19 | Identified engines, transmissions, primary sights and alternators/regulators as critical elements for increased procurement (Stage 2b) |
| D20 | Track development of emergency procurement of GBU-28 bunker-penetrating bomb (Stage 2b) |
| D21 | Service expansion and establishment of depot repair programs to meet ODS demands (Stage 2b) |
| D22 | Reprogramming of funding was a bar to replenishment of WRM and operational project stocks (Stage 2b) |
| D23 | Monitor Air Force capacity to accelerate depot activities to build and repair 1760 items, rather than surge production from industrial base suppliers (Stage 2b) |
| D24 | OSD logistics planning cell accelerated fielding of critical missiles, chemical protection gear, water purification systems, and GPS receivers (Stage 2c) |
| D25 | Continuing demand for atropine protection against nerve agents (Stage 2c) |
| D26 | Monitor early deployment of J-STARS, still in R&D test and evaluation (Stage 2c) |
| D27 | Increased in-theater forces and OPTEMPO, plus effects of desert environment caused increased demands for Class IX secondary items (spares and consumables) (Stage 2c) |
| D28 | Army deployed Patriot missile system to counter emerging threats to deployed ground forces (Stage 2c) |
| D29 | Army supported dedicated airlift (Desert Express) to provide quick support of fielded aviation units operating in harsh desert environment, far from CONUS resupply (Stage 2c) |
| D30 | Army began early fielding of CONUS replacement centers (CRCs), multiple launch rocket system (MLRS), and ATACMS (Stage 2c) |
| D31 | Expedite fielding of Heavy Equipment Transporters (HETs) to support arcent campaign plans (Stage 2c) |

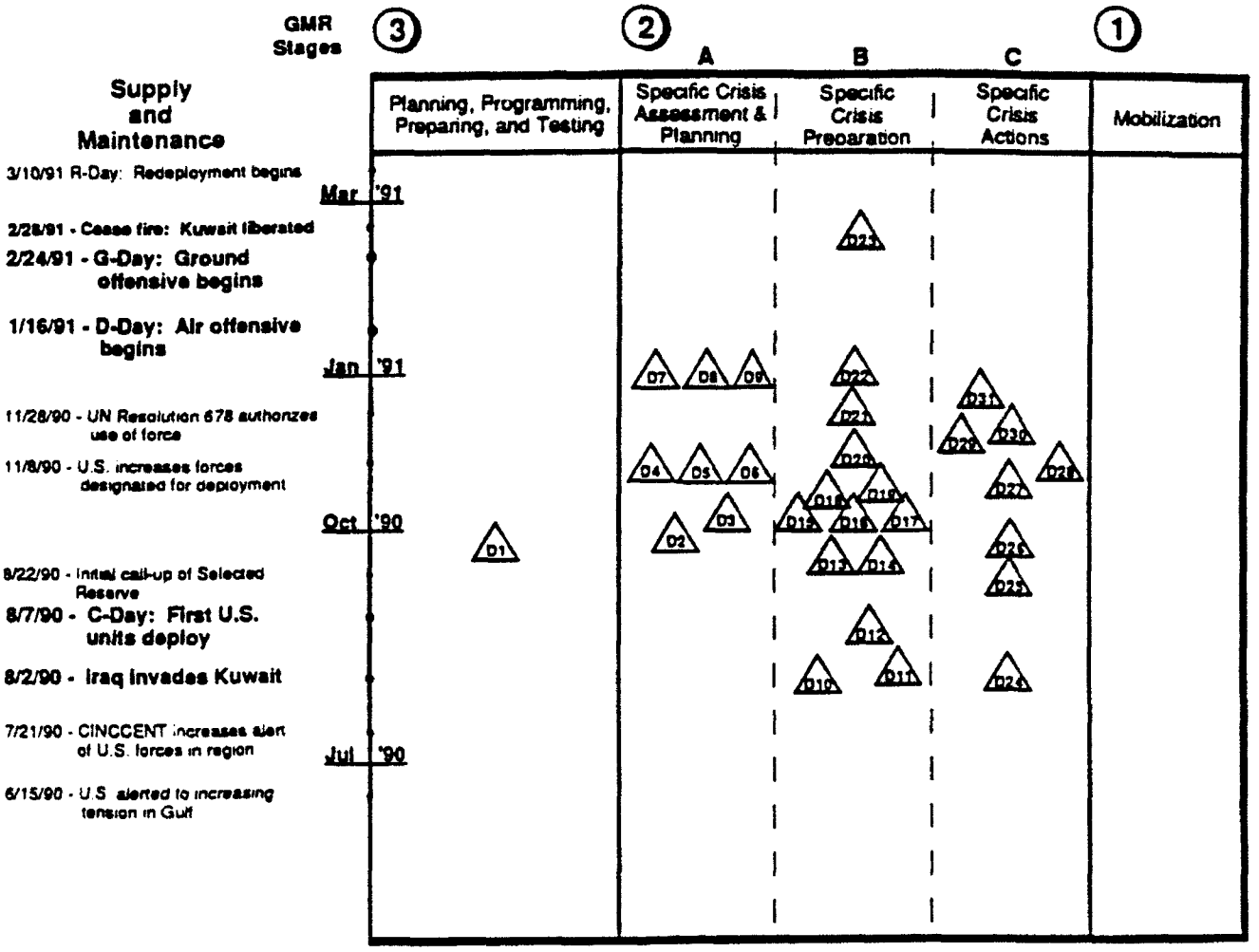


**FIG. IV–3–4. D. SUPPLY AND MAINTENANCE GMR–EQUIVALENT ACTIONS CHRONOLOGY**

Heavy Expanded Mobility Tactical Tracks (HEMTT) tanker and cargo variants were shipped directly from the manufacturer and some of the ARNG to augment the 5000 gallon tankers and S&P tractor-trailers in the Divisions and Regiments due to their lack of off-road mobility.

### *Procurement - Stage 2a*

The impacts of production breaks and bottlenecks were assessed across all the Major Subordinate Commands (MSCs). The AMC study found that production breaks were few, with no problem breaks, and that bottlenecks were previously known and not considered serious for ODS. Only in the area of anti-armor munitions was a production limit flagged. However, the short duration of ODS obviated that concern. **Stage 2b**. Taking advantage of easing world tensions outside the Gulf, ODCSLOG began, in October 1990, a program of in-theater modernization of the M1A1 Abrams tank and the M2/M3A2 Bradley Fighting Vehicles. This effort was coincidental with the growing USASG capability, allowing upgrade kits to be supplied directly from CONUS production lines to in-country refit activities. AMC identified certain spare/repair parts (engines, transmissions, alternators/regulators, optical sights) as critical elements for increased procurement. As hostilities approached, emergency procurement was begun for a bunker penetrating bomb for the Air Force (GBU-28)—a six week effort from design of the munition, based on a gun tube, to delivery to the field. **Stage 2c**. Atropine, an anti-spasmodic for nerve agents, remained in demand throughout the contingency. Acceleration in production of Class IX secondary items—spares and consumables—which occurred through October and November 1990 was due primarily to demands generated by the increase in major forces in theater, the increased tempo of operations (OPTEMPO), and the effects of the desert environment.

## Resources and Management (See Table IV-3-5 and Figure IV-3-5)

### *Policy - Stage 2a*

AMC reviewed its Basic Ordering Agreements (BOAs) for high demand items and drafted stand-by contracts for anticipated demand items. In early October 1990 a DoD decision was made to reprogram existing funds, rather than present a special funding relief request to Congress.

### *Procurement - Stage 2b*

Existing contracts were accelerated or extended, as Service requirements were established. In February 1991 a requirement to procure infrared reactive paint to mark friendly vehicles was contracted within 24 hours.

## TABLE IV-3-5
## E. RESOURCES AND MANAGEMENT GMR-EQUIVALENT ACTIONS

E1 • AMC reviewed its basic ordering agreements (BOAs) for high demand items

E2 • DoD decision to reprogram existing funds, rather than present a special funding relief request to congress (Stage 2a)

E3 • Existing production contracts accelerated or extended, as service requirements were established (Stage 2b)

E4 • Emergency contract formed within 24 hours to procure infrared reactive paint for marking coalition vehicles (Stage 2b)

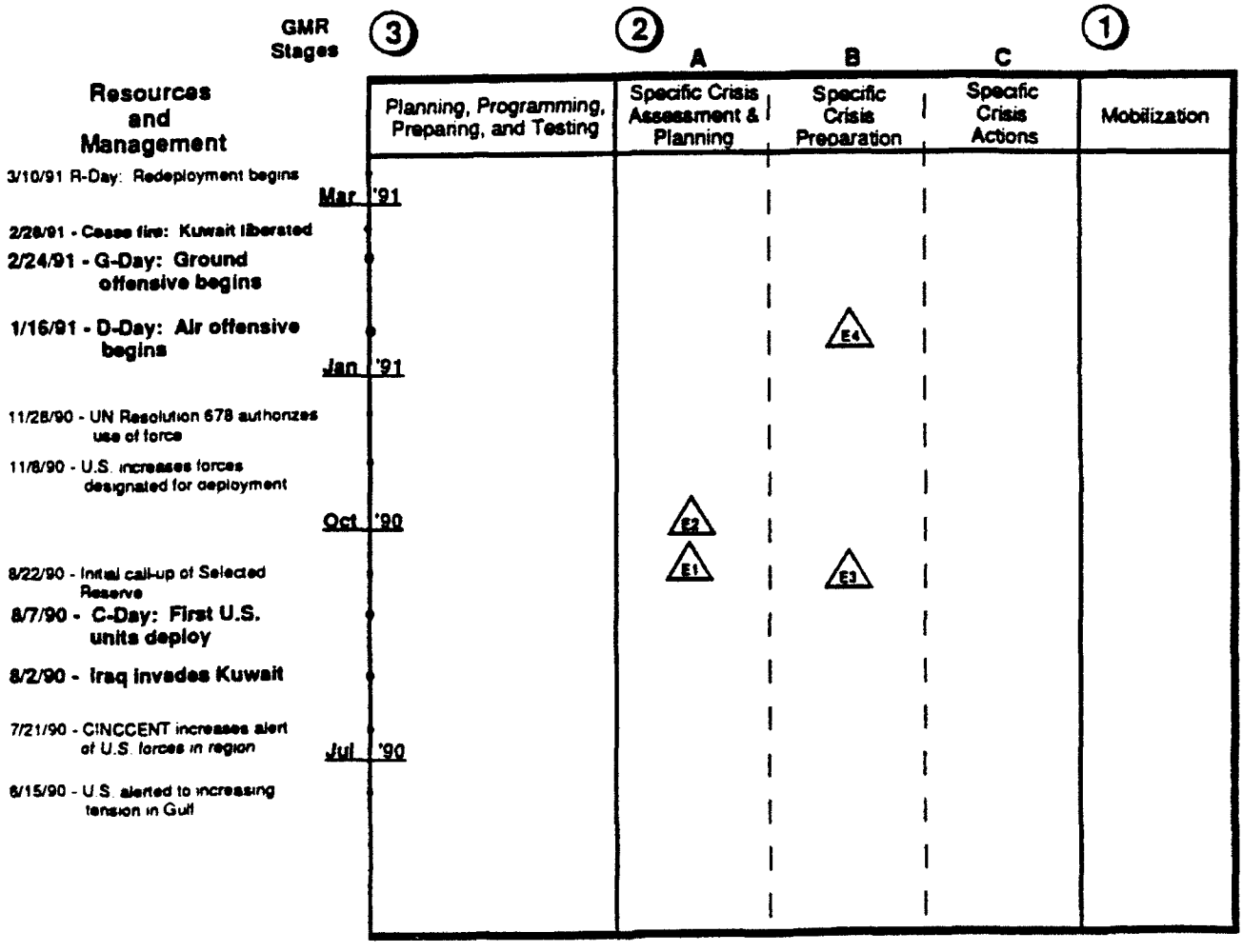


FIG. IV-3-5. E. RESOURCES AND MANAGEMENT GMR-EQUIVALENT ACTIONS CHRONOLOGY

# CHAPTER 4

# PHASE ONE OBSERVATIONS AND CONCLUSIONS

## OBSERVATIONS

Operation Desert Shield/Desert Storm was not a test of U.S. planning and preparation. Several studies have contended the U.S. resource and industrial base were never really stressed. Perhaps a better characterization is that the stresses on the logistics and transportation infrastructure were not so severe, and penalties for not acting on warning not so potentially defeating, because the U.S. was able to concentrate its immense military capability on a single objective.

Among the many lessons learned from ODS, the study team feels that two general observations sum up the relevant experience that should be carried forward to future Army logistics and industrial base planning:

**First, the historical U.S. bias toward global war preparation resulted in gaps in the capabilities of logistics and industrial preparedness planners to cope with the realities of the Gulf conflict.** Since World War II--including Korea and Vietnam--U.S. planners have fixed their attention on the toughest possible scenario--global conflict with the Soviet Union. The magnitude of this planning assumption overwhelmed available funding for industrial preparedness. Operation Desert Shield/Desert Storm, with its immense, but focused logistical and production demands on the industrial base, teaches the **need to allocate adequate planning resources across the spectrum of conflict.**

In ODS, characterized by rapid deployment; remote, austere theater of operations; high operations tempo; and short duration, the **pacing items were** not major end items but **secondary items** (e.g., troop support, Class I & II food and subsistence items, Class IX repair parts). Although industrial base shortfalls in Class I and II items have been known for years—and have surfaced in high-level planning exercises—the problem was not resolved during ODS.

**Second, coalition forces were fielded in vastly different than pre-planned configurations and numbers.** For example, by January 1991, 42% of all Army helicopters and 57% of armored vehicles (M1 Abrams and M2/M3 Bradleys) were in theater. This not imprudent concentration of troops and equipment was a fortuitous result of unprecedented

changes in the world situation. It created, however, tremendous pressures on the logistics and industrial base support structure intended to support a somewhat smaller Southwest Asia force. Add to the equipment numbers the toll of increased OPTEMPO and harsh desert environment, and a very large unplanned logistic problem resulted.

This second observation points up a national attribute or characteristic: the ability of the U.S. to innovate and, in the case of recent military deployments, create new force combinations and command arrangements without seeming effort. These ad hoc activities are consistent enough to have become the rule. Army planners need to recognize that their **preparations--at all levels--must stress the process over the plan.**

GMR-equivalent actions in ODS can be viewed as appropriate but unanticipated. That is to say, the GMR triggers (people) reacted to the unforeseen and unplanned resource requirements in a consistent and expeditious manner. In hindsight, it was a combination of myopia on the planning horizon and moving targets for force structures that created tremendous strains on certain segments of the logistics infrastructure and defense industrial base. An explicit and fully implemented GMR process would have made the problems of support in ODS no less difficult, perhaps, but somewhat easier to solve.

A fundamental assumption of the GMR process is that GMR-like actions taken in a timely manner serve to mitigate a crisis or, failing that, enhance U.S. forces' ability to take decisive action to end it. The GMR-equivalent actions identified in ODS were selected **because** they satisfied this fundamental assumption. However, key to understanding the action's importance in mitigating or terminating the crisis is establishing the timing or "triggering" of the action.

The graphics in Chapter 3 show when the GMR-equivalent actions occurred during ODS and provide a snapshot of "what was." But what can be said about the timing of the actions selected for this study? Did things happen according to plan or schedule? Could actions have occurred sooner and, if they had, would logistics support have been improved?

First, the GMR actions overlaid on actual ODS events show a clear breakpoint on August 2, 1990 as Iraqi forces invaded Kuwait. In a GMR sense on that date, the crisis clearly moved from Stage 3, "planning and preparation," to Stage 2, "specific crisis planning, preparation, and action." In the strictest sense, any GMR-equivalent actions categorized by the study team as Stage 3 were clearly late starters if they occurred after August 2nd.

## Stage 3 Observations

The penalty for not initiating a Stage 3 action is loss of the opportunity to mitigate a crisis and the creation of *ad hoc* activity usually resulting in inefficient use of time and resources, duplication of effort, and added cost.

Looking at the Army planning and preparation actions categorized as Stage 3, the study team found that, among many successes, Army logistics planners either **failed to anticipate the need to establish emergency operating policies** or did not carry to completion those planning policies which had been established. For example, Industrial Preparedness Planning (IPP) for Classes I & II was not fully developed—nor were any Industrial Preparedness measures funded—before the onset of the crisis. Similarly, planning and management tools were required, such as the PC-based CSS sizing model and the Diversion Decision Coordination process for foreign military assistance cases. These representative Stage 3 actions occurred after the Iraqi invasion. In a structured GMR process they should have been in-place before August 2nd. Another common complaint was that many provisioning and support activities—drawn on by both U.S. and coalition claimants—were geared to peacetime support rates with little planning or capability to surge. Had Stage 3 planning been done in a structured GMR environment, support may have been available by C-day. As it was, theater stocks—*especially Classes I & II*—were not judged adequate until December 1990, and this was only after extraordinary efforts and costs on the part of the logistical system.

## Stage 2 Observaticns

Stage 2 crisis preparation and action begin when the nature of the crisis becomes clear enough to the "triggers" that specific actions can be formulated. The study team observed that, in general, Army logisticians reacted swiftly and effectively once the Stage 2a, "specific crisis assessment and planning," tasks were decided. Getting to this point was, however, often sluggish and confused. Some delay can be attributed to the "pull" nature of the early phases of the logistics support concept; but, primarily, slowness to anticipate can be laid to the **lack of an Army institutional framework for transitioning from peacetime to crisis operations in a proactive rather than reactive mode**.

For example, reviewing critical items lists, convening established committees (like the Joint Production Committee or the AMC Surge Committee), or setting war reserve stockage objectives should be matter-of-course actions as soon as the specific nature of the crisis is known. In ODS, because of the "joint" nature of the operation, these activities occurred in

response to theater requirements, as the logistics support infrastructure adapted to the pace of the deployment, rather than as part of Stage 2a crisis assessment.

By the time the level of U.S. involvement and the logistics support concept became final (certainly no later than the November 8, 1990 decision to increase the deployment flow) the total logistics system had moved into high gear and began pushing support to theater. The actions the study team assessed as belonging to Stages 2b and 2c occurred in accord with what had become a thorough logistics plan and a mature theater. Timing was less important here than recognition by the "triggers" of the range of issues which required resolution before the CINC could confidently set H-hour, G-day.

## CONCLUSIONS

As a result of the Phase I analysis, the study team made the following conclusions:

- ODS should not be used as a template for future regional contingencies
- Because the Army was structured and provisioned to fight a NATO war, the benefits of an active GMR were minimized
- At least ten percent of the ODS activities should have been accomplished before August 1990 if GMR were operative
- Many of the non-political preparedness activities could have been accelerated if GMR guidelines and procedures were implemented
- The Army did not use the warning that was available to evaluate and prepare for highly likely future occurrences, as evidenced by the lack of a post-conflict asset recovery policy
- It is unclear if Army personnel were sufficiently indoctrinated in GMR to have effectively used it.

Several people have suggested that the ODS experience can serve as a template for future U.S. operations in support of a major regional contingency. However, it is unlikely that the political and military factors that existed during ODS can be assumed for future regional scenarios. Certainly, the administration is in the process of reducing both the force structure and the quantities of on-hand assets over the next few years. The specific GMR-equivalent actions identified in this report are, for the most part, peculiar to the Gulf theater of operations. While the specific actions should not be directly transferred into a GMR crisis checklist, the **general themes** that can be extracted from the set of actions can also be very **easily converted into crisis planning and execution guidelines** that will be **useful for the full spectrum of future crises.**

The GMR Stage 2a crisis assessment for ODS very quickly resulted in a conclusion that the operation could be conducted using existing world-wide assets. With that decision, the need to plan, prepare, or surge the industrial base was, for the most part, eliminated. This meant that the benefits generally derived from the early assessment of production needs, the timely elimination of capacity shortfalls, and the judicious exercise of procurement decisions were not required to support the military strategy. Nevertheless, the fact that some extraordinary effort was required to produce troop support items (food, clothing, chemical gear) endorses the contention of GMR proponents that planning for the worst-case scenario will not subsume all lesser scenarios, nor will it ensure that lesser scenarios will be handled any more prudently.

GMR is predicated on deliberate and knowledge-based decisionmaking. Any GMR implementation scheme must accommodate the peacetime development of policies, doctrines, procedures, processes, and organizations that provide for a rapid transition into crisis operations. The preferred way to accomplish the transition, of course, is to use existing processes and organizational structures for both peacetime and crisis decisionmaking. However, there will always be some need for special boards, committees, and task forces to focus particular attention on issues that are not part of the regular peacetime routine. Experience gained through exercises or actual crises and a realistic review of functional responsibilities should identify the majority of such needs. If the Army will use ODS lessons-learned and will formally establish needed resource methods for developing priorities and expediting actions, it can save a significant amount of start-up time for future crisis assessments.

Knowledge-based decisionmaking requires the establishment of valid databases and responsive decision support systems that are configured to support the full range of assessment needs. In order to accelerate preparedness activities, the Army must be able to perform assessments of the specific details of a crisis in minutes or hours rather than days or months. Such capability should be incorporated into the Army's ongoing data system development and upgrade.

GMR requires planners to evaluate current events for likely undesirable consequences, to identify options for mitigating those consequences, to determine whether any of the options has resource constraints, and to propose measures to overcome the constraints, if required. The ODS activities reviewed by the project team did not demonstrate that the Army had any individual or group that was actively evaluating future courses of action.

All of the preceding conclusions regarding the absence of a GMR application during ODS is attributed to the lack of concept indoctrination prior to August 1990. The project team was not able to identify any Army decisionmaker who understood the GMR fundamentals and process. Without some top-down direction within an organization, it is unlikely that the GMR concept can be applied to a crisis situation.

# CHAPTER 5

## VALIDATING THE GRADUATED MOBILIZATION RESPONSE CONCEPT

The concept of Graduated Mobilization Response (GMR) has been continuously evolving since it was first proposed in 1982. In 1982, the term "Industrial DEFCONs" was coined to describe states of industrial readiness. Modeled after DoD's Defense Alert Conditions, the various states would be invoked to produce immediate and measured reactions to varying levels of warning and crisis. The working title for this still-informal concept was changed to Industrial Alert Conditions (INDCONs) in 1984 to describe a range of industrial base actions that could be selectively applied to respond to various perceived threats. In 1987, OSD elected to broaden the concept's application beyond industrial base response issues and adopted the name of Graduated Mobilization Response (GMR).

Throughout that time, GMR was still a concept; since then, it has increasingly been recognized as a matter of national policy. In 1988, the concept became official DoD policy with the publication of DoD Directive 3020.36, "Assignment of National Security Emergency Preparedness (NSEP) Responsibilities to DoD Components." In 1989, the Federal Emergency Management Agency (FEMA) published a Defense Mobilization Order on GMR. In 1990, OSD revised its industrial preparedness program Directive and Manual to establish GMR policy and procedures for industrial base program planning and execution. In 1991, the Joint Staff's Joint Strategic Capabilities Plan (JSCP) required the Military Services to use the GMR concept to prepare their mobilization plans. The National Military Strategy document, published in January 1992, supports the use of the GMR concept for dealing with force reconstitution issues. The POM Preparation Instruction also requires each Service to conduct a reconstitution assessment to accompany the FY 94-99 POM submitted in April 1992.

During this period of concept development and policy definition, the threat environment has changed so significantly that some officials are beginning to question the need for GMR as a future operating framework. This report will review the original premises of the GMR concept, assess the continuing validity of that rationale in the Post-Cold War environment, and describe the organizational costs and benefits of using GMR for future crisis planning, programming, and execution.

## GMR CONCEPT RATIONALE

What ultimately became the GMR concept was first outlined in 1982 as a means to provide a constructive approach to enhancing industrial preparedness for potential conflicts. At the time, the Department of Defense was focused on a planning scenario which assumed a "worst case" of a major Soviet attack, with little or no warning, on NATO forces in Europe. Most analyses assumed that the industrial base would not be able to respond in a timely manner to such a major short- or no-warning scenario — or that the cost to ensure an adequate response was not affordable.

However, DoD's concentration on this extreme scenario resulted in relatively little attention to lesser scenarios where an industrial response might be more possible and relevant, including a major superpower conflict in Europe that was preceded by substantial warning. Because the "worst case" scenario did not allow for pre-crisis industrial responsiveness, few resources were committed to improve that responsiveness; because the resources were not committed, responsiveness did not improve and military plans were not generated to take advantage of the nation's economic strength.

The INDCON concept (which provided the basis for the GMR system ultimately adapted by the government) was developed in the mid-1980s to help provide a policy and planning structure to improve industrial responsiveness for a range of crises. It was specifically created to:

- Provide a flexible system that could support a range of National Security threats
- Provide a means to target preparatory funding to fill high priority near-term readiness deficits
- Provide enhanced industrial responsiveness for a crisis without major negative impact on peacetime procurement programs
- Enhance industrial responsiveness through more effective planning and coordinated actions in a crisis.

The INDCON concept was explicitly developed to provide a broad improvement in planning, preparedness, and response capability to meet a wide and uncertain range of potential future crises and emergencies. It envisioned a structured and intensive planning process that would identify problems likely to arise in a future crisis (and methods to deal with these problems) together with a measured series of response options that could effectively enhance military capabilities.

The INDCON system was intended to permit selective implementation. Not all actions within various functional categories would have to be taken at the same time nor would all industries, sectors, or weapons programs necessarily be placed at the same INDCON level. The system would be capable of responding to discrete, limited crises as effectively as it would respond to major crises affecting the entire economy.

Even though there was a major increase in the defense budget in the early 1980s, military planners always had to deal with the prospect of sustainability shortages as constraints to military actions. Merely increasing the **tempo** of peacetime operations and training as an indication of fighting readiness could deplete already short supplies of equipment, spares, and some consumables. The INDCON concept postulated that in addition to generating greater stocks of war reserves and otherwise preparing for conventional war in Europe, the enhanced preparedness could accelerate production of additional or replacement stocks to support smaller, localized conflicts.

A wide range of industrial responsiveness options is available to deal with any potential crisis. For most of these situations, very definite limits were assumed to exist on how much inconvenience or disruption to peacetime programs was practical. The INDCON concept recognized that in the early stages of a crisis, policymakers and planners perpetually face the twin risks of **overreacting** or **underreacting** to the situation. Thus the ability to generate and review a credible set of alternative actions and to predict the extent and limits of their impact is an important aspect of any crisis management system. The INDCONs were well adapted to a situation where policymakers have imperfect information about the nature of future events.

Each move through the INDCON phases was intended to provide an additional increment of responsiveness while avoiding the excessive costs, economic impacts, and political controversies that could be caused by premature "mobilization" actions.

The INDCON system recognized that comprehensive planning for all issues that could affect surge and mobilization capabilities was a necessary precursor to the later preparatory action and execution stages. A major premise of the concept was that effective planning can identify likely problems and options to deal with them before a crisis, and that these plans can promote a more effective response during a crisis. The planning process can **identify the general issues and problems** that are likely to occur in an emergency and **identify solutions** for these problems.

## THE CONTINUING VALIDITY OF GMR

Some people cite the recent demise of the Soviet Union and the diminished, but uncertain, likelihood that the United States will become engaged in fighting against a global threat as grounds for declaring GMR obsolete. The current geo-political environment has the actual effect, however, of forcing DoD to confront the quandary of identifying the current threat or threats that pose a sufficient national security risk to require the use of military force.

With all of this uncertainty in defining the possible threats, the possible scenarios, and the scenario requirements, GMR is even more valid and relevant as a crisis management framework than ever before. In fact, recent world events and technology changes suggest that GMR may be a more critical element of U.S. national security planning than it was thought to be in the NATO-dominated security environment of the late-1980s. The first significant change was the **collapse of the Soviet empire and the movement toward democracy in many of the Soviet Union's former allies in Eastern Europe**. The reduction of the perceived Soviet and Warsaw Pact threat has virtually eliminated the threat of a major short- or no-warning attack on NATO. The development of "mobilization response" plans and capabilities was one central casualty of the Cold War assumption that our most serious national security threats were nuclear or short-warning, major conflict scenarios. Basically, the dimensions of the requirements and short warning times obviated any potential response from the production base and required the United States to prepare for a "come as you are" war. It now appears certain that the principal national security threats faced by the United States in the coming decade or more will be regional conflicts involving considerably smaller buildup rates or sustainability requirements than the NATO scenario **or** a variety of potential crises that could escalate over time into a major conflict. Whether requirements are smaller than the previous "NATO" scenario or buildup times are longer, the effect is the same: mobilization response has a greater potential to contribute to meeting future national security needs than its perceived contribution toward meeting or deterring Cold War security threats.

A second factor that increases the relevance of GMR is the fact that **defense budgets will be reduced significantly in the coming years**. Especially in the early years of the Reagan buildup, a second factor arguing against a major emphasis on mobilization response plans and capabilities was the sense that adequate levels of readiness and sustainability in place before the conflict were not only necessary **but also achievable to a substantial extent**. In the coming years, DoD budget reductions are likely to yield a military force that is

smaller, less modern, less ready and less sustainable than the force that was planned only a few years ago. This will put a much higher premium on response plans and capabilities.

Third, while the near-term threat of superpower conflict has diminished considerably, it now appears that **the United States will face a wide diversity of threats, at varying levels of the conflict spectrum**. Responsiveness to a wide diversity of threats of varying levels of intensity is one of the key attributes of GMR.

Finally, **changes that are underway in industry will make it substantially easier for DoD to rely on a rapid and flexible industrial response**. DoD's ongoing CALS initiative plus the general trend in manufacturing industries toward "lean" production and flexible manufacturing capabilities will provide powerful enabling tools that could only be imagined when the GMR concept was originally defined.

Moreover, in terms of its validity as a DoD planning instrument, it is important to note that:

- Most GMR Stage 3 planning and preparation activities are not predicated on a specific threat scenario
- The GMR concept promotes a rapid and flexible response to a wide range of plausible crises
- The GMR concept recognizes the synergistic roles of war reserves and production base
- The GMR concept recognizes the need for spares and consumables in the early stages of a crisis
- The GMR concept requires the establishment of quantifiable resource goals and objectives to support cost/benefit assessments.

Proponents of GMR actively discourage the routine development of "precanned" option packages supporting specific hypothetical scenarios. During the course of the concept's development, some members of the preparedness community have attempted to relegate GMR planning to a single Illustrative Planning Scenario. But, GMR Stage 3 planning disciplines call for the development of procedures, processes, mechanisms, and organizations that will permit a more timely response to real situations as they occur. Efforts to construct detailed, "hard-wired" option packages before such planning is completed may actually retard DoD's ability to respond effectively to the full range of potential crises in a timely manner and may result in the misapplication of already scarce resources.

DoD probably will never again face such a clearly defined threat as that posed by the former Soviet Union. Because the military and political controversy over threat scenarios and resource requirements undoubtedly will continue for the foreseeable future, planning and preparation activities will only be possible if GMR remains the operative framework.

Future threat scenarios will impose time and quantity resource requirements which the Army may satisfy through a combination of on-hand stocks of consumables, repair and/or substitution of nonconsumables, and new production.

A fundamental tenet of GMR is the need to maintain a Stage 3 baseline response capability. GMR has always been predicated on an integrated peacetime defense program that is responsive to manufacturer risk-based objectives. GMR does **not** mean a deferment of investment in war reserves and the industrial base until a crisis actually occurs.

## THE COSTS OF DOING GMR

If GMR is ever to move from concept to standard procedure, the Army must indoctrinate its members in the culture, terms of reference, and general processes of the concept so that GMR becomes a natural way of thinking. This integration of the GMR "way" of conducting business will go far to minimize the cost of GMR implementation. There are a number of ways that such indoctrination can be conducted:

- Where logistics doctrine and operating procedures are taught (Army War College, Command and General Staff College, and Army Logistics Management College), modify the relevant material as a part of the formal instruction.
- Conduct seminars for selected personnel to get them "up to speed"
- Distribute manuals, pamphlets, and other documents that explain the concept.

The seminars and document distribution can serve as a near-term solution. Modifying the formal instruction is the best way to routinely reach future logistics practitioners.

### GMR Stage 3

For the Army, GMR Stage 3 costs may be partitioned into three categories:

- Operational management and support
- Acquisition and maintenance of industrial base capability
- Acquisition and maintenance of materiel inventories.

Operational costs include personnel salaries for planning and analysis and electronic data management/decision support systems. Industrial base costs generally include those actions that support the transition of an industrial capability from its peacetime posture to a specified crisis capability. Materiel inventory costs consist of reserve stocks to be used for other than normal peacetime activities.

### *General Planning - Stage 3a*

GMR Stage 3a (general planning) activities are focused on process and procedure development and assessment of the baseline response capability. Process development activities will require the Army personnel to evaluate their existing crisis management system in terms of changes in their operating environment and lessons learned from previous crises and exercises and to make appropriate changes to improve future response capability. Since these activities are a continuation of current efforts (e.g., the Integrated Army Mobilization Study), no additional outside costs should accrue as a result of instituting the GMR framework—except that the effects of service "downsizing" could have a negative affect on the ability to conduct business as usual while working through the requirements for GMR. In fact, because the most recent Joint Strategic Capabilities Plan requires the Army to revise its mobilization plans to conform to the GMR concept, an Army decision **not** to use GMR as its planning model could result in higher than current operating costs, since two parallel systems would have to be maintained.

An effective GMR requires a quick turnaround on crisis assessments. This means that databases must be configured and filled with data that can satisfy the full range of assessment needs. Decision support systems must respond in minutes rather than days or months. The recent changes to DoD's production base analysis process (including the Production Base Information System, ProBase) were developed to support GMR industrial base assessments. As of the time of this study, ProBase had not been implemented. Collection of data not previously required and the associated ADP effort will cause an unknown amount of new costs. CAA, LEA, and other Army model builders can be used to develop analysis tools that will meet GMR assessment requirements. Although an evaluation of the Army's data systems is outside the scope of this project, we can surmise that data system development and upgrade is ongoing, can accommodate altering or enhancing database systems to meet GMR data requirements for the full range of assessment needs, and outputs can be put in GMR format with minimal additional cost.

### *Programming, Preparing, and Testing - Stage 3b*

GMR Stage 3b (programming, preparing, testing) activities involve maintenance of a minimum level of preparedness for future emergencies. Programming activities include justifications for funding to maintain the crisis response capability specified in the Defense Planning Guidance and development of programs as a part of the POM building process.

Preparation activities include funding all response capability projects—such as procurement of war reserves to reach specified levels and funding for preservation and establishment of industrial base capability.

Testing of crisis response procedures is necessary to ensure that an effective response is possible. Testing can be accomplished by developing response options to selected illustrative threat scenarios during periodic exercises, conferences, and workshops.

The operational costs attributable to Stage 3b should not significantly vary from current expenditures. Programming activities, if properly focused, should remain at the same level, assuming that they are preceded by adequate analysis to develop the investment strategy. There may be some increase in testing costs. In order to fully test GMR, the Army will need, as a minimum, to modify its procedures-testing exercises (e.g., the Joint Staff Mobilization Exercise (MOBEX)) to reconfigure the scenario events to support the GMR concept. Traditionally, MOBEXs have tested force deployment procedures. GMR cannot be tested as a part of an exercise having that objective. Therefore, either the exercise objective will need to be modified or corollary exercises such as the 1987 Proud Scout Serial Exercise will need to be developed. Exercises such as the Naval War College's Global War Game (GLOBEX) can provide an excellent test bed for GMR concept evaluation. However, the GLOBEX is also limited because it uses surrogates for the key decisionmakers and lacks a structure for effective exercise play, decision support, and follow-up. An effective GMR must conform to the management styles and preferences of the most senior decisionmakers and these styles and preferences must be known before a crisis occurs. Because the Joint Staff has cancelled many of its scheduled exercises, the Army may need to supplement the exercise schedule with its own exercises; but since the testing process of GMR Stage 3 cannot be executed without the full participation of the Joint Staff, **effective** testing of GMR is only possible in a joint exercise environment..

In general, the GMR concept favors reliance on latent industrial base capability in preference to war reserves which can become obsolete and physically deteriorate over time. Also, under GMR, production enhancements obtained through technology innovations or

use of commercial products are preferred over standby production. A key factor in favor of an effective GMR process is that the process can actually **reduce** some **preparedness investments** (without reducing preparedness), thus freeing up resources for other investments. An effective GMR process can also provide a powerful justification to increase selected investment areas. Effective GMR plans may be especially attractive to Congress, which wants to fund enhancements in industrial preparedness and competitiveness and is increasingly frustrated with its perception of DoD as lacking leadership in this area.

Although, under GMR, some industrial base and material stockage costs may be higher than the current expenditure levels, approval to increase expenditures will only occur if the funding justifications are sufficiently convincing to obtain the approval of the decision authorities. The **GMR** concept **does not support unreasonable funding of crisis response capability**. Rather, it demands the establishment of explicitly defined programming objectives and the evaluation of each funding proposal on its ability to support those objectives. A decision to accept the risk associated with not funding a project is a valid alternative as long as the decisionmaker is fully informed of the possible consequences.

## GMR Stage 2

### *Specific Crisis Assessment and Planning - Stage 2a*

GMR Stage 2a (specific crisis assessment and planning) activities include the assessment of any world event that could require the obligation of military resources beyond normal program levels. Full incorporation of GMR could require the Army to revise its crisis situation monitoring procedures. Crisis assessments are triggered by **individuals** who recognize that a situation or the possible consequences of a situation may be detrimental to the organization. Currently the Army has no formal mechanism to trigger these assessments. The Army has three options for establishing GMR triggers: rely on groups such as the Army operations center watch team to provide notification; detail an individual (or rotate the duty among a group) to be responsible for evaluating events; rely on each member of a particular Army organization to identify those events that could have detrimental impact on his or her functional area. Each of these options would require the responsible persons to receive training in the GMR process and appreciate the logistical significance of situations and events.

No matter which triggering option is selected, each situation or event must be evaluated for its potential (or actual) risk to Army operations. Where risk areas are identified, options to overcome those risks should be developed and a range of options

presented to appropriate decisionmakers. Based on the option information, decisionmakers can decide to either accept the risk and continue to monitor the situation or to take risk reduction actions.

In every case, training people to think about events and issues from the GMR perspective will require the same kind of training that has been used to establish the Total Quality Management concept. This **training will cause** the Army **to incur an additional cost**. Additionally, the time spent in making crisis assessments and conducting crisis planning may require some diversion of personnel resources, with the possibility of requiring additional staff to conduct this function. The resource burden can be minimized by incorporating GMR into the daily activities of each Army member and providing the data and data management tools needed to perform rapid-turn-around, what-if risk assessments.

### *Specific Crisis Preparation - Stage 2b*

Stage 2b (specific crisis preparation) activities allow the Army to overcome crisis induced deficits in logistics support. Materiel shortages would be filled to the levels determined by the crisis assessment and industrial preparedness measures would be funded to bridge any production capacity gaps. Some of these activities could be funded by accelerating existing programs; others will require supplemental funding, depending on severity of the shortfall and the available time to respond.

# CHAPTER 6

# THE PROGRAMMATIC ASPECTS OF GRADUATED MOBILIZATION RESPONSE

One premise of GMR is that the industrial base can produce anything required, given enough time and money. GMR can provide managers timely information, allowing the managers to decide whether they want to, or can afford to, spend the money. GMR uses two mechanisms for developing programmatic strategies for crisis response: the **POM** investment strategy (peacetime—Stage 3); and, the crisis option package (crisis—Stages 1 and 2).

## THE POM INVESTMENT STRATEGY

The POM investment strategy is composed of three elements:

- Objectives
- Capability Assessments
- Action Plan.

### Investment Strategy Objectives

Objectives define decisionmaker goals. Ideally, the Army would start with broad strategic objectives such as: "Preserve essential, unique capabilities needed to design and produce weapon systems for the smaller, highly capable armed forces planned for the future and for larger forces if the need to reconstitute should arise." To be effective for POM purposes, each strategic objective should be restated as one or more specific objectives which, in turn, can be further refined to the point that each objective can be expressed as quantifiable measures of effectiveness.

Investment strategy objectives are programming targets. These targets represent the Army's desired peacetime baseline capability for supporting Army involvement in future crises. Under GMR, informed decisionmakers deliberately establish an acceptable level of risk they will assume regarding their ability to support likely, plausible future scenarios. This level-of-acceptable-risk approach could lead to a probability-based requirements generation process as opposed to rigid deterministic (chain-of-events) process.

For example, the Joint Staff has established a family of plausible scenarios ranging from peacetime operations through low intensity and regional conflict to the global scenario. The Army can evaluate each of these likely scenarios to determine their respective resource requirements. As depicted in Figure IV-6-1, the resource requirements for these scenarios can be placed on a scale that shows the relative level of resources that the Army needs to provide the projected logistics support requirement. A "100" represents the resource requirement for the Army to logistically support all scenarios. Broad programming targets can, then, be expressed as:

- "Ensure that 65 percent of the likely future scenarios can be supported"
- "Ensure that 65 percent of the likely future scenarios can be supported and all assets can be replenished to former levels within a year of the end of the conflict"
- "Ensure that all scenarios that have a 65 percent chance of occurring within the next five years can be supported."

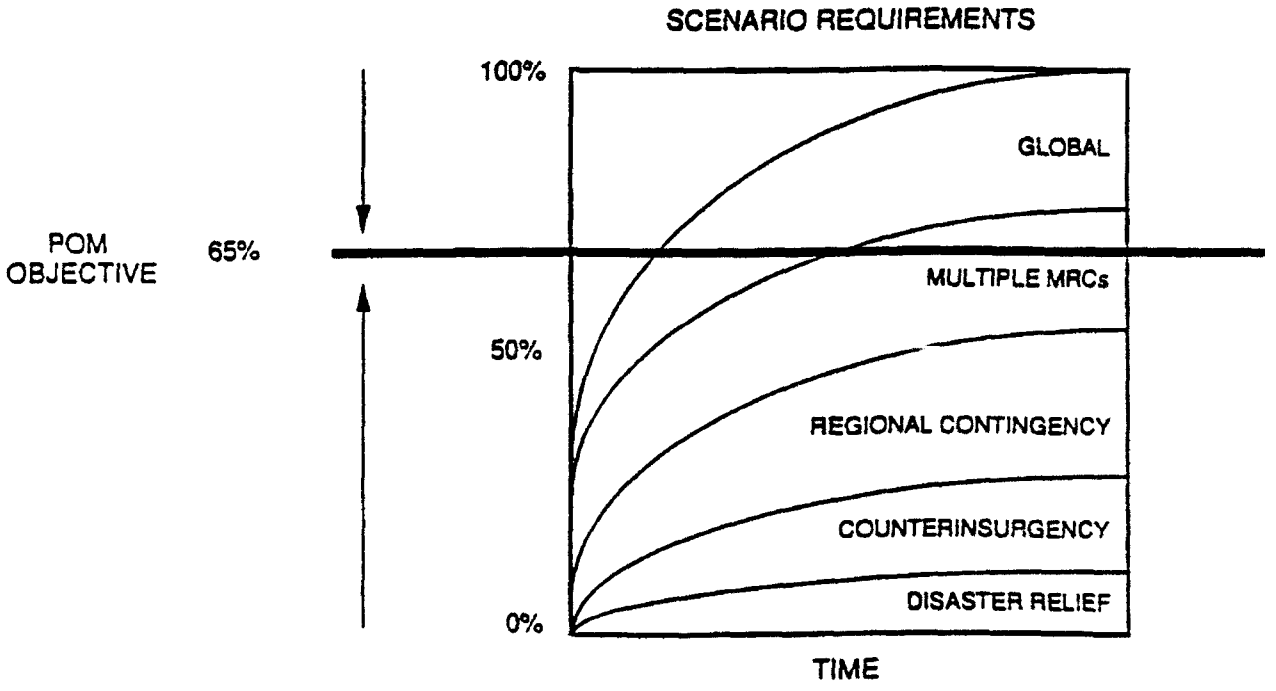


**FIG. IV-6-1. ESTABLISHING THE POM BASELINE**

For the industrial base, these broad targets must eventually be reduced to quantifiable objectives such as:

- "Be able to field six armor divisions (or their direct fire mission equivalents) within three years of a decision to do so"
- "Be able to triple production of TOW missiles within 18 months of a decision to do so."

In every case, industrial base objectives must be expressed in terms of quantities and time.

### Investment Strategy Capability Assessments

Capability assessments must answer three basic questions:

- Where are we now in the attainment of our objectives?
- What is the shortfall between where we are and where we want to be?
- What can be done to overcome the shortfall?

These answers must be expressed in terms of the measures of effectiveness.

Solutions to overcoming resource shortfalls will vary with the quantity and time constraints imposed by the objectives. As shown in Figure IV-6-2, low level, short lead time requirements are best satisfied by on-hand inventories. At some point, the costs of inventory procurement, storage, and disposal (due to obsolescence and shelf-life) will exceed the costs of maintaining production capacity (both in-production (warm base) and on-call (cold base). As the resource requirement grows and the response time extends, the Army will have to put less reliance on current production capabilities and more reliance on the technology base for more cost effective product and process enhancing solutions. At some level of requirement, even the Defense-controlled technology base cannot reasonably be expected to satisfy the shortfall and planners will need to look to the national or even the global economy to provide the necessary support.

### Investment Strategy Action Plan

The action plan develops a prioritized set of funding projects based on the assessment recommendations for overcoming resource shortfalls. Each project should contain a project title, priority, cost estimate, expected benefit (in terms of the measures of effectiveness), and the risk of not funding (also in terms of the measures of effectiveness).

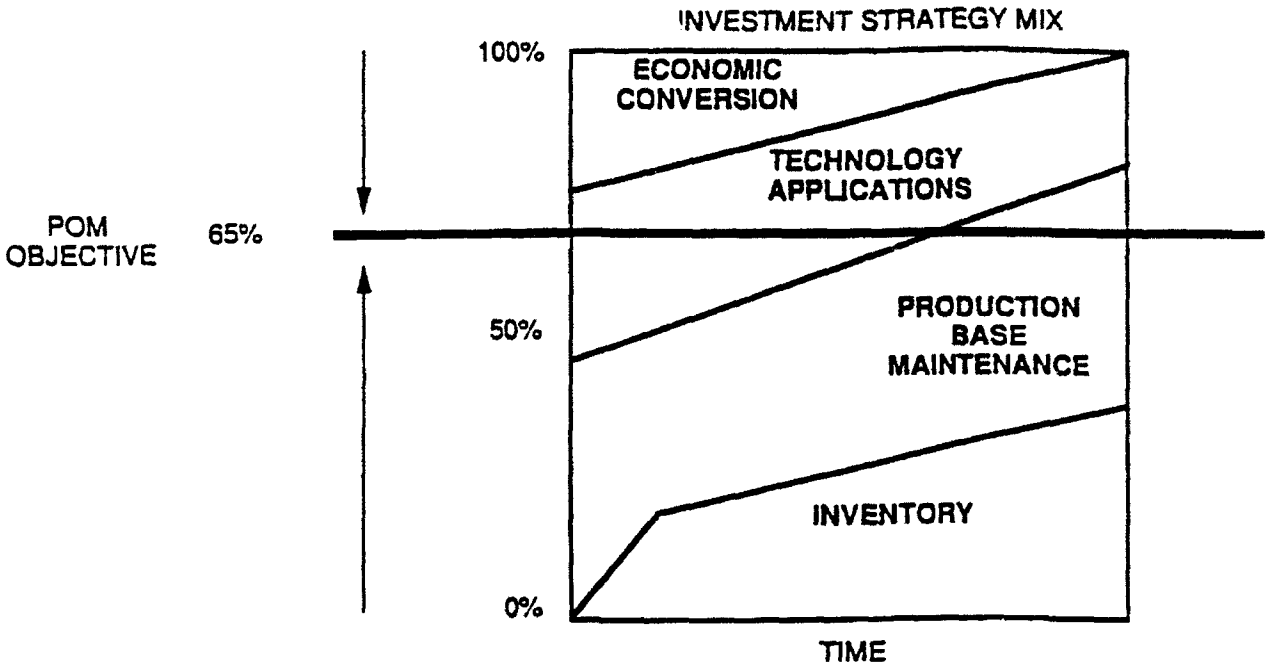


**FIG. IV-6-2. DEVELOPING THE INVESTMENT STRATEGY**

DoD 4005.1-M-1, "Industrial Base Program Procedures Manual," (a draft document currently in coordination) requires Army to:

- Produce an industrial base investment strategy by August of each odd-numbered year
- Summarize the strategy in its Production Base Analysis Report and deliver the PBA Report to OSD by November of each odd-numbered year
- Brief Army's industrial base program to the Assistant Secretary of Defense for Production and Logistics, following Army's POM submission in April of each even-numbered year.

## THE CRISIS OPTION PACKAGE

The crisis option package is a product of GMR Stage 2a (specific crisis assessment and planning). As described in more detail in Chapter 3, Stage 2a assessments occur whenever a world event is considered to be outside the range of accepted Army operations and has the potential to become a threat to national security. Each option package should provide the decisionmakers with a succinct statement of the risks, costs, and benefits of particular courses of action. The contents of a typical option package are summarized below.

### The Scope of the Event

Not all Army Components will need to respond to every event. In many instances, only individual Components or portions of Components may need to conduct Stage 2 activities while the remainder of the Army continues to function normally. Similarly, a technology breakthrough may only involve a particular industry; a client war may only involve selected weapon systems; and an earthquake may only involve manufacturers in a particular geographic region.

### The Likelihood of Undesirable Impact on National Security

This involves not only a consideration of the actual event but also an evaluation of potential corollary events. For example, the 1989 demonstration of national will by putting ships in the Persian Gulf led to short-term skirmishes with Iranian gunboats and could have grown into a single-theater conventional war with Iran. The drawdown of certain materiel to support one crisis could make U.S. forces vulnerable in other regions of the world.

### The Time Available to Respond

Stage 3 investment strategies are designed to improve the Army's capability to respond to future likely scenarios. However, there is no guarantee that the general planning assumptions of warning/response time will match the time available for the event being considered. A shorter response time requires a corresponding increase in the intensity of response actions.

### The Alternative Response Options

Response options fall in three broad categories: political, military, and industrial. Political response options include security assistance and support of a client war. U.S. military forces are not involved in these options. Military response options range from a demonstration of national will or short-term regional action through all of the variations of partial, full, and total mobilization. Industrial response options may be used to counter a major technology breakthrough, to demonstrate national will, or to recover from a natural disaster. Industrial options are often more appropriate when warning is considered ambiguous since they send a softer signal and the expended resources can be more easily diverted to other uses should the perceived threat dissipate.

Each response option will contain one or more actions selected to best (within cost and time constraints) mitigate the perceived risk.

### Response Implications and Shortfalls

Resource implications—including materials, productive capacity, labor, supporting services, and necessary Army resources—must be evaluated to ensure that each option is viable. The magnitude of any shortfall will determine the scope of necessary preparations that must precede option implementation.

### Capability to Meet the Shortfall

Currently available capability may be inadequate to timely provide the necessary materiel. If so, the Army should consider taking actions to improve industrial/logistics responsiveness.

### Actions to Improve Industrial Responsiveness

These actions will vary depending on the level of demand, the response leadtime, the production environment (surge or mobilization), and the expected duration of increased industrial activity. Preferably, these actions will precede production, however, some events may require simultaneous performance. An effective data collection and analysis capability is necessary to help determine which actions are most appropriate.

### Associated Costs

The decisionmaker will always be concerned with the costs associated with GMR options. Industrial base costs should be expressed in terms of preproduction investment, postproduction investment, and materiel procurement. Logistics costs should include the recurring as well as the nonrecurring costs.

### Political Feasibility

The views of the Administration, the Congress, and the public sector must always be considered. During long warning periods, some otherwise desirable options may be rejected because of adverse political consequences. A wide range of responsiveness options is available to deal with any potential crisis. For most situations, very definite limits will exist on how much the Government is willing to inconvenience the public. The best solutions are those that produce effective crisis responses while maintaining positive or neutral political reactions.

# CHAPTER 7

## GRADUATED MOBILIZATION RESPONSE TRIGGERS

The triggering of GMR crisis actions is probably the least understood and most controversial aspect of the GMR concept. Certainly, the complete implementation of the concept depends on astute individuals recognizing the inherent risks that may result from undesirable outcomes of current events. Because most improvements in logistics posture have significant acquisition lead times, early recognition of logistics support deficiencies and the willingness to take appropriate actions will reduce the requirement to maintain high levels of inventory and production capability in peacetime.

Some people believe that GMR crisis assessments are triggered by events. That is, it is assumed that the occurrence of an event will automatically cause policymakers to take a set of pre-specified actions. However, such a triggering mechanism would quickly mire the GMR process in an unmanageable concoction of many possible scenarios with a virtually limitless set of permutations of possible future conditions. This event "rolodex" would lead to multiple file cabinets of canned responses, all of which have an extremely low probability of actually occurring as forecast. An event-based triggering mechanism is actually the antithesis of GMR as it was originally conceived and accepted; it would return GMR to the "on-off switch" that has been the conventional approach to mobilization and would eliminate the flexibility that the GMR concept was intended to provide. Such a system would also consume considerable staff resources in preparing the pre-crisis response options — resources that impose a high opportunity cost to any organization.

From the beginning, the GMR concept has maintained that crisis actions are triggered by people rather than events. It is people that determine whether or not that an event or series of events pose risk to their organizations . This risk may be either perceived or real, depending on the circumstances. It is people that determine whether the circumstances warrant the commitment of resources.

Early in concept development, when global war was the predominant threat, GMR proponents believed that the crisis actions trigger would be the President's national security advisor or the Secretary of Defense. The development of crisis option packages would respond to top-down taskings from the national command authority.

Operation Desert Storm demonstrated that many crisis responses can be triggered in a decentralized, bottom-up recognition of need. During Desert Storm, the announcement of the Iraqi invasion caused immediate and simultaneous crisis assessments and actions at all levels of the Department of Defense. After evaluating these activities, we conclude that:

- There is no restriction on who may initiate a Stage 2a crisis assessment
- Decisions to engage in crisis preparatory actions (Stage 2b), crisis actions (Stage 2c), or mobilization (Stage 1) must be made by individuals who have funding authority
- The scope of GMR assessments and options depends on the level of the decisionmaker.

## IDENTIFYING WARNING INDICATORS

The Army acquires GMR warning through both formal and informal means. The formal avenue is the intelligence community, which is trained to identify world events that could be detrimental to national interests. Unfortunately, most of this capability is focused on tracking locations, activities, and capabilities of threat military forces. In the past, this focus resulted in the short warning (hours or days) reflex responses that were prevalent throughout the Cold War.

Within the last five years, proponents of GMR have lobbied the intelligence community to develop warning indicators that could provide longer lead times. In response to this request, some effort has been expended to look to threat economic conditions and industrial activity for essential elements of information. Even before the demise of the Soviet Union, available warning had been increased from hours to months. Now, with the current conditions of most threats, warning for major military responses can be expressed in years.

The Army should not be passive on this issue. decisionmakers will only respond to those warning indicators that they believe signal legitimate, probable risk to Army/DoD/ National interests and initiatives. This means that the Army should identify those observables that might be meaningful to their leadership and coordinate the development of collection targets and analytical methods with the intelligence community.

One key challenge will be to differentiate between observables that signal industrial mobilization (or preparatory actions) and those associated with peacetime product changes or modernization. Particularly promising observables may include:

- Operational factors, such as security procedures and general operations tempo
- Changes in product mix
- Changes in shipments in and out of the factory (raw materials/components and end products.

News reports and other publicly available material in print or on radio and television provide an informal warning mechanism. Individual members of an organization can be sensitized to recognize potential risks to their functional area of responsibility and to conduct preliminary "what-if" assessments.

## REPORTING WARNING INDICATORS

The formal Joint Reporting Structure has five intelligence reports which could be used to provide warning:

- Defense Intelligence Notice (DIN) — provides timely, finished intelligence about developments that could have a significant effect on current and future planning and operations
- Special Defense Intelligence Notice (SDIN) — provides timely intelligence about events that could have an immediate and significant effect on current planning and operations
- Spot Intelligence Report (SPIREP) — provides critical information on critical developments that appear imminent or are of potentially high interest to U.S. national-level decisionmakers
- Daily Intelligence Summary (DISUM) — provides a daily analysis of a crisis and a summary of relevant intelligence information produced during the preceding 24-hour period
- DIA Periodic Intelligence Summary (DIA INSUM) — provides timely, periodic intelligence summaries about a foreign crisis that could have immediate effect on U.S. planning and operations.

As discussed earlier, these reporting formats are not currently structured to support GMR warning requirements. Any applicable intelligence is coincidental to the information-gathering goals. Should the intelligence collection targets change, changes in the reporting formats will, undoubtedly, follow.

The informal process is more like a chain reaction. As depicted in Figure IV-7-1, when individual staff members are alerted by GMR-significant events, they can express their concern to their superiors or coworkers. Each of these people can, in turn, decide whether the concern is significant to them and can choose to react within their particular range of capabilities. As the concern ripples, both laterally and vertically, the event will either lose its significance and be disregarded or some decisionmaker within the organization will take risk-reducing action.

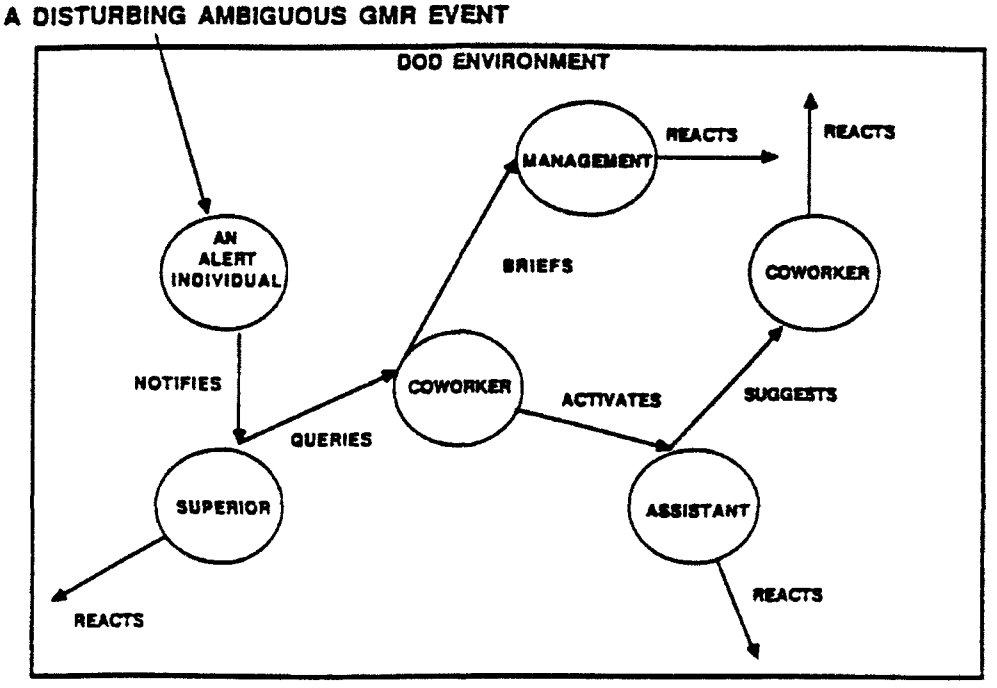


**FIG. IV-7-1. A GMR TRIGGERING REACTION**

## CONFIRMING WARNING INDICATORS

Training staff members to recognize GMR significant information provided by the formal process should not be difficult since the number of individuals reviewing such documents is relatively limited. The informal process requires a much more extensive indoctrination.

## ACTING UPON WARNING INDICATORS

Chapter 8 discusses how the Army can conduct GMR crisis actions during GMR Stages 2 and 1.

# CHAPTER 8

# CONDUCTING CRISIS ACTIONS

This chapter discusses the conduct of logistics and industrial base actions during GMR Stages 2 and 1. The discussion presupposes that:

- The Army staff is trained in GMR fundamentals
- The Army has a peacetime planning process
- The Army has an alert, assessment, and crisis decisionmaking process.

Should these suppositions not be true, conducting the necessary training and developing the necessary processes are the Army's first agenda items.

## GMR STAGE 2

As previously noted, the movement between GMR Stages 3 and 2 is a dynamic process supporting an easy transition in either direction. Every individual and office within the Army should be comfortable performing simultaneous actions in both stages.

### GMR Stage 2a

When an abnormal event triggers a Stage 2a assessment, the assessment should answer the following questions using the Option Package format described in Chapter 6:

- To which level of hostility (peacetime engagement, conflict, war) does this event apply?
- What are the appropriate response options (military, political, economic) to this event?
- Can the Army support the response options?
- What are the chances that this situation could require the Army to respond to one or more hostilities at this level or a higher level?
- What is the nature of those hostilities and the time required for them to become real threats?
- What response options should Army be evaluating for these threats?

## GMR Stage 2b

When the Option Packages are completed, they will be presented to an appropriate decisionmaker for possible action. An "appropriate decisionmaker" is defined as the person who has the authority to commit (redirect) resources. This commitment may be as simple as a reallocation of funds or may require a decision to reprogram or seek a supplemental appropriation.

Not all Stage 2b actions require the expenditure of funds. Other actions typical to this stage are:

- **Alert** subordinate organizations and key manufacturers to the potential for crisis/mobilization activity
- **Implement** quick reaction capabilities (developed and tested in Stage 3)
- **Signal** resolve and commitment by making deliberate improvements to readiness and responsiveness
- **Suspend** activities that consume critical, short-supply items
- **Initiate** liaison with outside organizations that can help expedite future activities.

## GMR Stage 2c

During this stage, the Army is concerned with crisis logistics support activities that provide the necessary materiel at the right locations, in the right quantities, and within the time determined by Stage 2a assessment and planning. In many instances, logistics activities will be operating within the definition of Stage 2c before equivalent personnel activities (those involved with partial mobilization) are initiated. In fact, logistics actions lead times must be integrated into force mobilization decisions. Lead times at this stage may be relatively short as compared to those derived from Stage 1 operations.

Most Stage 2c actions require the expenditure of funds. Actions typical to this stage are:

- **Implement** priority systems for transportation, maintenance, storage, and supply
- **Increase** DPAS enforcement
- **Procure** additional materiel, as required
- **Release** contingency contracts as required

- **Expedite** inventory buildup.

However, if the process has worked effectively up to this point, expansion targets, resource requirements, and resource management actions will be concisely defined and well-understood, in order to obtain the maximum response with the minimum possible expenditure of resources. Certainly, responses will be more effective and resource requirements (both materials and funds) will be lower than if DoD arrived at the same state of affairs without adequate plans and preparations.

## GMR STAGE 1

Although initiating Stage 1 activities does not require any special authorities beyond those currently in place, it does require a more deliberate decisionmaking process than is needed for Stage 2. This is because Stage 1 activities, by definition, disrupt current operations and cause the obligation of funds that cannot be salvaged should the situation fail to occur as projected.

Because there will always be some disruption, any decision to engage in Stage 1 activities should carry a corollary decision to plan for the future return to Stage 3 activities. The recovery assessment must include a determination of the asset posture (what items, what quantities) and the recovery times (how long to acquire the quantities) needed to respond to yet future contingencies.

Stage 1 actions almost always require the expenditure of funds beyond current authorizations. Typical Stage 1 actions include:

- **Expanding** storage warehouses, maintenance and manufacturing facilities, and the transportation infrastructure
- **Diverting** commercial and nonessential military goods and services to satisfy critical military needs
- **Extending** recycling, reclamation, and rework projects
- **Converting** commercial manufacturing and repair capability to meet essential military requirements.
- **Replacing** inventory buildup
- **Allocating** scarce resources to provide the best support to the field commander
- **Maximizing** machine tool production and the use of commercial items

- **Preempting** the unnecessary use of energy, materials, and labor
- **Creating** additional boards and committees, as required, to coordinate on-going planning activities.

However, as noted in the discussion of costs associated with Stage 2 actions (Section 8.1.3) the valid comparison here is not between GMR Stage 1 and funding-constrained peacetime operations. Instead, it is between the costs and responsiveness of major mobilization or reconstitution actions as a result of the deliberate GMR planning/preparations process outlined here and in other GMR documents versus the much more costly, and less effective, efforts if DoD arrives at a major mobilization without having developed these plans and preparations.

## GMR ACTIONS TABLE

Appendix A to this report contains a menu of potential planning, preparatory, and response actions that might be undertaken by the Army to address a crisis situation. These tables comprise the "heart" of the GMR process because they demonstrate the feasibility of establishing a crisis preparedness and execution system that stresses comprehensive planning during times when the Army does not face an imminent crisis and increasingly vigorous response activities as a national security emergency emerges and matures.

It is important to stress that the actions in these tables are not mandatory but, rather, represent a menu from which tailored responses can be developed as the need arises. It is impossible to predict how a future crisis will develop. Decisions to operate at a higher GMR stage or to implement specific actions within a given stage will depend on the nature of the crisis and the policy views of key decisionmakers at the time. The menu of GMR actions will accommodate a wide range of possible emergencies.

The five subject areas of the Army logistics GMR system displayed in Tables A through E. are:

- Plans and Operations (A.)
- Security Assistance (B.)
- Transportation, Energy, and Troop Support (C.)
- Supply and Maintenance (D.)
- Resources and Management (E.).

These tables can be used in two different ways. Perhaps most obvious is the ability to read these tables horizontally to identify precursor and follow-on activities that can be taken within a given functional area. However, the tables can also be read vertically to identify necessary supporting actions and coordination requirements.

**The tables in this appendix should be considered preliminary and first-level.** They are preliminary in the sense that an effective implementation of GMR is never static but is constantly expanding and evolving as more is learned about the crisis response process. "Lessons-learned" from exercises and crisis operations must be incorporated into the action tables. This set of actions is first-level. Further refinement may be needed to provide increasing detail down to the division, branch, team, or individual desk in order to remove any ambiguity or complexity regarding the conduct of GMR.

# GLOSSARY

| | | |
|---|---|---|
| AC | = | Active Component (Regular Army) |
| ALMC | = | Army Logistics Management College |
| AMC | = | Army Materiel Command |
| AMCCOM | = | Armament, Munitions, and Chemical Command |
| AMCLD | = | Army Materiel Command Office of Technology Planning and Management |
| ARCENT | = | Army Central |
| ARNG | = | Army National Guard |
| ASD (P&L) | = | Assistant Secretary of Defense for Production and Logistics |
| AVSCOM | = | Aviation Systems Command |
| AWC | = | Army War College |
| BDA | = | Bomb Damage Assessment |
| BDU | = | Battle Dress Uniform |
| BOA | = | Basic Ordering Agreement |
| C-Day | = | First day of troop deployment to theater of operations |
| CALS | = | Computer Assisted Logistics Support |
| CBS-X | = | Continuing Balance System-Expanded |
| CDE | = | Chemical Defense Equipment |
| CGSC | = | Command and General Staff College |
| CINC CIL | = | Commanders in Chief Critical Items List |
| CIS | = | Common Item Support |

| | | |
|---|---|---|
| CJCS | = | Chairman, Joint Chiefs of Staff |
| CONUS | = | Continental (i.e., contiguous) United States |
| CRC | = | CONUS Replacement Center |
| CSS | = | Combat Service Support |
| DCSLOG | = | Deputy Chief of Staff for Logistics |
| DCSOPS | = | Deputy Chief of Staff for Operations |
| DDC | = | Diversion Decision Coordination |
| DEFCON | = | Defense Condition |
| DLA | = | Defense Logistics Agency |
| DMO | = | Defense Mobilization Order |
| DoC | = | Department of Commerce |
| DoD | = | Department of Defense |
| DPAS | = | Defense Priorities and Allocations System |
| DPSC | = | Defense Personnel Support Center |
| EPW | = | Enemy Prisoner of War |
| FAST | = | Field Assistance in Science and Technology |
| FEMA | = | Federal Emergency Management Agency |
| FMA | = | Foreign Military Assistance |
| FMS | = | Foreign Military Sales |
| G-Day | = | First day of ground combat operations by Coalition forces |
| GAO | = | General Accoutning Office |
| GFE | = | Government Furnished Equipment |
| GLOBEX | = | Naval War College global war game |

| | | |
|---|---|---|
| GMR | = | Graduated Mobilization Response |
| GOCO | = | Government Owned, Contractor Operated |
| GOGO | = | Government Owned, Government Operated |
| HASC | = | House Armed Services Committee |
| HEMTT | = | Heavy Expanded Mobility Tactical Tracks |
| HET | = | Heavy Equipment Transporter |
| HNS | = | Host Nation Support |
| HNSA | = | Host Nation Support Agreement |
| IAMS | = | Integrated Army Mobilization Study |
| IAW | = | In Accordance With |
| IFF | = | Identification Friend or Foe |
| INDCON | = | Industrial Alert Condition |
| IPM | = | Industrial Preparedness Measure |
| IPP | = | Industrial Preparedness Planning |
| JPC | = | Joint Production Committee |
| JSCP | = | Joint Strategic Capabilities Plan |
| JTBS | = | Joint Transportation Board Secretariat |
| JULLS | = | Joint Uniform Lessons Learned System |
| KAPP | = | Key Asset Protection Plan |
| LMI | = | Logistics Management Institute |
| LPC | = | Logistics Planning Cell |
| MCM | = | Mine Countermeasures |
| MLRS | = | Multiple Launch Rocket System |

| | | |
|---|---|---|
| MMC | = | Materiel Management Center |
| MOBEX | = | Mobilization Exercise |
| Mobilization | = | Marshalling of national resources in response to a national security emergency |
| MRE | = | Meals Ready to Eat |
| MSC | = | Major Subordinate Command |
| MTTOP | = | Machine Tool Trigger Order Program |
| MUL | = | Master Urgency List |
| NATO | = | North Atlantic Treaty Organization |
| NSEP | = | National Security Emergency Preparedness |
| ODCSLOG | = | Office of the Deputy Chief of Staff for Logistics |
| ODCSOPS | = | Office of the Deputy Chief of Staff for Operations |
| ODS | = | Operation Desert Shield/Desert Storm |
| OPTEMPO | = | Operations Tempo (speed and intensity of military operations) |
| OSD | = | Office of the Secretary of Defense |
| PBA | = | Production Base Analysis |
| POE | = | Port of Embarkation |
| POL | = | Petroleum, Oil, and Lubricants |
| POM | = | Program Objective Memorandum |
| PX | = | Post Exchange |
| R&D | = | Research and Development portion of system acquisition process |
| R-Day | = | First day of redeployment of U.S. forces from theater of operations |
| RC | = | Reserve Component (Army Reserve and Army National Guard forces) |

| | | |
|---|---|---|
| REQVAL-Plus | = | Requisition Validation-Plus |
| SA | = | Security Assistance directorate (DALO-SA) of ODCSLOG |
| SARF | = | Saudi Arabia Redistribution Facility |
| SECDEF | = | Secretary of Defense |
| SELRES | = | Selected Reserves (combat-ready Reserve and National Guard units) |
| Surge | = | Doubling of rate of industrial production |
| SWA | = | South West Asia |
| TASC | = | The Analytic Sciences Corporation (report contractor) |
| TBMP | = | Technology Base Master Plan |
| Trigger | = | A person taking action at a specific point in time |
| U.N. | = | United Nations |
| USAREUR | = | United States Army, Europe |
| USASG | = | United States Army Support Group |
| USCENTCOM | = | United States Central Command |
| USCINCCENT | = | United States Commander in Chief, Central Command |
| USD(A) | = | Under Secretary of Defense for Acquisition |
| WRM | = | War Reserve Materiel |
| WRS | = | War Reserve Stocks |

# APPENDIX A

# GRADUATED MOBILIZATION RESPONSE ACTION TABLES

## APPENDIX A

## GRADUATED MOBILIZATION RESPONSE ACTION TABLES

The tables in this Appendix accompany the text in Chapter 4 of this report. They describe potential Army logistics activities designed to respond to crises and correlate these activities with crisis stages.

Figure IV-A-1 provides an overview of the GMR framework with the objectives, general activities, and key action verbs that apply to each GMR stage.

The tables address the following functional areas:

- Plans and Operations (A)
- Security Assistance (B)
- Transportation, Energy, and Troop Support (C)
- Supply and Maintenance (D)
- Resources and Management (E)

| | GMR Stage 3 | GMR Stage 2 | | | GMR Stage 1 |
|---|---|---|---|---|---|
| | Planning and Preparation | Crisis Management | | | National Emergency / War |
| | Planning, Programming, Preparing and Testing | Specific Crisis Assessment & Planning | Specific Crisis Preparation | Specific Crisis Actions | Mobilization Actions |
| Objective | Maintain:<br>• efficient RDA programs;<br>• effective and responsive industrial base;<br>• basic industrial mobilization preparedness | Develop:<br>• plans to increase production rapidly and efficiently | Complete:<br>• all preliminary activities necessary to expand production rapidly and efficiently | Increase:<br>• production of critical items to sustain combat and/or equip the active force | Transition:<br>• peacetime economy to wartime economy as rapidly and effectively as possible |
| Description of General Activity | • focus on peacetime industrial base;<br>• preliminary surge planning;<br>• "plan to plan" for industrial mobilization | • begin targeted planning for potential expansion of industrial output (very little spending involved) | • improve industrial readiness;<br>• screen long lead-time items for capacity and for production expansion | • place orders for increased output;<br>• accelerate certain high priority items;<br>• minimize disruption of civilian economy | • upgrade / expand existing forces<br>• move from moderate disruption of civilian economy to transformation of entire economy to controlled "wartime" footing |
| Applicable Action Verbs | • maintain<br>• organize<br>• plan how<br>• train<br>• monitor<br>• disseminate<br>• exercise<br>• standardize | • explore<br>• update<br>• plan<br>• review / revise<br>• promulgate<br>• gather<br>• simplify | • fund / order<br>• alert / notify<br>• implement<br>• substitute<br>• signal<br>• suspend<br>• initiate<br>• conserve | • implement<br>• induct<br>• procure<br>• release<br>• expedite | • expand<br>• divert<br>• extend<br>• convert<br>• replace<br>• allocate<br>• maximize<br>• preempt<br>• create |

FIG. IV-A-1. GMR FRAMEWORK

## A. Plans and Operations

**GMR Stage 3**

| | Planning and Preparation | |
|---|---|---|
| | General Planning | Programming, Preparing, Testing |
| 1. Planning | Develop Combat Service Support (CSS) force structure planning for above-the-line forces | Test revised CSS force structure in both general war and reconstitution exercises |
| | Review Critical Items List (CIL) and Master Urgency List (MUL) for currency | Propose changes to CIL/MUL to reflect current environment |
| | Request manufacturers conduct pre-emergency production planning | Identify Government Furnished Equipment (GFE) available to contractors for surge or mobilization production |
| | Determine U.S. dependence on foreign sources of critical materials | Test foreign dependency on critical items issues during Army and joint-Service war-gaming exercises |
| | Identify both inherently scarce strategic materials and those likely to become scarce in contingency conditions | War-game strategic materials supply issues in Army and joint-Service contingency exercises |
| | Develop generic plans for in-theater support of major assemblies, using contractor support of Service technicians | Coordinate in-theater support plans with potential support contractors |

| GMR Stage 2 | | | GMR Stage 1 |
|---|---|---|---|
| Crisis Management | | | National Emergency/ War |
| Specific Crisis Assessment & Planning | Specific Crisis Preparation & Investment | Specific Crisis Execution | Mobilization Actions |
| Assess likelihood of above-the-line forces in specific contingency | Tailor revised CSS force structure plans to specific contingency | Prepare to implement revised CSS force structure plans, upon force expansion | Implement revised CSS force structure plans, as required |
| Tailor CIL/MUL for critical items in specific contingency | Identify Industrial Preparedness Measures (IPMs) pertinent to specific contingency | Implement selected IPMs | |
| Identify GFE with potential use in specific contingency | Draft plans to allocate selected GFE to specific producers in specific contingency | Prepare to transfer selected GFE to identified producers | Transfer selected GFE to identified producers |
| Identify contingency specific foreign source critical end-items and support materiel, and determine alternate foreign and domestic sources | Monitor availability and loss of foreign supply sources | Activate alternate domestic and foreign sources of critical and alternate materials | Curtail nonessential production and use of critical materials and convert selected production processes to alternate materials, where possible |
| Identify suppliers of scarce strategic materials vulnerable to specific crisis | Determine alternate foreign and domestic sources of materials vulnerable to specific crisis | Execute alternate supply agreements for scarce strategic materials | Establish domestic suppliers of scarce strategic materials, if possible, and establish secure foreign supply sources |
| Tailor in-theater support plans to specific contingency | Prepare to execute contingency-specific in-theater support plans | Execute in-theater support plans and monitor results | Expand in-theater contractor support under conditions of surge production and accelerated fielding of weapon systems |

## A. Plans and Operations, continued

**GMR Stage 3**

| | Planning and Preparation | |
|---|---|---|
| | General Planning | Programming, Preparing, Testing |
| 2. **Policy** | Develop generic standby requests for reprogramming and for funding relief | Test requests for reprogramming and funding relief in Army and joint Services war-game exercises |
| 3. **Interservice Relationships** | Develop generic Army requirements and priorities for industrial resources during contingency operations | Prepare standby Army requirements and priorities inputs for potential use in joint operations |
| 4. **Procurement** | Review essential procurement contracts for surge and mobilization clauses | Prepare contract-specific surge and mobilization clauses, where needed |
| | Identify potential mechanisms for limiting need for surge and mobilization production through increasing asset visibility, speeding repairs, and expediting return of repaired items to field units | Test mechanisms for limiting need for surge and mobilization production during Army and joint-Service war-gaming exercises |
| | Review existing voluntary and standby production agreements with producers of critical materials and end items | Obtain voluntary and standby production agreements from producers of critical materials and end items not presently enrolled |

| GMR Stage 2 | | | GMR Stage 1 |
|---|---|---|---|
| Crisis Management | | | National Emergency/ War |
| Specific Crisis Assessment & Planning | Specific Crisis Preparation & Investment | Specific Crisis Execution | Mobilization Actions |
| Prepare reprogramming and supplemental budget inputs for specific contingency | Submit reprogramming and supplemental budget inputs | | |
| Participate in reviews of inter-Service requirements and setting of priorities for industrial resources during contingency operations | Provide representative to JMPAB | Provide input to JMPAB decision-making process | |
| Plan for handling contingency-specific Common Item Support (CIS) issues in a priority-setting mechanism | Prepare inputs for CIS deliberations | Articulate position at CIS deliberations | |
| Identify potential for surge and mobilization production in specific crisis | Prepare crisis-specific surge and mobilization production requirements for specific producers of critical items | Alert specific producers about potential for surge and mobilization production requirements | Reactivate inactive GOGO and GOCO laid-away production plants and execute surge and mobilization production, as required |
| Identify contingency-specific mechanisms to limit need for surge and mobilization production | Prepare to implement selected contingency-specific mechanisms to limit need for surge and mobilization production | Execute selected mechanisms to limit need for surge and mobilization production | Increase depot-level repairs by expanding shifts, increasing staff, and focusing on critical components, sub-assemblies and end items and expanding use of dedicated airlift and automated asset tracking to speed return of materiel to field units |
| Identify producers of contingency-specific critical materials who are signatories to voluntary and standby agreements | Alert specific producers of potential intent to activate specific voluntary and standby agreements | Alert specific producers of potential intent to activate specific voluntary and standby agreements | Activate specific voluntary and standby agreements to produce critical materials, as required |

## A. Plans and Operations, continued

**GMR Stage 3**

| | Planning and Preparation | |
|---|---|---|
| | General Planning | Programming, Preparing, Testing |
| **4. Procurement, continued** | Identify producers of critical Army materials and end items included in the Key Asset Protection Plan (KAPP) | Test, in Army and joint-Service war-gaming exercises, the effects on Army procurement of loss of selected production facilities covered by KAPP |
| | Perform an adequacy review of defense industry capabilities to support both short and long duration conflicts | Test, during Army and joint-Service war-gaming exercises, results of review of defense industry capabilities to support conflicts |
| | Review existence of machine tool trigger orders for producers of critical Army materiel | Prepare standby machine tool trigger orders for producers of critical Army materiel not presently covered by the Machine Tool Trigger Order Program (MTTOP) |
| **5. Authorities** | Identify and evaluate the need, in contingency situations, for legislative waivers to operate specific production facilities | Prepare standby requests for waivers for facilities required, under conditions of surge and mobilization, to support critical Army production needs |
| | Examine authorities affecting Army logistics support to determine potential problems when moving from peacetime production and operations to contingency operations and conditions of surge and mobilization | Prepare standby draft legislation and Executive Orders designed to eliminate gaps in authorities covering logistics support operations during contingencies and under conditions of surge and mobilization |
| | Review priorities and allocations authorities that affect Army procurement | Ensure war-gaming exercise scenarios test emergency priorities and evaluation programs |

| GMR Stage 2 | | | GMR Stage 1 |
|---|---|---|---|
| Crisis Management | | | National Emergency/ War |
| Specific Crisis Assessment & Planning | Specific Crisis Preparation & Investment | Specific Crisis Execution | Mobilization Actions |
| Identify selected KAPP production facilities of particular interest to Army in the specific crisis | Prepare crisis-specific emergency reaction plans for coping with loss of selected KAPP production facili-ties | Execute crisis-specific emergency reaction plans, as required | Execute crisis-specific emergency reaction plans, as required |
| Use results of adequacy review to identify crisis-specific industries with potential to limit Army procurement | Establish quick-reaction mechanisms to deal with contingency-specific demands on production resources | Implement quick-reaction mechanisms to deal with demands on production resources | Execute quick-reaction procurement mechanisms to improve surge capability of Army wholesale system |
| Identify producers of crisis-specific critical Army materiel enrolled in MTTOP | Prepare crisis-specific machine tool trigger orders for Army producers subject to requirements for surge and mobilization production | Execute selected machine tool trigger orders, as required | Maximize release of machine tool trigger orders |
| Identify crisis-specific Army materiel production facilities requiring waivers | Prepare waiver request inputs for specific facilities | Provide waiver requests, as required | Monitor effects of requests for waivers on facilities producing Army materiel under conditions of surge and mobilization |
| Determine what standby legislation and Executive Orders are pertinent for the specific crisis | Recommend to appropriate Army organization contingency-specific standby legislation and Executive Orders | | |
| Identify critical materials and end items with potential need for priorities and allocations | Recommend tailored priorities and allocation system for specific contingency | | |

## B. Security Assistance

**GMR Stage 3**

| | Planning and Preparation | |
|---|---|---|
| | General Planning | Programming, Preparing, Testing |
| 1. Planning | Resolve all Stage 3 planning topics prior to crisis in order to avoid a "crisis management" mindset in later stages and sub-stages of threats and conflicts | |
| | Review all FMS cases for potential problems, conflicts, and stresses on defense industrial base | |
| 2. Procurement | Develop a Diversion Decision Coordination (DDC) process to deal with multiple demands, during contingency operations, on limited Foreign Military Sales (FMS) end items and spare parts assets | Test plans for implementing a decision to establish a Diversion Decision Coordination (DDC) process |
| | Plan for accelerated operations in the event of a contingency, recognizing the critical nature of assistance programs in the event of coalition warfare. | Ensure potential barriers to accelerated procurement of FMS stocks are identified and evaluated |
| 3. International Agreements | Review existing Host Nation Support (HNS) agreements and identify potential host nations for future agreements under contingency situations | Prepare draft negotiation offers and HNS proposals for potential HNS signatories |

| GMR Stage 2 | | | GMR Stage 1 |
|---|---|---|---|
| Crisis Management | | | National Emergency/ War |
| Specific Crisis Assessment & Planning | Specific Crisis Preparation & Investment | Specific Crisis Execution | Mobilization Actions |
| Identify specific FMS stocks that might become critical in the specific crisis | Prepare diversion recommendations for critical FMS stocks | Divert FMS stocks, as required | Divert FMS stocks, as required |
| Tailor the DDC process to the crisis at hand | Staff and train personnel assigned to the DDC structure | Begin DDC operations | As required, recommend diversions of FMS stocks to U.S. forces involved in or supporting the contingency |
| Plan ahead to mitigate effects of identified barriers to accelerated procurement of FMS stocks | Take initial steps to activate an accelerated procurement program for FMS stocks | Direct the distribution of Security Assistance and FMS assets | |
| Prepare contingency-specific draft negotiation offers and HNS proposals for potential HNS signatories | Begin negotiating a Host Nation Support agreement designed to increase the military capability of deployed U.S. forces | | |

## C. Transportation, Energy, and Troop Support

**GMR Stage 3**

| | Planning and Preparation | |
|---|---|---|
| | General Planning | Programming, Preparing, Testing |
| 1. Planning | Identify those troop support items (particularly subsistence--Class I and personal demand--Class II) likely to require Industrial Preparedness Planning (IPP) in the event of a contingency | Prepare Industrial Preparedness Measures (IPMs), and draft standby IPM funding requests, to meet anticipated demand for troop support items |
| | | Prepare surge programs for those Class I and II materials likely to be pacing items in a contingency |
| 2. Policy | Plan generic programming actions needed to support troop support initiatives during contingencies, emphasizing sufficient flexibility to respond to rapidly changing requirements | Prepare generic transportation, energy, and troop support input to Army reprogramming planning and contingency plans for requesting funding relief |
| | Plan to provide bulk POL War Reserve Materiel (WRM) requirements input for Defense Logistics Agency (DLA) POM | Prepare base case bulk POL War Reserve Materiel (WRM) requirements input for Defense Logistics Agency (DLA) POM |
| | Review current Army, Navy, and Air Force guidance regarding the logistics aspects of POL and water resources during contingency operations | Prepare generic Army POL and water resources logistics policy and guidance appropriate for joint contingency operations |

| GMR Stage 2 | | | GMR Stage 1 |
|---|---|---|---|
| Crisis Management | | | National Emergency/ War |
| Specific Crisis Assessment & Planning | Specific Crisis Preparation & Investment | Specific Crisis Execution | Mobilization Actions |
| Tailor IPP planning and funding requests to specific crisis | Implement selected IPMs and funding requests | Monitor status of implemented IPMs and IPM funding approval | |
| Tailor surge plans to specific crisis | Alert selected producers to prepare for accelerated production | Execute accelerated production | Execute surge production of critical items |
| Provide transportation, energy, and troop support input to Army reprogramming planning and contingency plans for requesting funding relief | Refine reprogramming inputs and requests for funding relief to meet specifics of actual contingency | Provide transportation, energy, and troop support inputs, as requested | |
| Refine Army POL and water resources logistics policy and guidance to fit specific crisis | Prepare crisis-specific written POL and water resources policy and guidance for logisticians | | |

## C. Transportation, Energy, and Troop Support, continued

**GMR Stage 3**

| | Planning and Preparation | |
|---|---|---|
| | General Planning | Programming, Preparing, Testing |
| **3. Authorities** | Develop a system authorizing and certifying contingency Class A and B munitions carriers; and training, certifying, and using uncommitted Reserve Component (RC) transportation detachments to operate the carriers | Test and evaluate the Class A and B munitions carrier training and certification system on selected RC transportation units, during annual training "summer camp" |
| **4. Interservice Relationships** | Develop, in conjunction with other Services, policies and procedures for allocation of bulk POL during contingencies | Test, during joint Service exercises, bulk POL allocation policies and procedures |
| | Draft plans for the contingency of assuming status of executive agent for surface transportation, port operations, and joint Service logistics support during joint contingency operations | Test executive agent plans and procedures during joint Service exercises |
| **5. Procurement** | Develop procedures for planning the distribution of POL stocks and water purification systems during contingency operations | Test plans for distribution of current POL stocks and water purification systems in joint contingency exercises |
| | Identify troop ration tooling and packaging requirements for contingency operations | Prepare plans for acquiring new tooling and packaging to meet expanded troop ration requirements during contingency operations |
| | Identify Class II, IV, and VIII troop support item requirements for contingency operations | Prepare climate-specific plans for acquiring Class II, IV, VIII troop support items to meet expanded requirements during contingency operations |

| GMR Stage 2 | | | GMR Stage 1 |
|---|---|---|---|
| Crisis Management | | | National Emergency/ War |
| Specific Crisis Assessment & Planning | Specific Crisis Preparation & Investment | Specific Crisis Execution | Mobilization Actions |
| Identify actual RC transportation units to receive training and certification in support of the specific crisis | Develop specific training packages, alert trainers, and notify units to be trained | Train and certify selected RC transportation units | Employ, in support of contingency operations, newly trained and certified munitions transportation units |
| Tailor bulk POL allocations policies and procedures to specific crisis | Prepare to execute bulk POL allocation plans tailored to specific crisis | Execute contingency-specific bulk POL allocation plans | Modify bulk POL allocation plans to suit magnitude of expanded contingency |
| Plan for assuming responsibility of surface transportation, port operations, and joint service support during specific contingency | Conduct coordination discussions with all parties affected by Army's appointment as executive agent | Assume executive agency of all joint support operations tasked to Army | Maintain close coordination among all parties covered by Army's executive agency and modify support operations procedures to match level of contingency operations |
| Tailor plans for distribution of current POL stocks and water purification systems to specific contingency | Prepare to implement contingency-specific distribution plans for current POL stocks and water purification systems | Monitor and adjust intra-CONUS and inter-theater distribution of current POL stocks during contingency operations | |
| Tailor plans for new troop ration tooling and packaging requirements to fit specific contingency | Procure tooling for accelerated preparation and packaging of troop rations | Accelerate procurement of troop rations | Use civilian producers for emergency supplementation of troop support items, particularly rations, until the defense industrial base is able to meet mobilization needs |
| Tailor plans for acquiring new troop support items for specific contingency | Prepare to accelerate procurement of troop support items required for specific contingency | Accelerate procurement of troop support items | |

## C. Transportation, Energy, and Troop Support, continued

**GMR Stage 3**

| | Planning and Preparation | |
|---|---|---|
| | General Planning | Programming, Preparing, Testing |
| 6. Logistics Support | Identify potentially critical transportation, energy, and troop support items likely to require extensive logistics efforts in the event of contingency operations | |
| | Review existing logistics support plans for all potentially critical transportation, energy, and troop support items | Update or draft new logistics support plans for each class and sub-class of supply item identified as critical to transportation, energy, and troop support |
| | | Test selected logistics support plans during Army and joint Service exercises |
| | Identify potential bottlenecks and shortfalls of critical transportation, energy, and troop support items likely to require extensive logistics efforts in the event of contingency operations | Prepare plans to eliminate or mitigate bottlenecks and shortfalls of critical transportation, energy, and troop support items |

| GMR Stage 2 | | | GMR Stage 1 |
|---|---|---|---|
| Crisis Management | | | National Emergency/ War |
| Specific Crisis Assessment & Planning | Specific Crisis Preparation & Investment | Specific Crisis Execution | Mobilization Actions |
| Identify transportation, energy, and troop support items critical to specific contingency and tailor support plans accordingly | Monitor: priority movements of supported commands and change requests; preparation of and movement to unit POE; and scheduled intertheater movements | Provide Army member to Joint Transportation Board Secretariat (JTBS) | |
| Develop crisis-specific plans for intra-CONUS and intertheater distribution of bulk POL stocks; and for intheater distribution and support of water purification systems | Identify and eliminate bottlenecks and shortfalls in distribution of bulk POL stocks and water purification systems | Monitor execution of and expedite distribution efforts for bulk POL stocks and water purification systems | |

## D. Supply and Maintenance

**GMR Stage 3**

| | Planning and Preparation | |
|---|---|---|
| | General Planning | Programming, Preparing, Testing |
| 1. Planning | Plan surge programs for construction materials (Class IV), ammunition (Class V), and repair parts (Class IX) | Test Class IV, V, and IX surge programs in Army and joint-Service war-gaming exercises |
| | Identify pacing items and components critical to Army's needs across the spectrum of contingency planning scenarios | Prepare plans to reduce production lead times for critically needed pacing items and components |
| 2. Policy | Monitor J-4 development of War Reserve Materiel (WRM) requirements sufficient to support contingency planning scenarios and establish stockage policy for *direct and general support activities* | Provide WRM requirements and desired direct and general support stockage levels inputs to Army POM |
| | | Test WRM inputs in Army and joint-Service war-gaming exercises |
| 3. Interservice Relationships | Develop generic common Service planning factors in support of complete range of contingency planning scenarios | Test common Service planning factors in joint-Service war-gaming exercises |

| GMR Stage 2 | | | GMR Stage 1 |
|---|---|---|---|
| Crisis Management | | | National Emergency/ War |
| Specific Crisis Assessment & Planning | Specific Crisis Preparation & Investment | Specific Crisis Execution | Mobilization Actions |
| Develop contingency-specific accelerated production and surge plans for selected Class IV, V, and IX items | Alert producers of selected Class IV, V, and IX items of imminent need for accelerated production | Execute accelerated production plans for selected items | Execute surge production plans for selected items, as required |
| Develop contingency-specific plans to reduce production lead times for selected pacing items and components | Prepare to implement steps to reduce production lead times on selected pacing items and components | Execute selected production lead time reduction steps | |
| Develop contingency-specific programmatic action plans for maintaining adequate War Reserve Stocks (WRS) of individual equipment | Prepare contingency-specific emergency inputs for potential reprogramming and requests for funding relief | Provide contingency-specific reprogramming and request for funding relief inputs, as required | |
| Develop contingency-specific plans to rely on and use WRS in the event an absence of funding relief bars formation of replenishment contracts with private sector suppliers | Monitor war reserve stocakage levels and prepare plans to mitigate a funding bar to replenishment of WRS and Operational Project Stocks | Implement mitigation plans, as required, in order to adjust and maintain war reserve stockage at adequate levels | Implement mitigation plans, as required, in order to adjust and maintain war reserve stockage at adequate levels |
| Develop contingency-specific common Service planning factors | Prepare contingency-specific plans incorporating selected common Service planning factors | Implement selected common Service planning factors, as required | |

## D. Supply and Maintenance, continued

**GMR Stage 3**

| | Planning and Preparation | |
|---|---|---|
| | General Planning | Programming, Preparing, Testing |
| **4. Logistics Support** | Determine generic contingency production requirements for Army Materiel Command's Major Subordinate Commands (MSCs) | Prepare generic contingency production targets for MSCs |
| | Develop generic contingency plans for Army selection as Executive Agent for support of multi-Service/multi-national logistics | Test and evaluate, in joint war-gaming exercises, plans for Army executive agency for logistics during contingency operations |
| | Evaluate equipment status of AC and RC units likely to deploy in a contingency, | Designate critical equipment items for contingency operations and develop an equipment distribution policy for deploying units |
| | Evaluate status of POMCUS and WRS stocks available for generic contingencies | Monitor AMC preparation of plans for cross-leveling WRS and for requesting accelerated procurement during contingencies |
| | Evaluate Army logistics asset visibility (item-tracking) mechanisms for potential contingency operations | Develop and test improvements in asset visibility, rather than rely on accelerated or surge procurement, to speed up supply and equipment deliveries to field users |

| GMR Stage 2 | | | GMR Stage 1 |
|---|---|---|---|
| Crisis Management | | | National Emergency/ War |
| Specific Crisis Assessment & Planning | Specific Crisis Preparation & Investment | Specific Crisis Execution | Mobilization Actions |
| Assess specific contingency and revise MSC production targets to fit threat level and anticipated duration of a resulting conflict | Prepare contingency-specific MSC production target plans | Implement production target plans | |
| Plan a contingency-specific functional organization to manage joint and coalition logistics | Prepare to implement Army-directed joint logistics plans | Implement joint logistics operations | Revise joint logistics operations to accommodate expanded contingency efforts |
| Monitor equipment status of potential AC and RC deployers and determine shortages | Request release of WRS to equip early deployers and to pure-fleet unit transportation and heavy-lift equipment | Implement unit equipment plans and distribute stocks released from WRS | Revise unit equipping plans to fit realities of deployment revisions and increased demands of mobilization |
| Monitor status of and determine contingency-specific shortages in POMCUS, WRS, and training base equipment | Validate continuing materiel requirements IAW new or established priorities | Request accelerated procurement of critical POMCUS, WRS, and training base shortages | Request surge procurement of critical POMCUS, WRS, and training base shortages |
| Monitor total Army logistics readiness in specific contingency and identify critical logistics bottlenecks and shortfalls | Prepare plans to overcome Army logistics bottlenecks and shortfalls during specific contingency | Implement plans to overcome contingency-specific logistics bottlenecks and shortages | |
| Develop contingency-specific improvements to item-tracking mechanisms | Prepare to implement item-tracking mechanism improvements | Implement improvements designed to speed up deliveries of supplies and equipment to field users | Modify and continue to improve asset visibility mechanisms |

## D. Supply and Maintenance, continued

**GMR Stage 3**

| | Planning and Preparation | |
|---|---|---|
| | General Planning | Programming, Preparing, Testing |
| **4. <u>Logistics Support, continued</u>** | Evaluate AMC Field Assistance in Science and Technology (FAST) program as part of generic contingency planning | Test FAST program in Army and joint-Service war-gaming exercises |
| | Evaluate current munitions reserves and theater stockpiles | Prepare generic contingency plans for worldwide redistribution of munitions reserves and theater stockpiles |
| | Evaluate worldwide WRM stockpiles for use in generic contingencies | Develop general contingency plans for redistribution of WRM weapon systmes |
| | Evaluate existing manual and automated Army supplies and equipment reporting mechanisms | Develop streamlined automated supply and equipment reporting mechanisms, based on Continuing Balance System-Expanded (CBS-X) and Requisition Validation-Plus (REQVAL-Plus) |
| | Determine capability of depots to expand repairable activities during contingency operations | Develop general plans to expand Army depot repair level of effort during contingencies, including inter-Service cooperative efforts, to maximize use of existing facilities |
| | Evaluate Army and joint-Service planning for quick-response lift for high priority repairable and repaired parts and subassemblies | Develop, in conjuction with other Services, plans for quick response lift for high priority repairable and repaired parts and subassemblies |

| GMR Stage 2 | | | GMR Stage 1 |
|---|---|---|---|
| Crisis Management | | | National Emergency/ War |
| Specific Crisis Assessment & Planning | Specific Crisis Preparation & Investment | Specific Crisis Execution | Mobilization Actions |
| Review use of FAST program in specific contingency | Prepare to implement FAST in specific contingency | Implement FAST to collect on-site data from specific operational equipment problems | Maintain FAST program as level of contingency operations increases |
| Develop contingency-specific plans for worldwide redistribution of munitions reserves and theater stockpiles | Prepare to implement, as required, contingency-specific redistribution of munitions | Execute redistribution of munitions plans | |
| Develop contingency-specific plans for worldwide redistribution of WRM weapons systems | Prepare to implement, as required, contingency-specific redistribution of WRM weapons systems | Execute redistribution of WRM weapons systems plans | |
| Assess potential for improved supply and equipment reporting mechanisms in specific contingency | Prepare contingency-specific supply and equipment reporting mechanisms | Implement supply and equipment reporting mechanisms | |
| Assess general depot repair plans for specific contingency | Prepare contingency-specific plans to increase depot level repair activities | Implement plans to increase depot level repair activities | |
| Evaluate general quick response plans for specific contingency | Prepare contingency-specific quick response lift plans | Implement quick response lift plans | |

## D. Supply and Maintenance, continued

**GMR Stage 3**

| | Planning and Preparation | |
|---|---|---|
| | General Planning | Programming, Preparing, Testing |
| **5. Procurement** | | |
| | Evaluate potential for in-theater modernization of Army end items during contingency operations | Develop plans for Army facilities and supply mechanisms to allow in-theater modernization of end items during general contingency operations |
| | Determine critical warfighting end-items and support materiel most susceptible to production breaks and bottlenecks | |

| GMR Stage 2 | | | GMR Stage 1 |
|---|---|---|---|
| Crisis Management | | | National Emergency/ War |
| Specific Crisis Assessment & Planning | Specific Crisis Preparation & Investment | Specific Crisis Execution | Mobilization Actions |
| Assess, across all Major Subordinate Command (MSC) lines, the impacts, on specific contingency, of current production breaks and bottlenecks | Prepare plans to mitigate impacts of procurement problems critical to specific contingency | Execute production break and bottleneck mitigation plans | |
| Evaluate potential for in-theater modernization of contingency-specific end items | Plan facilities and supply mechanisms to allow in-theater modernization of contingency-specific end items | Execute plans for in-theater modernization of end items | |
| Identify critical contingency-specific spares and repair parts for increased procurement | Establish mechanisms for potential emergency procurement of contingency-specific critical spares and repair parts | Execute emergency procurement plans | Maintain accelerated procurement of spares and consumables throughout contingency |

## E. Resources and Management

**GMR Stage 3**

| | Planning and Preparation | |
|---|---|---|
| | General Planning | Programming, Preparing, Testing |
| 1. Policy | Review current Army weapon system program funding and identify systems most susceptible to reprogramming in contingency situations | Develop generic methodology for reprogramming existing Army funding and for providing input to requests to Congress for funding relief |
| 2. Procurement | | |

| GMR Stage 2 | | | GMR Stage 1 |
|---|---|---|---|
| Crisis Management | | | National Emergency/ War |
| Specific Crisis Assessment & Planning | Specific Crisis Preparation & Investment | Specific Crisis Execution | Mobilization Actions |
| Review Army Basic Ordering Agreements (BOAs) for contingency-specific high demand items | | | |
| Prepare both to reprogram existing Army funding and prepare Army input to a possible DoD request to Congress for funding relief during a contingency for logistics programs | Tailor reprogramming and requests to Congress for funding relief to requirements of unfolding contingency for logistics programs | Reprogram existing Army funding and provide tailored Army inputs to requests to Congress for funding relief for logistics programs | Reprogram existing Army funding and provide tailored Army inputs to requests to Congress for funding relief for logistics programs |
| | Program base support logistics requirements | | Program base support logistics requirements |
| Determine the need for regulatory power to address crisis production requirements for logistics programs | | | |