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**Peacetime Industrial
Preparedness
for
Wartime Ammunition
Production**

HARRY F. ENNIS

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**PEACETIME INDUSTRIAL
PREPAREDNESS FOR
WARTIME AMMUNITION PRODUCTION**

by

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FOREWORD

*How about
time &
location?*

Defense preparedness, in simplified terms, has two basic dimensions: manpower and materiel. While the public and academic debate over military manpower problems reflects a healthy concern for the readiness of our armed forces, it addresses only one side of the issue. Deserving of equal attention is US preparedness to provide adequate logistical support to the military, which is the general subject area of this study by Colonel Harry Ennis.

Specifically, Colonel Ennis examines the capability of US industry to produce sufficient quantities of ammunition to sustain a major conventional war. Although solidly grounded in history, his analysis considers relatively new factors—the “short war” philosophy, renewed congressional interest, and budgetary constraints—that add a novel dimension to the old guns-versus-butter debate. Colonel Ennis’ study of ammunition has the potential for application to other areas of the defense production base and to other essential wartime commodities.

To find evidence that logistical support is a major area for concern, we need go no further than the DOD’s recent and widely reported “Nifty Nugget” exercise, which revealed, among other logistical shortcomings, a deficiency of ammunition support for a major conflict in Europe. This monograph is a positive contribution toward alleviating such problems; it suggests relatively simple, cost-effective steps that might strengthen the ammunition and overall defense production capability of the United States.



R. G GARD, JR.
Lieutenant General, USA
President

ABOUT THE AUTHOR

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PEACETIME INDUSTRIAL PREPAREDNESS FOR WARTIME AMMUNITION PRODUCTION

I

INTRODUCTION

Praise the Lord and Pass the Ammunition
Popular Song Title¹

Ammunition is essential in modern warfare. It is also an interesting commodity in many respects. A shortage of ammunition has mandated revisions in operational plans in the past and might well have more severe effects in the future.

After the apparently successful incursion through Belgium into France in August of 1914, the German Army was stopped at the Marne River by what some historians consider to be "miraculous" French resistance. This serious setback was to become the first of a succession of events which would, before long, dash the German hopes of achieving a rapid victory in the west. What is somewhat less well known is the effect which ammunition had on the attempt made by Falkenhayn, Chief of the German General Staff, to regain the initiative by launching the Flanders campaign in the fall of 1914.

By the end of October, ammunition reserves were exhausted and expenditure became dependent on current production. Despite the considerable effort to increase munitions production, it could not keep pace with demand. Shortages consequently assumed critical proportions for both sides in November and seriously affected strategy. They probably influenced Falkenhayn's decision to discontinue his Flanders campaign since he could accumulate munitions reserves sufficient to attempt a breakthrough only by reducing the rate of expenditure.²

Both sides were similarly constrained.³ The French and the British could not mount an effective counteroffensive after German failure to secure a decisive victory in Flanders due to their own shortage of munitions. "After Flanders the war of annihilation became a war of attrition in the west."⁴ The western campaign had ended—

trench warfare began. This experience points up another interesting characteristic of ammunition, viz, wartime expenditure rates.

Ammunition appears to be expended during wartime at rates well in excess of peacetime forecasts. In the introduction to an excellent postwar report, French General Charles Payot expressed the problem concisely in 1924:

Even during the first months of the war, the scales provided were clearly inadequate to the wants of the forces engaged, and all the countries concerned were suddenly compelled to turn their energies almost exclusively to the question of intensive production of material of all natures required for the prosecution of war . . . materials of all sorts and ammunition. . . .⁵

Such shortages in wartime can derive from a number of sources. Prewar economic and political priorities may have obscured the wartime needs. Insufficient initial stockage at the outset of the war certainly springs to mind as a primary cause of shortages of supplies. Failures or inadequacies in the transportation and distribution systems could create localized shortages of wartime commodities even if the overall levels of stockage were sufficient to support combat operations. Enemy and accidental action might produce the same result. In a protracted engagement, the lack of an adequate industrial capability to compensate for insufficient levels of initial stockage and to replenish consumption and combat losses could cause critical shortages to develop. It is to this latter potential cause that this study is addressed.

Ammunition will be used as an example of a wartime commodity which is clearly dependent upon the existence of a sound industrial base for long-term supplies. It should be noted, however, that the experience with ammunition supply and consumption provides a useful analog in dealing with other members of the military commodity family which are inextricably bound to the industrial sector of the economy. Like large-caliber ammunition, there are many other items of military materiel which share the distinction of having no direct commercial counterpart. Examples include: land combat vehicles (tanks, armored personnel carriers, and the like); large-caliber and automatic weapons (cannons, mortars, guided missiles, nuclear devices, and machine guns); and to an extent, combat aircraft and naval vessels. These commodities are commercial anomalies but, for the most part, find their source in the commercial sector. Therefore, in an open market economy, extraordinary measures must

be taken to insure that the capability exists to manufacture these specialized items of military hardware.

Since munitions manufacturing capabilities cannot be created instantaneously when they are needed most, at the outbreak of war, attention must be given to providing for production capability which can be activated in a reasonable time to meet national defense needs when required. The purpose of this study is to present the results of a selective investigation into the current status of the industrial base for ammunition production, to analyze its sufficiency to meet our potential national security needs, and to offer some suggestions for improvement of our industrial preparedness posture. Implicit in the exposition, using ammunition as a test article, is the applicability of the recommended solution to the larger problem of industrial preparedness for furnishing those other unique items of military hardware necessary for the conduct of modern warfare.

This study will confine itself to an investigation of a limited segment of conventional ammunition production in the US industrial sector which includes both private and governmental elements. A brief look into our nation's history will highlight the importance of industrial preparedness and perhaps provide some guidance for future actions from the hard-won experiences of the past. The present status of the industrial base for the production of selected ammunition items will be examined. Although the primary examples will be drawn from the Army inventory of ammunition, an Air Force example is included. The broad philosophical implications for preparedness will have meaning to all of the Armed Services. This paper will suggest some practical solutions to the difficult dilemma of providing concurrently for near-term readiness and intermediate-range sustainability. Such a study should prove valuable to policymakers who guide the efforts of the services, the practitioners who must devise programs for the implementation of these policy decisions, and to the thoughtful members of the public who are concerned with industrial preparedness as an essential element of our national security.

The foregoing implies that there is a dangerous shortfall in our ability to sustain ammunition production in the event of war. Does this situation actually exist? By investigating the evidence, the true condition of the Nation's capability to produce ammunition can be found.

CHAPTER I ENDNOTES

1. Frank Loesser, "Praise the Lord and Pass the Ammunition" (n.p.: Famous Music Corporation, 1942), Title page.
2. Lancelot L. Farrar, *The Short War Illusion: German Policy, Strategy and Domestic Affairs* (Santa Barbara, Calif.: ABC-Clio Press Inc., 1973), p. 137.
3. Erich von Falkenhayn, *General Headquarters, 1914-1916, and Its Critical Decisions* (London: Hutchinson and Co., 1919), pp. 11, 28, 33.
4. Farrar, *Short War Illusion*, p. 126.
5. *Report of the Military Board of Allied Supply, the Allied Armies Under Marshal Foch in the Franco-Belgian Theater of Operations*, Vol. I (Washington, D.C.: Government Printing Office, 1924), p. 42.

II

THE PROBLEM

But suppose the whole process of war is transported out of the region of reality into that of imagination. . . . Every set of assumptions which it is necessary to make, draws new veils of varying density in front of the dark curtain of the future. The life of the thoughtful soldier or sailor in time of peace is made up of these experiences—intense effort, amid every conceivable distraction, to pick out across and among a swarm of confusing hypotheses what actually will happen on a given day and what actually must be done to meet it before that day is ended. Meanwhile all around people, greatly superior in authority, and often in intelligence, regard him as a plotting knave, or at best an overgrown child playing with toys, and dangerous toys at that.

Winston Churchill¹

For the most part, the future is not predictable. Therefore it is reasonable to conclude that future wars are unpredictable also. Particularly puzzling is the problem of trying to forecast the nature of the war if it comes to our nation. Over what issues will it be fought? Where will it be waged? Will it be conventional or nuclear? Will it be possible to separate the two? How long will it last? Such questions confound the military planner. Perhaps equally puzzling are the questions regarding the military responses which may be required during periods of world tension without the declaration of a national emergency. Are mobilization planning and industrial preparedness for US ammunition production sufficiently flexible to meet a wide variety of possible peacetime and wartime contingencies? Ammunition mobilization planning involves the visualization of the ammunition requirements which may present themselves in any future war and the creation of a blueprint of actions to be taken to redirect, as required, the resources of the nation to the meeting of these perceived requirements. Industrial readiness requires that the manufacturing capability be provided or identified and structured to make possible a timely implementation of the mobilization plan.

THE SHORT-WAR SCENARIO

Clearly, the earliest phases of any future conflict, or the entire conflict if it be short enough, will have to be supported by forces in being and supplies on hand. Recent dialogue regarding the probable duration of a war has produced a fashionable interpretation which has come to be known as the "short-war scenario."² Embodied in this concept is the belief that a short intense war will be fought, probably in Western Europe, which will end quickly or escalate to the use of tactical or selected strategic nuclear weapons. It is held that this eventuality would cause the opposing national leaderships to seek a settlement because of the abhorrence of entering into a massive strategic thermonuclear exchange. Under these conditions, the settlement would occur before any effect could be felt from the existence of an industrial capacity which could be turned to support of the war effort. As evidence of the stature that this short-war philosophy has attained, the following statement of Secretary of Defense Harold Brown is offered. Following a discussion of actions taken to redress prior materiel readiness shortfalls, the Secretary declared:

Our immediate capability to engage in combat is being degraded by the peacetime materiel readiness problems described above. Thus, we have decided to place more emphasis on initial combat capability and relatively less emphasis on combat staying power than has been done in the past. . . . The net effect of these changes in priorities has been to place our current emphasis less on long-term staying power and more on areas with a higher payoff in immediate combat capability.³

The short-war concept is certainly not a recent phenomenon without precedent. Nations have planned for and attempted to bring a decisive end to wars as quickly as possible throughout history. Resolve and determination of the opposition have often been the undoing of such aspirations. This aspect of preparation for war will be given careful consideration in the next chapter of this study.

The origin of this current resurgence of the short-war philosophy is difficult to pinpoint but some guideposts are in evidence. As national attention in the early 1970's shifted from Southeast Asia back to our NATO commitments, a number of "new looks" at our participation in the conventional defense of Western Europe were inevitable. The Nunn amendment to the Senate Authorization Bill for fiscal year 1975 required a realignment of US forces in Europe to attain a more favorable "teeth-to-tail" ratio (i.e., a

replacement of support forces with combat forces).⁴ This realignment was intended to "increase immediate combat power at the expense of staying power."⁵ The effect of this view of NATO defense has been seen to ripple back to and through the US industrial base. The experiences of the recent high-intensity Arab-Israeli War of October 1973 added credibility to the short-war logic. The pendulum set in motion by these events began to swing more in favor of preparation for a short war to the exclusion of some serious long-war considerations.

The importance of this short-war philosophy to the industrial readiness question, particularly ammunition industrial readiness, was highlighted by the drawdown in Vietnam with its attendant economic ramifications. The defense production to support the war in Vietnam began its decline in 1968, ending abruptly with the fall of Saigon in April of 1975. The military procurement budget peaked in 1968 at \$44 billion, expressed in terms of the value of the dollar in 1976. In fiscal year 1976, the procurement budget had declined to \$17 billion.⁶ With this reduction in production activity, the "overhead account" for the support of this active industrial capacity began to become a significant economic burden. During the war with its sizeable defense appropriations, the industrial base flourished while meeting the needs of the war.

The military operations in Vietnam represented a somewhat unique war from the perspective of industrial support. It was a war conducted in the absence of a declared mobilization. Thus, there were enacted few of the traditional wartime measures which customarily enhance defense-related industrial output. "Business as usual" conditions prevailed, without central administration and price controls, with little or no priority allocation of resources, and with peacetime contracting and procuring techniques in effect. Indeed, from the industrial viewpoint, the Vietnam era appeared as peacetime. For the most part, this posture was possible because the United States unilaterally decided on the tempo of its involvement in the war, a most unusual opportunity and one which would be dangerous to adopt as a valid perception of future wars.

DEPARTMENT OF DEFENSE AND CONGRESSIONAL INTEREST

As the immediate needs for defense materiel receded, the vitality of the defense industrial base and its healthy perpetuation declined. This malaise, after evolving for some 2 years, finally led to increased Department of Defense and congressional interest in the

viability of the industrial base to support our national defense policies.⁷ Understandably, attention was drawn to mobilization planning. These investigations suggested that the planning then underway might be focussing on the wrong kind of war. In 1976 the Congressional Joint Committee on Defense Production emphasized the need to consider the possibility and probability of a short conflict and the concomitant adjustments to mobilization planning which might be required.⁸ Thus, short-war planning was again becoming fashionable. However, the attention expressed in both the Congress (Senator Proxmire) and the Department of Defense (Dr. Gansler) did not appear to foreclose the continued preparation for long wars. Indeed, Dr. Gansler, Deputy Assistant Secretary of Defense for Materiel Acquisition, testified:

Therefore we are taking steps to update our plans and programs to cover the full spectrum of potential conflicts while continuing to provide for an extended duration conflict.⁹

Fueled by the demands for near-term readiness of our forces and increased levels of war-reserve materiel, the short-war scenario became more fiscally acceptable. This approach was seductively attractive because economies could be realized by rationalizing that a short decisive war obviated the need to maintain an extensive industrial capability tailored to support the Defense Establishment.

The early months of 1977 saw an intensification of focus on the short-versus long-war dialogue. In February, the Defense Science Board and the Congressional Joint Committee on Defense Production released reports on the subject.

The Defense Science Board Study acknowledged the inadequacies of the logistics support and industrial preparedness to meet a wide range of contingencies. In an unclassified memorandum for the Secretary of Defense, the Acting Chairman of the Defense Science Board noted:

. . . a major finding of the study is that the US is presently deficient in logistics support for the forces in being as well as in maintaining the industrial base required to meet the needs of potential conflict.¹⁰

The cause of that deficiency was identified within the Executive Summary of the same report:

Without attempting to pass judgment on the validity or adequacy of the decisions in the current FYDP Five Year Defense Program, it is the impression of the Task Force that preparedness planning and programming for wartime does not appear to be receiving an adequate share of the funds spent by the services in any one fiscal year.¹¹

It appears clear that the Defense scientific community sensed the inadequacy of US industrial preparedness planning and programming.

The report of the Joint Committee on Defense Production culminated a year-long investigation inter alia, into the condition of the defense industrial base. A cogent criticism was leveled at industrial preparedness investments which seek to cover the entire spectrum of contingencies (while not discouraging the planning for such a range), without rational assignment of priorities for resources on the basis of greatest probability of occurrence.¹² The report suggests a rather extreme application of the short-war philosophy in quoting Dr. George H. Heilmeier, Director of the Defense Advanced Research Projects Agency as follows:

As I see it, in future conflicts there will be a premium on fast response. Modern weapons may make the first battle the last battle. This means that forces in being are more important than force potential and deterrence more important than inherent capability. The manufacturing base that was critical to the United States in past wars will be of little use to us in future conflicts that are likely to be short, violent, and dominated by advanced technology. There simply won't be any time to mobilize an entire nation and its manufacturing base. There will be no time for bond drives, gearing up, mobilization, and determined national production.¹³

It may be true that the first battle may be the last, but it is also possible that such may not be the case. Then does it follow that a manufacturing base will be unequivocally of little use? Apparently, the consensus of the committee did not support Dr. Heilmeier's view. On the contrary, one of the major conclusions of the reasonably well-balanced and objective report highlighted the importance of industrial preparedness as follows:

Although forces-in-being will continue to be of paramount importance in any reasonable projection of future conflict, the current funding of industrial preparedness and mobilization activities is not commensurate with the importance of these

functions. Nor can emphasis on development of adequate forces-in-being be expected to provide as a side benefit, for all mobilization needs, as the experience before, during, and since the Vietnam war has so amply demonstrated.¹⁴

Despite the sensible cautionary admonitions of these investigations on the subject of balance, the evidence belies that such a balance is being attained in the maintenance of ammunition production capability. The Association of the United States Army sounded a pointed warning:

The Army's program to maintain inactive ammunition plants in layaway has not fared well. . . . To date, an average of less than one percent of the \$7.8 billion replacement cost of laidaway facilities has been spent annually to maintain this huge investment, and as a result, the condition of the laidaway base is deteriorating. . . . A current estimate for overdue maintenance of plants is approximately \$40 million.¹⁵

The recent budget history of the Industrial Preparedness Operations account, out of which ammunition plants are funded, is instructive. A fiscal year 1978 budget request of \$77 million for maintenance of inactive ammunition plants was reduced by the Congress by \$7.7 million. At the operating level, the command responsible for implementing the maintenance program had to absorb \$7.2 million of the reduction and the maintenance of government-owned, contractor-operated (GOCO) ammunition plants took the cut.¹⁶ An even larger reduction of \$12.5 million was suffered the year before.¹⁷ In the 1979 Appropriation Bill the House Committee on Appropriations reported out an increase of \$15.0 million for this troubled account, in apparent recognition of the untoward consequences of earlier reductions.¹⁸ In fairness it must be noted that the Army has been provided \$1.8 billion from a different appropriation since 1970 for modernization of the ammunition production base.¹⁹ Such investment is beneficial; however, deterioration starts immediately if the improved facilities and production lines are not activated and if funding for adequate layaway maintenance is not provided. This subject and the overall problem of maintenance of laid-away production capability will be addressed more fully in a subsequent chapter of this study.

The pressing needs of near-term (now) readiness problems have led to the allocation of constrained resources in favor of meeting current requirements to the serious detriment of providing for a sustained effort in some future conflict of extended duration. As

inflation eats at a program manager's procurement budget, the difficult choice arises between providing more units of hardware to the fighting man in the field or providing for industrial preparedness measures which may be needed to keep that soldier in the field for a longer period of time. In this context, it is almost inevitable that the hardware account will get the nod.²⁰ Interestingly, in June of 1941 when faced with a similar dilemma as today, the Army Chief of Staff General George C. Marshall was said to favor the speedy equipping of 2 million men immediately rather than divert funds for ultimately equipping 4 million. A strong imperative influencing this preference was the fact that there had been virtually no prior provision made for expansion of the industrial base.²¹

One final reference to the important report of the Joint Committee appears appropriate. The committee's investigation observed that preparedness has suffered from a lack of centralized direction in the recent past. It concluded:

The reorganization of the Federal preparedness effort in this decade has left Federal preparedness programs without adequate visibility as a separate and distinct function of the Government without meaningful access to programmatic and budget decisionmakers, and without central budget and program planning.²²

The absence of national leadership with experience from World War II has left the Nation deficient in personnel who learned the painful lesson of US unreadiness during the months of desperate crisis which followed Pearl Harbor. One such leader, Bernard Baruch, who saw the Nation through two world wars and the Korean conflict, exhorted students at the Industrial College of the Armed Forces not to repeat past errors:

We have had more than enough experience with inadequate mobilization programs. We cannot afford to repeat the errors of the past. They cost us more than \$160 billions more than was necessary.²³

Despite all the warnings bred of past experience, the budgetary appeal of planning for a short war continued to attract adherents. Perhaps none of these was more important than the authors of the 1977 Nunn-Bartlett Report. This report, prepared by two distinguished US Senators, indicated that decreased warning time was the essence of the "new Soviet threat." The Senators argued that planning which allows for 3 weeks warning and a 6-month war is

probably unrealistic and suggested: "... coordinated preparation for an intense war preceded by perhaps as little as a few days' warning."²⁴ The report recognized the need for balance in that it did recommend the maintenance of "hedgies" against the eventuality of protracted war in conjunction with short-war preparations.²⁵ The short-war message seemed to dominate, however.

While the foregoing discussion describes the context of the debate over the probable wartime scenario in which this Nation's military planners find themselves, one should not overlook a somewhat less tangible consideration implicit in the dialogue. That consideration is the perception by a potential adversary of this Nation's resolve as well as war-fighting capability.

THE DETERRENT ADVANTAGE

A nation which is prepared to sustain a conventional (or tactical nuclear) war for an indefinite period would give an aggressor sufficient reason to pause and thus to afford an effective deterrent to conventional adventurism. It is not inconceivable that a conventional war could escalate to one involving the use of tactical nuclear weapons and still not necessarily expand to a massive strategic exchange of thermonuclear weapons. Various respected futuristic authors have considered this scenario, based primarily on the innate insanity of the employment of mutually destructive strategic weapons.²⁶ If the abhorrence of the use of strategic weapons is strong enough, a capacity for rapid and massive mobilization and industrial preparedness to sustain protracted conventional conflict takes on even greater importance. The exercise of such constraint in the employment of advanced weapons in a nation's arsenal is not without historical precedent. Even in the most dismal latter days of the Second World War, no nation resorted to the use of deadly gas. This weapon, effective on the battlefield during World War I, did not find favor in the international political arena in the years which followed and has not been used extensively "in anger" since the Armistice.

If, on the other hand, a nation adopts a short-war philosophy and postures itself only to respond to that type of scenario, it invites potential adversaries to structure their forces and support arrangements to sustain combat for periods in excess of the short-war capability chosen by their adversary. The Defense Science Board, in its previously cited study, suggests that increased levels of defense industrial activity could serve as an effective "intent warning" providing a strong deterrent signal to the Soviet Union.²⁷ Additional

support for this interest in industrial readiness can be found in the recent writings of Dr. Fred C. Ikle, former Director of the US Arms Control and Disarmament Agency:

Further, we need to improve the capacity of American industry to mobilize rapidly for a major expansion in defense production. That in itself might act as a potent deterrent to major aggression; if it does not, we would at least have the means to respond.²⁸

At the crux of the readiness dilemma is the human inability to forecast the future accurately. If carried to its logical conclusion, the inability to predict the nature of such variables of future wars as intensity, combat consumption, and duration with any precision argues persuasively that war reserve stocks, in and of themselves, cannot sustain combat indefinitely. This observation is not new; it was recounted in antiquity by Vegetius, the military historian and advisor to the Roman Emperor Valentinian:

Besides, scarcity of provisions, . . . soon ruins . . . large armies where the consumption is so prodigious, that notwithstanding the greatest care in filling the magazine they must begin to fail in a short time.²⁹

Rationing, which has been the traditional resort when supplies ran low in wartime, was noted as being similarly ineffective. "When provisions once begin to fail," declared Vegetius, "parsimony is ill-timed and comes too late."³⁰

Therefore, it is clear that the mix must be found between war reserve stocks and replenishment capability which will meet the most broad-range needs of our national security. Of late, it appears that the composition of this mix has been arranged heavily in favor of the near-term, first-battle philosophy to the detriment of the maintenance of the sustaining base. This imbalance must be redressed if we are to assure the existence of a prudent capability and not a dangerously shortsighted capability founded on economic constraints and questionable short-war assumptions. Some examples will be presented in the following chapter of this paper which will highlight the dangers of adherence to a short-war-only preparedness posture. A nation which commits its citizens to participation in war has a concomitant responsibility to provide the wherewithal to prosecute that endeavor successfully.

Given the peacetime competition for scarce defense dollars and the popularity of the short-war scenario, it will be useful to investigate in greater detail the elements of the defense industrial base and to analyze the current capabilities of that base and its present and future potential weaknesses. The defense industrial base comprises a myriad of private and public institutions which are, or are capable of, producing a vast array of military hardware. Ammunition has been selected to serve as an example of a discrete military commodity which is unique in some ways but, in general, represents the production dilemma inherent in this Nation's entire spectrum of mobilization planning and industrial preparedness.

AMMUNITION—A SUITABLE EXAMPLE

Aside from the requirement for sporting rifle and pistol ammunition, there is virtually no private commercial counterpart to military ammunition as a commodity. Therefore, no commercial market exists outside of orders to federal and other governmental customers. This characteristic, which is shared by some other military items, creates an unusual procurement environment, the unique features of which deserve some explanation.

The production of ammunition is highly capital intensive and involves industrial machinery and tools which, although they may be adaptations of commercial machinery, must be tailored to the manufacture of items to strict military and safety standards and specifications. The manufacture of ammunition end items entails the combination of the output of the metalworking industry and the chemical industry into the deliverable product in a process known in the trade as load, assemble, and pack (LAP) operations. In the chemical sector and in the LAP operation, the explosive hazard demands the utmost care and involves expensive safeguards to prevent accidents. Similarly, the ammunition industry carries a heavy burden in insuring compliance with the laws and regulations enacted to protect the environment and the safety of the industrial employee.

In general, the market which the industry faces is characterized by a single buyer and few sellers (oligopoly). The primary reason for the existence of only a few sellers is that, by and large, the ammunition market is not a particularly attractive one. The "merchant of death" stigma discourages many capable companies from entering the business. Further, the market demand is subject to wide fluctuations which makes stability of production difficult to achieve. This volatility of demand is caused not only by shifts between peace

and war, but also by the vicissitudes of military procurement programs from year to year. Low profitability continues to plague defense business³¹ despite recent efforts by the Department of Defense to improve the profit picture.³² These factors, combined with the inherent underutilization of capital in periods of low production activity, especially in peacetime, have made many potential producers reluctant to undertake the large capital investments necessary to insure that a defense production capability exists. Considerably more will be written in later chapters of this study regarding the methods by which the Department of Defense has taken cognizance of these characteristics and seeks to provide the necessary incentives to retain this needed capability.

Before proceeding to summarize the elements of the industrial readiness problem, one more feature of the ammunition industry warrants exposition. The present ammunition industrial base is represented in the marriage of public and private institutions. During various periods of our history, notably during the 1930's, government arsenals and armories were expected to be the primary sources of war materiel.³³ But the experience of World War II brought a reversal of this stance. And with the passage of the Defense Industrial Reserve Act of 1973, the US Government reaffirmed its faith in the efficacy of the arrangement by which both government and industry carried the burden. The law provides for the private sector to carry the "lion's share" of defense production, while requiring the maintenance of an essential nucleus of government-owned plants and equipment.³⁴ The result of this evolutionary process can be seen in the present ammunition manufacturing complex which is mostly civilian in character, with private firms operating either privately owned or government-owned facilities.

The existence of this amalgamation implies a close relationship between the government and private industry which is normally expressed in terms of a contract. One of the most serious mobilization planning and industrial preparedness problems is that contracts do not exist which secure government-industry mobilization agreements.³⁵ Without the binding contractual obligation, planning is haphazard, industry's interest is superficial, and the wherewithal to convert planning into viable industrial readiness is not provided.³⁶

SYMPTOMS OF DETERIORATION

The underlying deterioration of the industrial base occasioned, in part, by the adoption of a short-war philosophy and the ever-

present economic pressure to reduce expenditures, is evidenced in the following symptoms. Insufficient resources are being devoted to the maintenance of the inactive or underutilized defense materiel production facilities. No effective centralized national leadership appears to exist to attend to mobilization planning and industrial preparedness. And, finally, the industrial mobilization effort is characterized by incomplete planning, unenforceable mobilization agreements, and insufficient readiness incentives to industry.

Against this background of the current industrial preparedness problem in the area of ammunition production, it will be useful now to consider some earlier examples of how the Nation came to grips with the problem of providing the materiel needed to prosecute previous wars, to see if there are any insights to be gained.

CHAPTER II ENDNOTES

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III

LOOKING BACK FOR LESSONS

Adequate preparation for war has never yet in history been made after the beginning of hostilities without unnecessary slaughter, unjustifiable expense and national peril. It is only in the years of peace that a nation can be made ready to fight.

Huidekoper, The Military
Unpreparedness
of the United States¹

Americans, in general, do not seem to be imbued with a desire to study the lessons of the past to the extent other cultures are. Perhaps this proclivity can be attributed, in part, to the impetuosity of our youth as a nation. Old World nations, and in particular our ideological adversary, the Soviet Union, place greater store in learning and benefitting from the lessons of history. As incongruous as it may appear to current short-war advocates, Soviet military leaders had consistently displayed great interest in the lessons of their most recent long war.

The Soviets certainly place enormous emphasis on the lessons of World War II—both Marshal Ustinov, Minister of Defense, and Marshal Kulikov, Commander-in-Chief, Warsaw Pact, have written of the relevance of World War II to possible future wars.²

This chapter will recall some of the mobilization experiences of the United States, its allies, and its enemies. However, before looking back, it is important to draw a distinction between the general terms of mobilization and the more specific phrase "materiel mobilization" used to describe but one facet of the overall process.³

Mobilization in the general sense, as alluded to earlier, encompasses all of the factors necessary to convert a nation at peace to a nation at war. Thus it includes manpower, training, economic and financial adjustments, governmental controls, etc, as well as materiel mobilization. This latter element provides the wherewithal with which to fight. The supplies and equipment for issue to the men and women being placed in uniform must come from previously provided stockpiles or from industrial capacity converted from peacetime pursuits to the production of military hardware. The materiel

mobilization aspect of preparation for war is inherently time-consuming. In the past, materiel mobilization, rather than manpower mobilization, dictated the speed with which an effective fighting force could be deployed.⁴

Therefore, as the history is sketched, munitions stockage and industrial mobilization considerations will receive the focus. The ultimate reliance on production to provide the essential war-fighting commodities will be underscored.

PRIOR TO THE WORLD WARS

Even before the United States declared its independence, the imperatives of materiel mobilization influenced its military viability. Washington's army besieging the British in Boston in 1775 suffered severe shortages of gunpowder (which equated to ammunition firepower potential in those simpler technological days). In Washington's letters one finds the anguished report:

Our advanced works and theirs are within musket-shot. We daily undergo a cannonade, which has done no injury to our works, and very little hurt to our men. These insults we are compelled to submit to for want of powder, being obliged, except now and then giving them a shot, to reserve what we have for closer work than cannon-distance.⁵

And on Christmas Day 1775, Washington wrote, "Our want of powder is inconceivable. A daily waste and no supply present a gloomy prospect."⁶

Along with the many national traditions established during our early formative years, the lack of interest in things martial between the wars seems to have been born before the Revolution. The capability which existed for powder manufacture in the colonies during the French and Indian War had been permitted to atrophy. Both the physical plants and the manufacturing expertise had passed from the scene by 1775.⁷ Under the urging of the Continental Congress and the promise of profits from the sale of gunpowder, numerous manufacturers sprang up in the colonies. And although during the first two and a half years of the war, the colonies manufactured approximately 115 thousand pounds of powder from domestic saltpeter, over 90 percent of the powder available for use during that period was derived from foreign sources.⁸

Two other features of our war for independence are pertinent to the study at hand: perceived war duration and centralization of mobilization authority. Little thought appears to have been given to how long the war would last or to the staying power of the Continental Army. As is easily recalled from Longfellow's poem, the warning of the outbreak of open warfare went out "On the eighteenth of April in Seventy-five . . ." ⁹ However, the initial enlistments of the soldiers under Washington's command were to expire on the last day of that same year. ¹⁰ Providing for the army in the field was initially conceived as being the responsibility of the respective colonies. After attempts to direct the mobilization effort through a succession of boards and committees, the Second Continental Congress vested the mobilization authority in a single Secretary of War, Major General Benjamin Lincoln, in the same month that the war ended, October 1781. ¹¹

The Revolutionary War taught the Nation its first lessons in materiel mobilization. Successful conduct of war is inextricably bound to the availability of war-fighting supplies and equipment. Without prior planning and action, mobilization of the necessary resources cannot take place after the war begins without suffering attendant inefficiency and waste.

In the halcyon years immediately following the American Revolution, the need to retain a large Military Establishment was not seen to exist. Demobilization and reduction in the Armed Forces was almost absolute. Eighty enlisted men were authorized to be retained in the Regular Army by the Congress in 1784. ¹² In succeeding years, the Congress, reacting to various international tensions, passed enabling legislation which would have permitted sizable increases in the Armed Forces but the Presidents, notably Thomas Jefferson, chose not to implement the approved programs. On the eve of the War of 1812 with England, mobilization measures were passed, but the legislation came too late to provide for the required reaction time for thorough war preparation. The delays in equipping the naval forces on the Great Lakes has been viewed as contributing to disastrous failures of the unsupported land forces ashore. ¹³

In the period between the War of 1812 and the Mexican War (1846), a number of beneficial organizational and infrastructure measures were enacted by the Congress. One of the results of these measures was the significant enhancement of the arsenal and armory system for the manufacture of munitions. The inspired and enlightened leadership of Secretary of War John C. Calhoun strongly

precipitated the improvements in both the quality of weapons and the industrial capability to produce them during the pre-Mexican War period. The improvement actions were given impetus by the recent Seminole Wars in the South.

Logistical support of the Mexican War was, in general, very satisfactory despite the annoying transportation problems occasioned by the vast distances needed to be transversed during the campaign. The aforementioned arsenals and armories, as well as civilian contractors, provided artillery, small arms, and ammunition in an efficient and timely fashion. The provisioning of supplies was so thorough as to prompt at least one historian to write:

When carried too far, attempting to provide for every contingency can have consequences as unfortunate as those resulting from too little preparation. An army waiting for supplies it does not really need, or paralyzed by having to move more materiel than it does need, may be just as inefficient as an army that has completely outrun its supplies.¹⁴

After the Mexican War, increasing unrest between the Federal Government and the Southern States assisted in keeping attention focused on military affairs. When the American Civil War did come it was of such enormous scope and intensity that it ushered in a new era in wartime mobilization. Some of the problems of earlier wars resurfaced. One such problem was the relatively slow mobilization of material compared with the rapid recruitment of men. However, in the long run industrial and technological advances gave new meaning to the term mobilization: the marshalling of public and private industrial capability to support the war effort. Early mobilization efforts in the North were, for the most part, decentralized to the States, while in the South, tighter centralized control over inferior industrial resources was the norm. Even the expanded government manufacturing facilities, which acquitted themselves so well in providing munitions during the Mexican War, could not hope to keep pace with the voracious demands which confronted the industrial base in 1861.

As in the past, mobilization started essentially when the war did, a quick victory was sought by the North, only to be met with a serious reverse at the hands of the Confederates in the first major engagement, the Battle of Bull Run. After this setback, all of the stops were removed in an attempt to secure the necessary munitions for the conduct of what was to be a protracted and devastating conflict. Early conversion of private industry to the production of almost all types of military items was spurred by the lure of profiteering. Examples of

inferior quality and exorbitant prices were rampant in items purchased by the Government.¹⁵ Herein is provided an early economic lesson that the Nation was condemned to repeat again and again. The Government traditionally enters a "seller's market" when it buys war materiel (or the capital equipment to produce it) after the Nation is at war and pays dearly in so doing. Enormous expenditures of money result in excessive commercial profits, or even worse, outright waste, without an appreciable compression in industrial response time or increase in the quality of output. Expenditures made wisely before a war begins can have a markedly more salutary effect.

As the war dragged on, the industrial asymmetry began to tell. That the Confederacy was able to sustain the war effort for 4 years is adequate testimony to the commendable mobilization effort made by the South.

Clearly illustrated during the Civil War was the strong interdependence between governmental and private sources of war materiel. Gone were the days when the country could maintain an extensive arsenal and armory system and rely on it to meet its military hardware needs (although a resurgence of this concept gained some favor between the world wars¹⁶). To illustrate the extent of the Government's reliance on the private sector, consider the following:

Private industry was the source for all the artillery . . . , all the gunpowder, and a large share of the small arms procured during the Civil War. . . . Private arms makers produced 670,600 of these Springfield weapons [Rifled muskets]. Other purchases from domestic industry and from abroad included nearly 1,225,000 muskets and rifles, over 400,000 carbines, and 372,800 revolvers.¹⁷

For purposes of comparison, it is noted that the Government's Springfield Armory produced 802,000 rifled muskets during the war.¹⁸

With the end of the war in 1865, the Nation turned its attention to binding up its wounds and reconstruction of the South. Demobilization ensued once again and by 1876 the Army had been reduced to 27,472 men.¹⁹ The period of US military history between the Civil War and the World War was punctuated by intermittent Indian campaigns along our western frontier, a short but decisive war against Spain in 1898, and the suppression of an insurrection in the Philippine Islands one year later.

Prior to the Spanish-American War, some improvements had been made in modernizing our cannon and ammunition inventories. But, because of bureaucratic dallying, little progress was made in the development of small arms and smokeless gunpowder.²⁰ Despite these shortcomings and the fact that Congress delayed approval of funds for purchase of supplies and equipment until after war had been declared, mobilization of an army and equipping it to fight in an overseas theater from a virtual standing start was performed remarkably well. The lateness of the funding appropriation did occasion shortages during the early mobilization period, but a sufficiently equipped force (to meet an inferior Spanish threat) was assembled and launched successfully against Santiago de Cuba in June 1898. Because of the shortness of the war (109 days from the declaration of war to the cessation of hostilities),²¹ attention naturally focused on the need for adequate prewar reserve stocks. In the postwar report of the Presidentially appointed Dodge Commission, we see what is probably the first official recognition of the importance of materiel, vis-a-vis manpower mobilization:

One of the lessons taught by the war is that the country should hereafter be in a better state of preparation for war. . . . Especially should this be the case with such supplies, equipment, and ordnance stores as are not in general use in the United States and which cannot be rapidly obtained in the open market.²²

Although US combat efforts in the War with Spain met with resounding success, the obvious lack of organization and the paucity of prior mobilization planning caused considerable alarm within military and other governmental circles. Organizational reforms of the Military Establishment resulted in the creation of the Army General Staff and the position of Chief of Staff of the Army. Major General Leonard Wood became the fifth Chief of Staff in 1910. With his personal Spanish-American war experience still keenly in mind, General Wood is quoted as having said about providing war materials:

. . . once a state of War exists with a first-class power there will be no opportunity to buy this materiel abroad or time to manufacture it at home, even if all available plants were running at maximum capacity, without such delay as would be fatal to our hopes of success.²³

The importance of prewar industrial preparation perceived by General Wood was dramatically demonstrated by the industrial preparedness experience of the belligerents in the First World War.

THE WORLD WARS AND THE INTERWAR YEARS

In the early years of the twentieth century, antiwar sentiment and pacifist ideologies were being strongly asserted. Only a year before the outbreak of the World War, the noted pacifist David Starr Jordan wrote:

What shall we say of the Great War of Europe, ever threatening, ever impending, and which never comes? We shall say that it will never come. Humanly speaking, it is impossible.²⁴

The World War

And yet, war did come to Europe and eventually to the United States. Even before the United States became embroiled in the World War, the lesson of preparing for no more than a short war was visited upon the European Powers at a very high price.

The brilliant German strategist, Alfred von Schlieffen, assumed that a lengthy conflict was not possible, ". . . in an age in which the existence of nations is based on the uninterrupted progress of trade and commerce. . . . A strategy of exhaustion is impossible when the maintenance of millions necessitates the expenditure of billions."²⁵ Early in August of 1914, the Imperial German Chancellor, Bethmann-Hollweg, reckoned with a short but violent war lasting only 3 or 4 months.²⁶ The reader may detect a reminiscent echo of the Chancellor's prediction in Doctor Heilmeyer's quote in the previous chapter of this study.²⁷

The short-war philosophy was so pervasive that neither side could bring itself to believe that a war of attrition was possible. Germany was convinced that she was prepared to wage a short war and be successful. However, even to outsiders, Germany's inadequacy to sustain a protracted war was evident. The shortcomings in Germany's preparation for war were widely recognized in military circles. The General Staff had repeatedly appealed to the Ministry of War for increases in ammunition, weapons, and manpower only to be told that the meeting of such demands would place the country on the verge of bankruptcy or revolution.²⁸ At the outset of the war, Germany, even with its extensive chemical industry, had only enough nitrates, the key ingredient in explosives, to last for 6 months. France, in the early days of the war, suffered the loss of the Lorraine iron fields through inadequate defense in the belief that a quick French victory would soon restore

this valuable territory. As a result of this miscalculation, France denied herself access to 80 percent of her iron ore for the duration of the war.²⁹

But the war did not end quickly, and even in its earliest stages it exhibited a tremendous appetite for the products of industry, especially ammunition. In a typical month, the allied forces of France and England expended more than twice as much artillery ammunition as was used by the Union Army in the 4 years of the American Civil War.³⁰ And the Civil War ammunition expenditures were unprecedented in US history up to that time. General Sieger, Chief of the German Field Army Munitions Service, foresaw the coming ammunition shortages and urged conservation. He was told that saving was unnecessary because it was going to be a short campaign. The resulting depletion of ammunition made the German Army dependent on new production as early as October 1914, 2 months after the war began.³¹

After the reverses on the Marne River, the combined implications of the prolongation of the war and the extraordinary rates of expenditure of ammunition began to become clear to top German leadership. General Erich von Falkenhayn, the younger von Moltke's successor as the Chief of the German General Staff, wrote after the war of this period:

The spectre of the shortage of munitions was already apparent. According to views accepted hitherto the German Army had gone into the war well prepared. The Ministry of War had done everything possible during the last few years before the war, according to the views current at that time, to meet the demands of the General Staff. Consumption however, exceeded peace-time estimates many times over and was on the increase in spite of the strict measures taken to avoid wastage of ammunition.³²

There is an ironic note attached to the difficult supply position in which Falkenhayn found himself in September and October of 1914. He had been the Minister of War for over a year prior to the start of the war and in that position was responsible for equipping and supplying the German Army. This fact may account for his belief that "everything possible had been done" and, perhaps in the existing political environment, it had. Nonetheless, there had indeed been a serious miscalculation. "The intention of forcing a speedy decision which had hitherto been the foundation of the German plan of campaign had come to nought."³³ The shortages of ammunition

emphasized deficiencies in the field artillery formations which Falkenhayn attempted to redress with the use of unwieldy siege guns. Even after these guns were in place, their use could not be turned to advantage for lack of ammunition.³⁴

Erich Ludendorff, Chief of Staff to the beloved Hindenburg, recorded in his memoirs: "In many directions we had prepared for a short war, and in this [railroad transportation] and other matters now had to make arrangements to meet a long one."³⁵ But such "arrangements" then, as now, could not be made instantaneously by a nation at war. German industry embarked on an energetic ammunition manufacturing program and by the spring of 1915 (some 9 months after the start of the war), the pipeline was filling up and supplies were sustained at adequate levels until midsummer 1916, when they once again began to decline. Ludendorff, in discussing the renewed shortages, said:

Much could be done, and had to be done, by our industries to increase our resources. . . . It was clear that our munitions factories, in spite of their immense output, . . . were never in a position to overtake the enemy, so long as the enormous industrial areas of the latter continued to work undisturbed. . . .³⁶

This dire prediction might have been evidence of Ludendorff's prescience of the later entry into the war effort of another industrial giant, the United States.

Even the elderly Field Marshal Von Hindenburg felt, by 1917, the impact of the inadequacy of the wartime industrial base. In a dispatch to the Chief of the Military Cabinet, he wrote:

The difficulties in our munitions industries were not foreseen on the scale on which they actually materialized. . . . I am compelled to raise my voice against this shortage. The output of ammunition is far behind the figures promised and, as I have said repeatedly, is paralyzing operations.³⁷

In April of that same year, with Germany struggling to attain industrial and military superiority, the United States entered the war on the side of the Entente. In characteristic fashion, the United States mobilized her manpower with creditable rapidity (although not at the rate experienced in the Civil War and the War with Spain). Nine months after the declaration of war, 1,500,000 men were in federal service, if not yet under arms. In March of 1917, only the rifle-manufacturing capability, represented by two government and three

private plants, could meet the needs of the influx of new recruits. For other commodities, the US Forces were destined to face the realities of long production lead times, ranging from 12 months for small arms, through 18 months for ammunition and machine guns, to the extreme of 30 months for new artillery production. The upshot of this industrial constraint has become a well-known feature of US participation in the World War; viz, we fought with weapons and equipment provided by our allies. Table 1 displays this reliance rather clearly.

Table 1
Source of Equipment for
American Expeditionary Forces in the World War

Equipment Type	Total Quantity Furnished	From France	From Great Britain	From the United States
Artillery	4,194	3,532	160	502
Railroad Artillery	158	140	0	18
Caissons	9,023	2,658	0	6,365
Trench Mortars	2,555	237	1,427	891
Automatic Weapons	124,352	40,484	0	83,868
Tanks	289	227	26	36
Airplanes	6,345	4,874	258	1,213

Source: Adapted from Huston, *Sinews of War*, pp. 334-35.

Almost all of the artillery ammunition, approximately 10 million rounds, used by the US Forces were provided by the French. There is an interesting logistical twist connected with the ammunition production for Allied use. Since the primary manufacturer of chemicals in Europe was Germany, both England and France were required to place huge orders with American industry for militarily important chemicals for use in ammunition manufacture. As one US official put it: "The result was an enormous production of propellants and explosives in the United States during the period of American belligerency, no other prime phase of the ordnance program being carried to such a stage of development."¹³⁸ Response to this increased need for the manufacture of explosives saw US industry respond with private capital investment when properly motivated by contracts which assured a reasonable return on the investment.

The establishment of a centralized materiel mobilization capability was troubled by ambiguity in national policy as to the extent of US involvement in the European War. Early orders from our Allies for military materiel provided some impetus to US industrial mobilization and various items of equipment and supplies of US manufacture reached the theater of operations between 1914 and 1917. The legislative foundation of the Army Appropriation Act of 1916, a Council of National Defense, was created to coordinate preparedness efforts. This modest beginning had evolved into an efficient War Industries Board by March of 1918. Under the leadership of industrialist Frank A. Scott, the mobilization of US industry was geared for the long pull. The programs were systematically and deliberately designed to reach peak production in the years 1919 and 1920 at the expense of what might have been attained as stopgap measures as early as 1917 and 1918. This farsighted approach may have been as telling as the arrival of our "doughboys" in France. Benedict Crowell, wartime Assistant Secretary of War, wrote in 1919:

It was the mobilization of her [US] might, almost as much as the leverage of her immediate force, which helped to convince the German general staff of the futility of further resistance and assisted to bring the war to an early end.³⁹

The First World War served as a useful proving ground for learning the lessons of industrial mobilization which the United States as an emerging industrial power would have to master in the years to come. First, from our enemy, we learned that a nation may consider itself ready to wage a particular version of war (i.e., Germany and her short-war fixation) and be totally unprepared for the war which ultimately comes. Our own mobilization experience in the World War retaught the lesson that manpower mobilization and materiel mobilization must be coordinated endeavors. Again from Crowell:

... our strategical equipment included plans ready drawn for the mobilization of men ... this equipment included no plan for the equally important and equally necessary mobilization of industry and production of munitions, which proved to be the most difficult phase of the actual preparation for war.⁴⁰

Implied in this admonition is the desirability of compressing that industrial mobilization phase if possible. But, how quickly we forget. Finally, the war effort hinted at the need for centralized leadership of the mobilization effort and the need for the Government to provide suitable incentives to our commercial partners in the mobilization of

this Nation's industrial resources. These lessons were embraced wholeheartedly in the early interwar years but as we shall soon see, had flagged sufficiently to require some relearning by the time the United States became the Arsenal of Democracy in April of 1941.

The Interwar Years

The two decades between the World Wars display an interesting ambivalence in US national security thinking. On one hand, there was strong political sentiment supporting the notion that the maintenance of huge reserves of war materiel and the retention of a defense industrial capability were both inimical to the policy of neutrality which would insure peace. On the other hand, voices were raised in the plea that the Nation should never again find itself as singularly unprepared for war as it was for its participation in the World War. Nonetheless, amid the sometimes vociferous pacifist urgings, the preparedness viewpoint found its expression in the passage of the National Defense Act of 1920.

This legislation recognized the need to provide for national defense preparedness. Although the primary thrust of the law dealt with Armed Forces personnel strengths, it contained some important provisions which set the stage for organizational reforms and mobilization planning measures. Responsibility for procurement of military supplies and the mobilization of materiel and industrial organizations was explicitly assigned to the Assistant Secretary of War.⁴¹ Through the Planning Branch of the Office of the Assistant Secretary of War (OASW), created in 1921, plans were drawn up for future procurement and mobilization of US industry. These plans, which subsequently became known as the Industrial Mobilization Plans, identified some 10,000 industrial plants to be designated as planned producers of war materiel. Further, the plans provided for the extension of some educational orders to enable the planned producers to take required industrial preparedness measures in advance of actual wartime production.⁴² Industrial Mobilization Plans were prepared every 3 years from 1930 to 1939. Inadequate funding and the absence of legislation, which would have provided authority for immediate execution of the plans upon the declaration of a national emergency, prevented the National Defense Act of 1920 and the Industrial Mobilization Plans from reaching their full potential. However, both instruments served the nation well (when augmented by foreign orders) in preparing for the immense industrial undertaking which was to begin in 1940-41.

The following order was published in 1924 by authority of the Secretary of War, John W. Weeks, which gave additional impetus to industrial preparedness:

A college, to be known as The Army Industrial College is hereby established for the purpose of training Army officers in the useful knowledge pertaining to the supervision of procurement of all military supplies in time of war and to the assurance of adequate provision for the mobilization of materiel and industrial organization essential to war-time needs.⁴³

The Army Industrial College, direct ancestor of the Industrial College of the Armed Forces, was a school of practical fundamentals. Current procurement problems were the subject of study assignments, and proposed solutions were of practical assistance to the Planning Branch of the Office of the Assistant Secretary of War and served as useful inputs to the emerging Industrial Mobilization Plans. Indicative of the unique stature enjoyed by the Industrial College was the fact that it came under the purview of the Assistant Secretary and not the Army General Staff as was true of the other service schools. The academic focus of the Industrial College has undergone evolutionary changes over the years and the description of its present thrust awaits exposition in a later chapter.

Despite encouraging signs of the awakening of US interest in peacetime preparedness for war, as the 1920's and the 1930's wore on, legislative and fiscal support of preparedness programs began to wane. The Army suffered a disproportionate share of the neglect, presumably because the Navy could serve to defend the Nation on its ocean barriers. Dating from the early twenties, pronouncements of the Army Chiefs of Staff, including General Pershing and each of his interwar successors, bewailed the deterioration of the Nation's military preparedness. The uniformed military were not alone in this regard (indeed if they were, there might be reasonable grounds for skepticism). The Secretaries and Assistant Secretaries of War joined in the litany of requests for increased funding support.⁴⁴ Particularly poignant to the study of the ammunition manufacturing industry is an observation made by Secretary of War George H. Dern in 1935. After visiting government manufacturing facilities and asking how well prepared they were to turn out "munitions in large quantities on short notice," he records the usual reply as:

We are not prepared at all. Our machines are antiquated and ought to be replaced by up to date equipment. Our shop is poorly arranged. In short our plant ought to be remodelled and

overhauled, if not rebuilt. Why we cannot even get the money to repair our roofs.⁴⁵

Insofar as one can detect the mood of the body politic from public opinion polls, it appears as though the American public was well ahead of the Congress in perceiving the need for defense appropriations. George Gallup reported that the people canvassed in a 1935 poll were "... strongly in favor of increasing appropriations... at a time when Congress was going exactly in the other direction."⁴⁶

Neither Japanese aggression in Asia nor the menace of Facism in Europe could awaken the democracies to action either collectively or as individual nations. In the late 1930's a young American living in England observed that country trying so desperately to avoid war that she was seriously imperiling her military capability, if not her national sovereignty. Johh F. Kennedy maintained that in delaying her rearmament program from 1934 to 1936, England was militarily enervated at two crucial historical junctures. The first of these was in 1936 when Britain was unable to enforce naval sanctions against Italy in the Mediterranean. Especially interesting in the context of this study was the part which ammunition played in that particular confrontation since: "... the Fleet... found that many of their guns had ammunition for only one or two rounds."⁴⁷ The second test came in 1938 when England did not oppose Hitler's designs against Czechoslovakia and acceded to the infamous Munich agreement.⁴⁸ Within 6 months of the Munich conference, Czechoslovakia was absorbed into the German sphere of influence. Notwithstanding the oportunities which may have been missed in these 2 crucial years, England's belated rearmament program, which began in earnest in 1936, enabled her to attain what industrial viability she did enjoy at the time she entered the war in 1939.

The value of England's "shadow factories" was pointed up succinctly by Lord Swinton, former Air Minister, in May of 1938:

Factory extensions, new factories, shadow factories were created of a size which would not only cope with orders which were then given, but which, with little further extension, would be on a scale and of a size to cope with a much larger output... it was that preparation, that laying-out of factories on an extensive scale, which alone makes possible much that we are putting in hand at the present time.⁴⁹

Despite the limitations imposed by the Treaty of Versailles, Germany was able to rearm so thoroughly and quickly because she

accepted the reality of long industrial lead time and made provisions for accommodating it. Again, as an observer of the unfolding world crisis, Kennedy wrote:

... it takes more than a year to get factories organized for the production of munitions on a large scale. Germany got the jump principally by *getting everything set for a large-scale output rather than by actual output itself*, though its output was considerable [emphasis is Kennedy's].⁵⁰

Germany had learned her World War lesson well.

As America was drawn closer to the European war, persistent isolationist opinion continued to impede our preparations for war. In early 1939, during a review of the proposed aircraft procurement program, a congressional Representative is reported to have claimed that an aircraft program of 15,000 or 20,000 aircraft would “bankrupt the nation.”⁵¹ When the final tally was made, however, the United States produced between 200,000 and 300,000 airplanes of all types or 10 to 15 times the “bankruptcy” level. Such was the scale of things to come as the United States, despite a strong national desire to preserve peace, once again became embroiled in a world war.

The Second World War

When munitions orders began to be received from England and France in 1938, the US industrial capability for the manufacture of war materiel had deteriorated almost to pre-World War condition. Particularly acute was the lack of a capability for production of powder and explosives.⁵² Therefore, the buildup of industry to meet Allied requirements was to have a beneficial long-range effect on the defense industrial base. However, because of the limitations within the industrial sector, competition for its munitions output was inevitable between foreign orders and the US requirement to equip her own expanding Armed Forces. The coordination and allocation problems which this competition presented were taken in hand by the Army and Navy Munitions Board. This experience served as a fitting prelude to what was to become the extremely difficult mobilization task of allocation of industrial and raw materials resources throughout the war. The early war materiel transfer programs, which intensified after the British were expelled from the Continent at Dunkerque in 1940, culminated in the enactment of the Lend-Lease Act of 1941. These programs also revealed an inadequacy in existing mobilization planning which was predicated on unilateral national

planning for what was shaping up to be a coalition war of unprecedented proportions.

The difficulty in meeting the war materiel requirements stemmed, in large measure, from the fact that, as noted earlier, the munitions factories from the World War had been permitted to decay during the interwar years. The cost of such neglect in terms of industrial response time to meet increasing requirements was estimated by Leo A. Codd, Executive Vice-President of the Army Ordnance Association, early in 1941, as follows: "If our World War plants were in readiness today, our armament production would be advanced anywhere from 6 to 18 months."⁵³ Codd saw what industrial planners before him had seen; even extraordinary efforts and dedication of resources to production programs cannot change the fact that in industrial readiness endeavors, money cannot buy time when its investment is ill-timed. Peacetime preparation for wartime production is again underscored.

With the defeat of France in the spring of 1940, the seriousness of the war in Europe and the imminence of our increased involvement began to break on the official consciousness of the United States. The period from June 1940 until the Japanese attack on Pearl Harbor in December 1941 saw the United States embark upon a serious rearmament program, albeit short of declared total mobilization. Each successive Nazi gain in Europe elicited repeated supplemental defense appropriations from the US Congress. Once Congress has been convinced of the need, its munificence can be impressive indeed. In the 18 months of the immediate prewar period, \$36 billion were appropriated to the War Department; this was more than the total expenditures of the Army and Navy during the First World War.⁵⁴ This capital infusion activated the munitions industry and paved the way for the prodigious deliveries which would be made as peak production was reached in 1944. Thoughtful conjecture has arisen regarding the timing of this important decision point in American preparedness history. Could the war effort have been facilitated if the decision to rearm had been taken a year earlier when our primary allies declared war on Germany? Or, more frightening to contemplate, what would have been the effect of delaying this decision until the United States had been attacked? !!!

As late as November 1941, the United States was still not fully committed to an all-out mobilization effort to support the war, nor did it have an effective centralized body charged with administration of the mobilization process. After Pearl Harbor, President Roosevelt,

acting on an earlier suggestion, assigned to the newly formed Strategic Munitions Board the responsibility of establishing allocation and production programs for the United States and her allies "to achieve sure and final victory."⁵⁵ The Board never really functioned as intended because the President retained to himself the prerogatives of determining the materiel requirements and the setting of goals and programs needed to meet the requirements. These Presidential actions were, at best, expedients which served the country well while a mobilization mechanism to support an all-out war effort was being evolved. Mobilization on a national scale with its attendant economic dislocations required centralized governmental controls over the factors of production: men, material, and money. The Nation, through a relearning process of the mobilization lessons of the First World War, performed its conversion to a wartime footing through a number of superagencies: viz., Office of Price Administration, Office of Defense Transportation, War Manpower Commission, War Food Administration, etc. Bernard Baruch, who had been down this road before, had strongly recommended that such centralized control be initiated at the outset of mobilization considerations, but his urgings (and the suggestions arising out of Army Industrial College studies) were largely ignored. Eventually, the establishment of the War Production Board under the chairmanship of merchandising executive, Robert Nelson, and the appointment of William Knudsen, President of General Motors, as the Director of Production in the Office of the Undersecretary of War, centralized the mobilization effort after the successful model of the World War, War Industries Board.⁵⁶ Thus, centralized administration was again seen to be necessary, but the mechanism for preserving the high-level advocacy for mobilization matters had not been retained between the wars.

The industrial response to the war effort after Pearl Harbor is well known. United States citizenry was galvanized to action and willing to accept sacrifices in support of the war. During the war, the United States produced fully 40 percent of all the munitions produced in the entire war and in the peak production year of 1944 produced "... about 50 percent more than either all its allies or all its enemies combined."⁵⁷ Particularly striking was the production of the ammunition commodity. From a sorely inadequate industrial base in 1939, nearly a billion (988,547,839) rounds of artillery and mortar ammunition were produced in the United States during the war. By way of comparison, this figure represents a fifty-fold increase over the US production (approximately 20 million rounds) during the First World War.⁵⁸ The fighting forces' appetite for ammunition continued to grow.

Perhaps more important to this study than the absolute, aggregated output of industry is the time it took to reach that enormous capacity for production of munitions. Using 1944 as the peak production year yardstick, the United States was producing at about 5 percent of that level in 1940, while Germany in the same year was producing at approximately 35 percent of her maximum effort. It took 2 1/2 years for the United States to reach nearly maximum production output. What is obscured in these statistics is the vital activation and tooling-up of the munitions industry going on from 1940, and before, enabling the attainment of the production rates which ultimately overtook the German war machine. The strategic importance of American industrial might was not lost on our enemy. It portended such ill for the Third Reich that Hitler forbade the discussion of US war production statistics in Germany.⁵⁹ Before reviewing the preparedness lessons of the war, one further observation appears to be in order.

The generally increasing levels of munitions production throughout the war displayed an anomaly in ammunition manufacture. There was apparently a greater attempt made to "fine tune" ammunition production to anticipated expenditures than was true for other materiel commodities. When the end of the war in Europe was in sight, ammunition programs for 1943 and 1944 were adjusted downward. The result was the creation of a potentially perilous situation when expenditure rates rose again in response to strong German counterattacks toward the end of 1944. According to an Ordnance Department historian, Berkely Lewis: "Apparently, anticipation of an early end of the hostilities with Germany had caused production to be cut back too far during the preceding year."⁶⁰ The message is clear: war, like a football game, is not over until the final gun is fired.

With the conclusion of the most demanding defense endeavor in our Nation's history, it was desirable to review the bidding. Was the industrial effort adequate to the task? The answer is a resounding yes. Could more have been done, or could improved industrial preparedness have enabled us to do the job better? Probably yes again. What lessons are to be learned?

Thorough peacetime planning and appropriate preparedness measures taken before the onset of hostilities are imperative if the full industrial potential of the Nation is to be effectively brought to bear on the war effort. The purpose of planning in peacetime is to preclude hasty, expensive, and dangerous improvisation in time of crisis.⁶¹

Money cannot buy time when it is so desperately needed after a war begins and huge appropriations are provided too late, and in the absence of existing facilities cannot be spent to good advantage.⁶² Long industrial lead times must be acknowledged and peacetime actions taken to mitigate the untoward effects of these lead times. Following from this premise it becomes clear that money must be spent in advance of the actual need to assure the existence of a warm industrial base, already tooled-up for munitions production, and experienced in the manufacture of military materiel.

Ammunition production continued to be a dominant force in the industrial equation. According to one historian, ammunition was the immediate and pervasive shortage in the early stages of the war; such a shortage could be redressed only through increased production.⁶³ The mobilization effort must be coordinated, directed, and controlled through a single organizational focal point. Preferably that coordinating mechanism and advocacy would be in place and exercised in peacetime and not created (or recreated) on an ad hoc basis for the meeting of each national emergency. Finally, the Second World War demonstrated anew that, intrinsically, wars are of uncertain duration even when the "end is in sight." This lesson was to be embarrassingly reinforced in our Nation's postwar experiences. It is to the 35 years since the end of the Second World War that the attention of this study now turns.

SINCE THE SECOND WORLD WAR

Determined Japanese resistance, and with it the fighting war, ended with the detonation of two atomic weapons over Japan in August of 1945. The advent of atomic warfare not only shook the traditional concepts of war-fighting, but also radically altered the debate over how we should prepare ourselves to wage future wars. Early postwar views of the US atomic monopoly and the Nation's perennial desire to return immediately to the status quo antebellum led to rapid demobilization. These factors, coupled with the existence of a huge surplus of postwar stockpiles of equipment and ammunition, denigrated the importance which might have attached to the mobilization and industrial preparedness lessons of the Second World War.

However, by 1948 increasing Cold War international tensions had already infected the country with new uncertainties. In that year, the Congress overwhelmingly voted the institution of a peacetime draft, which was signed on the day the Russians completed the Berlin

Blockade.⁶⁴ At the same time that the call was going out for manpower, budget cuts in 1949 and 1950 were causing the closing of depots and government and private munitions-manufacturing facilities. This sequence of events, it may be recalled, is a repetition of the formula for future materiel mobilization disaster. The admonitions of industrial preparedness planners of earlier days had once again slipped from our institutional memory. Communist aggression in Korea would reawaken interest in industrial preparedness.

When the United States deployed forces to Korea from Japan in June of 1950, the munitions base at home had already suffered noticeable deterioration in the years since the Second World War. The maintenance of all segments of the inactive base had been neglected, owing particularly to the shortage of funds dedicated to that purpose. However, it was the ammunition base which was to draw the most official and public attention and criticism during the Korean conflict. In reporting to the Congress in 1953 Major General Elbert L. Ford, Chief of Ordnance, testified:

In 1950 there was no ammunition industry for the production of metal components. Our reserve plants for the production of powder and explosives, and for the loading and assembly of finished ammunition were far from being in a state of immediate readiness for production.⁶⁵

Despite the deteriorated condition of the ammunition manufacturing base, there were two factors which permitted the immediate needs to be met while the industrial capability was being restored. First, there existed an immense stockpile of ammunition produced but not expended during the previous war. And although its worldwide distribution did not match the immediate requirement, and some of it had become unserviceable by dint of expired shelf-life, this stockpile served well to fill the breach. Second, when World War II production stopped, it was essentially halted in-place. The implication of this factor is that vast numbers of ammunition components which represented work-in-process at the time production ceased were retained in what was somewhat ominously dubbed "terminal inventory." The existence of these components shaved valuable lead time from the production cycle of certain ammunition items.⁶⁶ Notwithstanding these two advantages, repeated reports of ammunition shortages (which were never fully substantiated though extensively investigated by congressional committees) were returned from Korea.

When the industrial mobilization program did get underway, it was under different ground rules than previous mobilization efforts. Korea may be viewed as the first "Guns *and* Butter" war in the sense that the industrial buildup to support the war was to be done with minimum disruption to the civil sector of the economy and without a declaration of mobilization or national emergency.⁶⁷ Consequently, delays were experienced in getting deliveries from the production base even after the funds for ammunition procurement had been appropriated. A failure on the part of the Congress to appreciate delays which are occasioned by peacetime inattention to industrial preparedness, and the realities of industrial lead time made the Congress increasingly impatient with the lack of output from the ammunition segment of the base. In defense of the Army's efforts General Ford explained to the Congress:

This matter of lead time is the hard fact of life that controls the deliveries, and therefore, the expenditure of funds devoted to the production of ammunition. In every war it has been the same, and every military man and industrialist in the production field has had to contend with a general unwillingness to recognize the fact that complicated military items cannot be produced overnight by industry previously devoted to other types of manufacture.⁶⁸

The Army even drew some support from Senator Kefauver in a minority view to the Preparedness Subcommittee report on ammunition shortages:

One of the reasons that we were so slow in getting ammunition delivery, according to testimony before our committee, was because when plants in standby status were put in operation it was found that they had deteriorated and that much more work than was anticipated was necessary before they started producing.⁶⁹

Summing up these points in a zoological analogy; it requires 21 months to make an elephant, 21 elephants gestating for one month will not produce a single elephant.

The Korean ammunition experience highlighted the essentiality of the preservation of a manufacturing capability even when a substantial inventory of war reserve materiel is on hand. Because of extremely high rates of fire (exceeding World War II rates⁷⁰) the prewar stockpile of ammunition was practically exhausted by May of 1952.⁷¹ A Preparedness Subcommittee of the Senate Armed Services Committee was prompted to report after an extensive investigation

into ammunition shortages: "There is a limit to which any stockpile can be called upon to meet continuing demand; it must be augmented continually with new production."⁷² The report goes on to insist that the ammunition production base must not be reduced and cites that if the base were to be inactivated, that a stockpile two and one-half times larger than planned would have to be provided.⁷³

The wartime production buildup which was undertaken under the direction of Secretary of Defense Robert A. Lovett provided for a sensible and deliberate long-term improvement in industrial capability. Such a policy, which became known as "creeping mobilization," was particularly prudent in light of continued Cold War tensions and the possibility of the Korean episode escalating into a more industrially demanding confrontation.⁷⁴ Such a program would have provided an excellent blueprint for continuing and future industrial preparedness were it not for two countervailing decisions, one taken during the War and one after. The first appears to be almost a throwback to First World War German mentality. Repeatedly, and even after the Chinese entered the Korean War, planning guidelines insisted upon a planning horizon of only 6 to 12 months in advance under the assumption that hostilities would be concluded by that time.⁷⁵ After the War, a new Secretary of Defense, Charles E. Wilson, launched an economy drive to get "more bang for a buck" in which long-term preparedness was sacrificed on the altar of immediate cost savings as the production base was again permitted to shrink.⁷⁶

Pre-Korean War insensitivity to the preservation of a responsive munitions production capability extracted its toll. It created heightened anxiety in the minds of the tactical forces who were relying on ammunition resupply, the source of which was not assured. Further, expensive improvisations, like airlifting ammunition into Korea and Japan from the United States, had to be resorted to to keep the pipelines filled with combat consumables. We could have done better.

Our next major tactical military confrontation with the forces of world communism came in the mid-1960's in the jungles and rice paddies of Southeast Asia. As incomprehensible as it may seem in retrospect, Vietnam, the most protracted military involvement in our history, was undertaken with the hope that it would be a short war. Even the Nation's early treatment of the issue of US servicemen missing in action was tempered by this hope. US Navy Captain Douglas Clarke wrote in 1979: "During the first years of the war, the POW's/MIA's were not a public issue. The expectation that the war would be a short one certainly contributed to this fact."⁷⁷

But the Vietnam War was not a short one and as the requirements to support the War grew, the drain on the US economy and the national psyche grew also. As was the case during the Korean War, the industrial mobilization was performed against an essentially business-as-usual peacetime backdrop. The fundamental problem with attempting to support a war on a peacetime basis is that mechanisms designed to facilitate wartime support are not evoked, and the Vietnam experience was no exception. In the absence of a declared national emergency, the elaborate system of relying on planned mobilization producers (firms which had previously agreed to accept defense munitions orders in wartime) was ignored and competitive bids were extended to the general commercial market. This competitive procurement procedure, coupled with a tightening (rather than a relaxation which might be expected in wartime) of procurement procedures, created inordinate delays in meeting the increasing combat requirements.⁷⁸

The pinch was once again felt very sharply in the ammunition sector. The ammunition manufacturing facilities were outmoded and sadly neglected World War II vintage plants, many of which were 25 years old when the Vietnam buildup began in earnest in 1965.⁷⁹ This shortcoming precipitated a massive modernization program of the ammunition base which began in 1971, too late to have any noticeable effect on the ammunition supply to Southeast Asia. Compounding this inadequacy were the unprecedented expenditure rates of conventional ammunition which demanded ever-increasing levels of production. In many ways Vietnam was looked upon as a small war. But on the score of ammunition consumption it was definitely a big leaguer. General Henry A. Miley, President of the American Defense Preparedness Association observed, ". . . the tonnage shipped in the peak month to Vietnam exceeded that of World War II and the Korean War."⁸⁰ The conventional ammunition expenditure spiral continued its ineluctable climb. Adding to the problem of providing enormous quantities of ammunition, was the problem of misinterpretation of the types of ammunition which were to be expended in Vietnam. In the early 1960's there appeared to be no future requirements for standard aircraft "iron bombs." Precision-guided munitions or "smart bombs" seemed to be the wave of the future. Consequently, the heavy industrial equipment needed to forge the bombs was disposed of. During the 18-month wait required before the first iron bomb was available from new production, such bizarre suggestions as affixing stabilizing fins to 55-gallon drums filled with explosives were forthcoming in the desperate attempt to fill the void.⁸¹ Subtending all of these problems was the optimism of an early end to hostilities and

almost psychotic fear of having surplus ammunition on hand at the war's end. This apparent dread disrupted the smooth buildup of ammunition production capability throughout the period.

The final experiences upon which we are able to draw are the Arab-Israeli wars which have been flaring up periodically since Israel became a sovereign state in 1948. These wars have been characterized by short, violent bursts of hostility which have consumed unheard of quantities of ammunition, tanks, antitank and anti-aircraft weapons, and even airplanes. It is interesting to note that in an age of electronic warfare and sophisticated and esoteric weaponry, at least one chronicler, Trevor Dupuy, maintains that artillery fire probably inflicted more casualties than the combination of the other combat arms.⁸² Amid the swirling controversy of whether or not these Middle Eastern wars have revolutionized warfare, two propositions appear to remain valid: (1) the Middle Eastern war may not be over yet, and (2) if war continues it will implicate the United States and her munitions production capability. In the latter connection, the Yom Kippur War of 1973 resulted in a significant drawdown in US War Reserve Materiel to satisfy the needs of our allies. The painfully slow buildup⁸³ of our industrial capacity to replenish our stocks was particularly alarming when one considers that under other circumstances, we may have been attempting that replenishment while our own national security was at stake. In the Middle East involvement, as in Vietnam, the pace and level of our participation was of our own choosing. Can the future assure such luxury?

Thus, the era from the ending of the Second World War to the present has witnessed enormous changes in weaponry and war-fighting techniques, yet certain constants appear to have remained. A nation cannot rely solely upon stockpiles for fighting her future wars; stored items must be complemented by new production. Particularly underscored by Vietnam was the sad lesson that support of a war in a business-as-usual context is ponderous and potentially dangerous. Finally, modern wars still appear to require vast quantities of munitions and the collateral production and procurement mechanisms to assure their timely delivery to the fighting forces. Let us, for a moment, reflect upon the lessons learned in this retrospective glance.

LESSONS LEARNED—AND LESSONS UNLEARNED

In looking back we see that each of our wars presented an

opportunity to learn how better to provide for our national security. Some of the lessons were learned early and well, and some we were destined to repeat.

Our formative years saw the Defense Establishment becoming increasingly more reliant upon the tools of war. As our needs expanded from gunpowder and muskets to repeating weapons and breach-loading cannons, the size and the appetite of our armies grew. The early response to the industrial need was answered with the creation of government arsenals and armories to supplement private manufacturers, with the faint hope of their being able to take over the entire manufacturing job for the Armed Forces. The American Civil War clearly demonstrated that only a marriage of US Government and the burgeoning private industrial sector could hope to meet the munitions needs of modern warfare.

The First World War taught the importance of Allied cooperation on a scale unprecedented up to that time. Especially noteworthy was the materiel support furnished the American Expeditionary Force (AEF) by our French and British Allies. It became abundantly clear that we could quickly provide the uniformed manpower, but not the military hardware, from a peacetime standing start. These inadequacies were addressed in the interwar years through organizational and educational reforms. However, despite early postwar interest, the deterioration of the defense industrial base was well advanced by the mid-1930's. The US involvement in the Second World War was preceded by a period in which our industrial machinery was activated to support the war in Europe almost 2 years before the United States was drawn into the war. Financial resources were lavished on the industrial base as war approached and the prodigious industrial output of the "Arsenal of Democracy" provided the lion's share of munitions throughout the war. Since World War II, the United States has had to learn how to support and actually fight in wars for which there is no declaration of national emergency. In many ways this environment tries the industrial ingenuity of the country more severely than does an all-out declared emergency.

From this brief recitation it is clear that our responses to national emergencies throughout our history have had to be flexible enough to respond to a broad spectrum of conflict. National security has been tested against scenarios ranging from intermittent Indian Wars and a 3-month war with Spain to global war of immense proportions. Through it all there has emerged a consistent thread of features, common enough to each of our experiences to be reasonably cited

collectively as lessons learned. They are presented here, by way of summary, in their simplest form.

- (1) In wartime, manpower can be mobilized more quickly than the materiel resources needed to support them.
- (2) Wars are of uncertain duration.
- (3) Preparatory actions must be taken in peacetime to insure responsiveness of the industrial sector and to avoid waste in wartime.
- (4) The mobilization process must have a centralized focal point at the national level.
- (5) Ammunition is likely to be an essential commodity in future wars and difficult to produce in a hurry as it has been in the past.

There can be little question that preparedness is preferable to unpreparedness in mobilizing our national resources for national security; to hold otherwise would be to defy logic. The question devolves into how best to achieve the level of preparedness desired. There are alternative paths to the same end. Provisions must be made for acquiring the manpower needed to fill the Armed Forces. Stockpiles of war reserve materiel must be laid in to provide the fighting wherewithal during the early phases of any future war or for the entire war if it be of exceedingly short duration. Finally, in deference to the long pull which may be required if the war is protracted, industrial readiness must get its share of national attention. How, then, are these complementary requirements to be accommodated? What mix is the most desirable? And how are all the measures to be financed from a finitely limited national defense budget?

The next chapter of this study will address these questions through an investigation of the present condition of the industrial base to support the production of ammunition items. The base will be described and its shortcomings identified. A methodological approach will be suggested to determine how these often competing preparedness requirements can be met within existing resources.

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IV

THE PRESENT

A nation such as the United States cannot afford to scrap that production capacity over and over again. This time these plants ought to remain in stand-by for years to come and, most important, plant and equipment should be rehabilitated and renovated periodically.

Leo A. Codd, Army
Ordnance Association
Eve of World War II¹

Clearly, in our present enlightened society, no one would knowingly "scrap" useful production capacity; however, the insidiousness of benign neglect can turn useful machinery (both manufacturing and organizational) into scrap though no such consequence is intended. The purpose of this chapter is to describe the ammunition manufacturing base; to show, through selective examples, some symptoms of more serious underlying maladies which are causing a deterioration of that base; and, finally to suggest a cost-effective way to reverse this trend.

OVERVIEW

The foregoing review of the history of US preparedness showed a decline in interest after each of our major wars. This declining interest has been seen to carry greater import as the Nation became more dependent upon the output of the industrial sector to equip and sustain its fighting forces. The present period in our history, with rapidly fading memories of the industrial effort needed to support the war in Vietnam, is not unlike other interwar periods. The Nation's top military advisors are not unaware of the inadequacy of our current industrial sustainability. The Joint Chiefs of Staff recognized the problem in the military posture statement for fiscal year 1980.

... there is cause for concern about the maintenance capabilities, transportation assets, medical support, and the ability of the industrial base to provide a sufficient sustaining capability for a major conflict.²

Unfortunately, this expression of concern has been relegated to an appendix of a supplement to the Chairman's overview of United States Military Posture. As recently as 2 years before, industrial preparedness occupied a position in the Chairman's Posture Statement of equal importance with such factors influencing the military balance as airlift; sealift; research and development; command, control, and communications; and readiness.³

Thorough investigation into the Nation's industrial preparedness posture has revealed other subtle indications of a waning of national interest in the subject. Two examples are provided: the disappearance of a single organizational focal point above the departmental level in the National Government; and the shift in curriculum concentration at the institution created specifically to attend to industrial preparedness education, the Industrial College of the Armed Forces. Each of these indicators will be discussed in turn.

In 1973, President Nixon abolished the Office of Emergency Preparedness (OEP) and transferred its functions to other governmental agencies.⁴ With the abolition of OEP, the Director's voice was no longer heard as a member of the National Security Council. In the rationale supporting the reorganization, President Nixon explained:

The Executive Office of the President should no longer be encumbered with the task of managing or administering programs which can be run more effectively by the departments and agencies.⁵

In the interest of efficiency and economy, the defense mobilization functions were transferred to the Federal Preparedness Agency under the General Services Administration where they were destined to languish until the creation of the Federal Emergency Management Agency (FEMA) in 1979. In the present FEMA construct, industrial preparedness has a reasonable chance of revival if the Director is afforded membership in the National Security Council.

Examination of the evolution of the academic program of the Industrial College of the Armed Forces (ICAF) over the years is instructive with regard to its declining focus on industrial preparedness. The Army Industrial College (as ICAF was originally named) grew out of the Nation's sad experiences in World War I and was intended to train officers in wartime procurement and mobilization procedures.⁶ This thrust remained unchanged until the

Second World War. Immediately after the war, the curriculum appears to have been based heavily upon a "lessons learned" philosophy. However, by the 1950's and 1960's executive skills (e.g., public speaking and human relations) and later management and public administration (e.g., resource management and mastery of the Planning, Programming and Budgeting System) began to be emphasized.⁷ It appears that this expansion in scope, which continued into the late 1970's, caused the curriculum to become broader until it fairly cried out for a return to the basics. A review of the 1979-1980 ICAF Curriculum Guide reveals movement in that direction with two of the four phases of the Core Program being oriented toward acquisition and mobilization management.⁸ Continued reforms of this nature will be most helpful in reestablishing the proper importance of mobilization planning and industrial preparedness among ICAF graduates.

The present environment in which the military planner finds himself is aptly summarized by General Edward C. Meyer, who, while serving as Deputy Chief of Staff for Operations and Plans, Department of the Army, expressed his belief that the United States must be prepared for a "three day war." He explained that the day before the war involved deterrence, the day of the war required warfighting, and the day after the war must provide for continued deterrence, however long each of those days may turn out to be. Being ready for those days will require balancing, within the available supply of scarce resources, the needs of short-term readiness, mid-term modernization, and long-term sustainability, with due consideration being given to doing first things first.⁹ It is that balance point which must be sought.

This study, thus far, has addressed the problem of preparedness for war in the historical context of the industrial readiness of the United States, its allies, and its enemies. The importance of the supply of ammunition to combat operations has been highlighted where appropriate. The direction will now change to the somewhat more specific investigation of the ammunition manufacturing base. The reader is enjoined to remember, as the discussion proceeds, that ammunition is illustrative of a class of military materiel for which a unique (noncommercial) manufacturing capability is required.

THE AMMUNITION BASE

The ammunition base is characterized by a web of complex interrelationships which involve the public and private sectors of the

industrial milieu. The ensuing exposition will describe the base, discuss its present conditions as to its physical and fiscal well-being, and finally, disclose the mobilization and contractual agreements presently in effect within which the base operates.

Description of the Base

The present ammunition manufacturing complex consists of 28 government-owned production facilities; approximately 165 sets of industrial plant equipment, assembled into what are called plant equipment packages¹⁰ and agreements with private industry to make up the difference between what the government can provide with its own capital equipment and the wartime mobilization requirement. Before the base is taken apart for a more detailed inspection, it would be helpful to review briefly the process by which ammunition comes into being.

A complete round of ammunition, whether for the smallest individual weapon or for the largest caliber artillery weapon in our inventory, is the final product of three distinct industrial processes:

- (1) Metal Parts (MPTS) Production.
- (2) Propellants and Explosives (P&E) Production.
- (3) Load, Assemble, and Pack (LAP) Operations.

The metal parts components (e.g., shell projectile bodies, rotating bands, cartridge cases) and the propellant and explosive components (e.g., propelling charges, explosive fillers, primers) are integrated into the complete end items, or round of ammunition, at the load, assemble, and pack facility. See Figure 1.

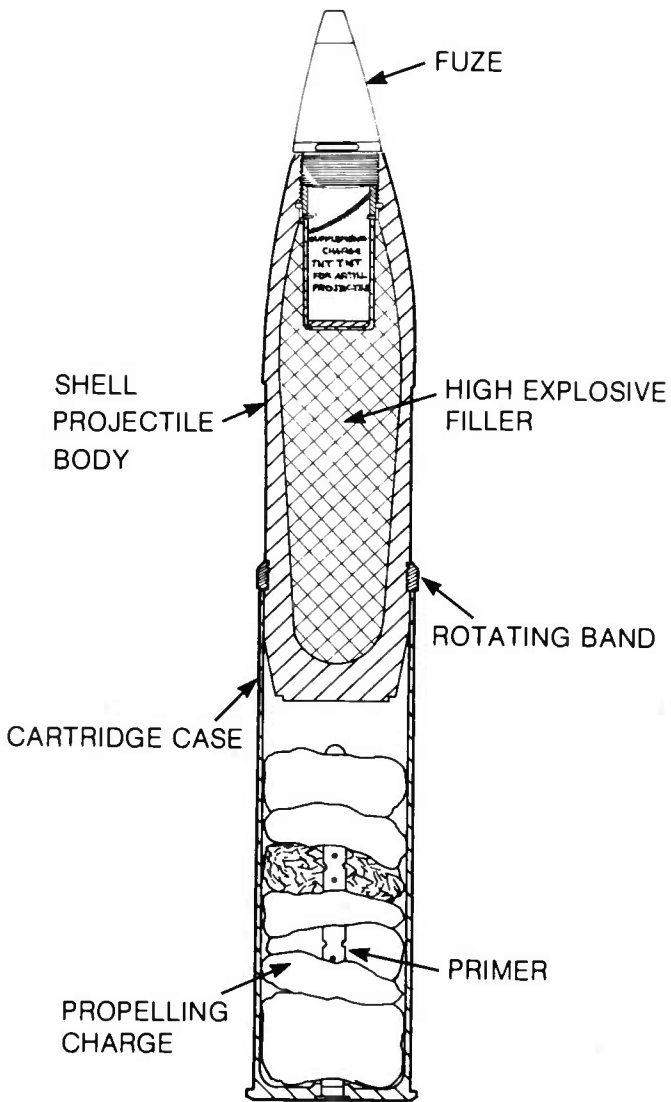


FIGURE 1. A Complete Round of 105mm High Explosive Ammunition

Within our present ammunition base, the production facilities, generally, are not collocated. The metal parts (MPTS) are purchased from private industry operating its own facility or operating government-owned plants and equipment. The manufacture of MPTS requires extensive heavy industrial capital equipment (e.g., steel heating furnaces, forging presses, metal working machines). The chemical (P&E) and loading (LAP) operations are, for the most part, performed within government-owned contractor-operated (GOCO) facilities. Thus, it can be concluded that the ammunition industry encompasses activities which range from the "Dante's Inferno" of a metal parts plant to the antiseptically clean environment of a load, assemble, and pack facility. Examples are shown in Figures 2 and 3.

A closer look at the base which supports these activities will be helpful. First, with respect to facilities, a clear distinction between government-owned and privately owned plants must be made. Private industry is reluctant to invest heavily in capital equipment needed for ammunition manufacture because there is virtually no commercial market for the product. Consequently, the Government has been required to provide the plants for such manufacture. During World War II, 84 government plants were actively producing ammunition and an additional 29 plants had been authorized and were under construction when the war ended in 1945. After the war, the Government disposed of all but 56 of these plants, 38 of which were in active use to support combat operations in Korea from 1951 to 1953. During the Vietnam era, 25 ammunition plants remained in the complex and the activations and deactivations were governed by the extent of involvement in the war and its intensity.¹² When the base was called upon for Korea and Vietnam, the signs of deterioration were clearly discernible and precipitated the extensive modernization effort which was begun in 1971. The same revelation led to the decision to build a new ammunition plant.



(Source: Figure 2 and 3 photographs courtesy of *Soldiers* magazine.)

**FIGURE 2. Forging 105mm Artillery Projectiles
at Scranton Army Ammunition Plant**

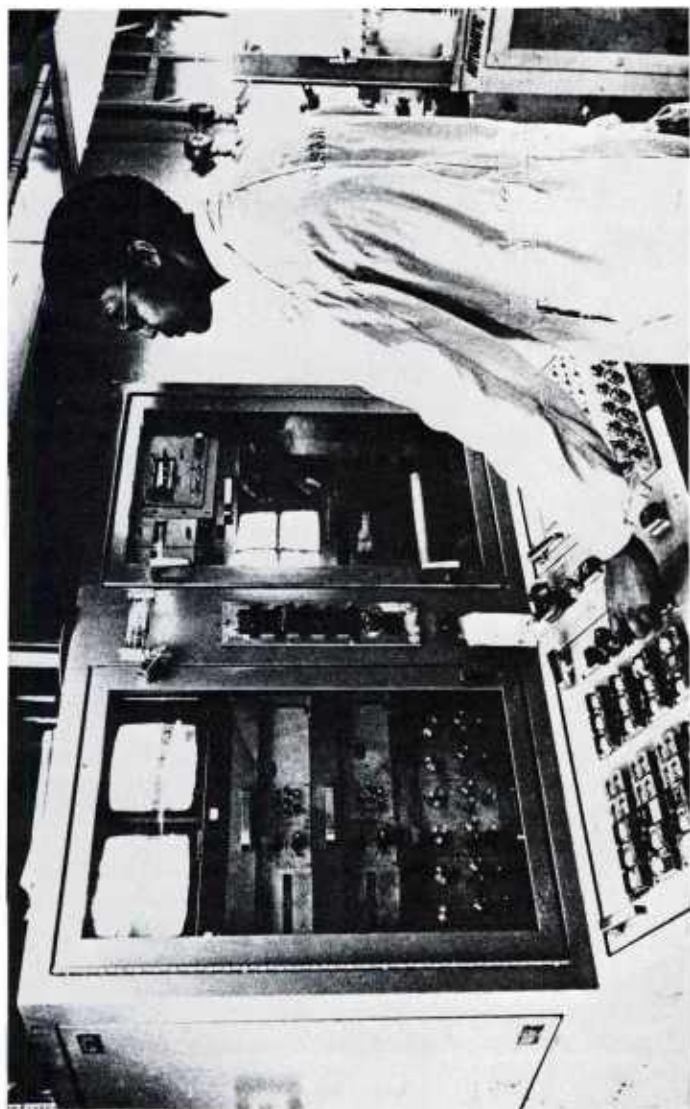


FIGURE 3. Remotely Monitoring the Loading of Explosives at Lone Star Army Ammunition Plant

The Mississippi Army Ammunition Plant has been authorized and is under construction. This facility will be the first new Army ammunition facility built in the United States in 25 years. The plant, scheduled for completion in 1983, will be dedicated to the production of a single model of artillery ammunition and will combine at one location the MPTS and LAP manufacturing operations.¹³ Since, in its present embryonic state, the Mississippi plant can make no contribution to immediate production needs, it will not be included as part of the base in subsequent discussions.

At present, of the 28 government-owned facilities, 15 plants and one arsenal are actively producing ammunition for US or Allied use; the remaining 12 plants are inactive. The facilities which comprise the government-owned complex at the time of this writing are shown in Table 2.

Table 2. Army Amunition Production Facilities¹⁴

Active Facilities

<u>Metal Parts</u>	<u>Propellants and Explosives</u>	<u>Load, Assemble, and Pack</u>	<u>Small Arms</u>
Riverbank, CA	Holston, TN	Indiana	Lake City, MO
Scranton, PA	Radford, VA	Iowa	
?	<u>Pine Bluff Arsenal</u>	Kansas	
		AR (Chemical)	Lone Star, TX ?
		Longhorn, TX	
		Louisiana	
		Milan, TN	
		Crane, IN*	
		Hawthorne, NV*	
		McAlester, OK*	

Inactive Facilities

Gateway, MO	Alabama	Cornhusker, NE	Twin Cities, MN
Hays, PA	Badger, WI	Ravenna, OH	
St. Louis, MO	Joliet, IL		
	Newport, IN		
	Sunflower, KS		
	Volunteer, TN		
	Indiana!		

*Recently acquired Navy plants

The second element of the ammunition industrial base is the number of Plant Equipment Packages (PEP's) which are not in active production, i.e., they are idle at government or private industrial locations awaiting mobilization or other activation signals. Collectively, they represent the production expansion capability of the base which the Government owns. Of the total of some 165 ammunition PEP's (active and inactive), approximately 20 percent are located at government facilities, while the remainder are out in private contractors' plants or storage locations.¹⁵ These PEP's are backed up by about 33,000 pieces of industrial equipment not identified with specific equipment packages, but held in a general reserve by the Defense Industrial Plant Equipment Center (DIPEC).¹⁶ The inactive PEP's embody a sizeable manufacturing potential; however, signs of serious deterioration of this equipment cast doubt upon its usefulness as a mobilization asset. These indicia will be addressed more fully in a subsequent section of this chapter.

The final segment of the ammunition base triad is found in the mobilization agreements between the Government and the future potential wartime producers. These agreements have come to be known as "1519's," a sobriquet derived from the Department of Defense form (DD Form 1519) upon which the agreement is recorded. Under these agreements, which are not legally binding, a producer (known as a planned producer after the agreement is signed) agrees to manufacture and sell to the Government a certain item of materiel at a specified rate of delivery after an emergency is declared and a contract is concluded. There are approximately 300 ammunition end items containing nearly 100 component parts which have been identified for this type of mobilization planning. Approximately 200 planned producers are involved in mobilization planning for the production of these items through the execution of some 970 agreements.¹⁷

The preceding discussion identified the ammunition industrial base as having three essential interrelated elements: The governmentally owned and privately owned manufacturing capability, the store of manufacturing equipment owned by the Government and retained in identifiable plant equipment packages, and agreements with private industry to augment the Government's in-house production capability. The system is not without its problems however, and the shortcomings, hinted at in the description of the base, must be discussed. Specific examples of ammunition items will be offered to underscore the systemic inadequacies of the mobilization planning process.

Condition of The Base

When compared with the attention that the ammunition manufacturing base has received in other peacetime periods, it would appear that the base is in better condition than it has ever been in the past, and in many respects this may be true. The Vietnam war awakened interest in the industrial capability to produce ammunition in the large quantities required and supported the initiation of the Munitions Production Base Modernization and Expansion programs in the early 1970's. A visit to a modernized production line is enough to warm the cockles of the coldest industrial engineer's heart. One sees automated machinery clicking right along, producing the finished product at rates which could not be contemplated with comparable manual operations. See Figure 4. These lines are composed of literally "well-oiled machines." The machinery which supports active production gets adequate maintenance attention because that is where the money is and, of course, the profit motive of the civilian operators of the GOCO plants must be accommodated if these companies are to stay in business with the Government.

Thus, the 15 active ammunition plants which comprise the nucleus of the Nation's peacetime manufacturing capability present a deceptively rosy picture of the present condition of the base. Unfortunately, hidden from view by the dazzling performance of modernized active production lines is the condition of the real property which houses the Industrial Plant Equipment (IPE) and the condition of the IPE which is presently inactive. Recall from the description of the base that this inactive capacity represents the industrial sector's flexibility to respond to a range of possible contingencies for ammunition production. The inactive portion of the base is being neglected as it has been in previous peacetime eras and is showing signs of serious deterioration. Even newly modernized lines, if not activated to support current production, begin to suffer if, upon completion of modernization, maintenance money is not provided for their upkeep. A review of the House of Representatives version of the Fiscal Year 1979 Defense Appropriations Bill provides a startling example of how the lack of understanding or appreciation of this industrial fact of life has adversely affected the inactive base.

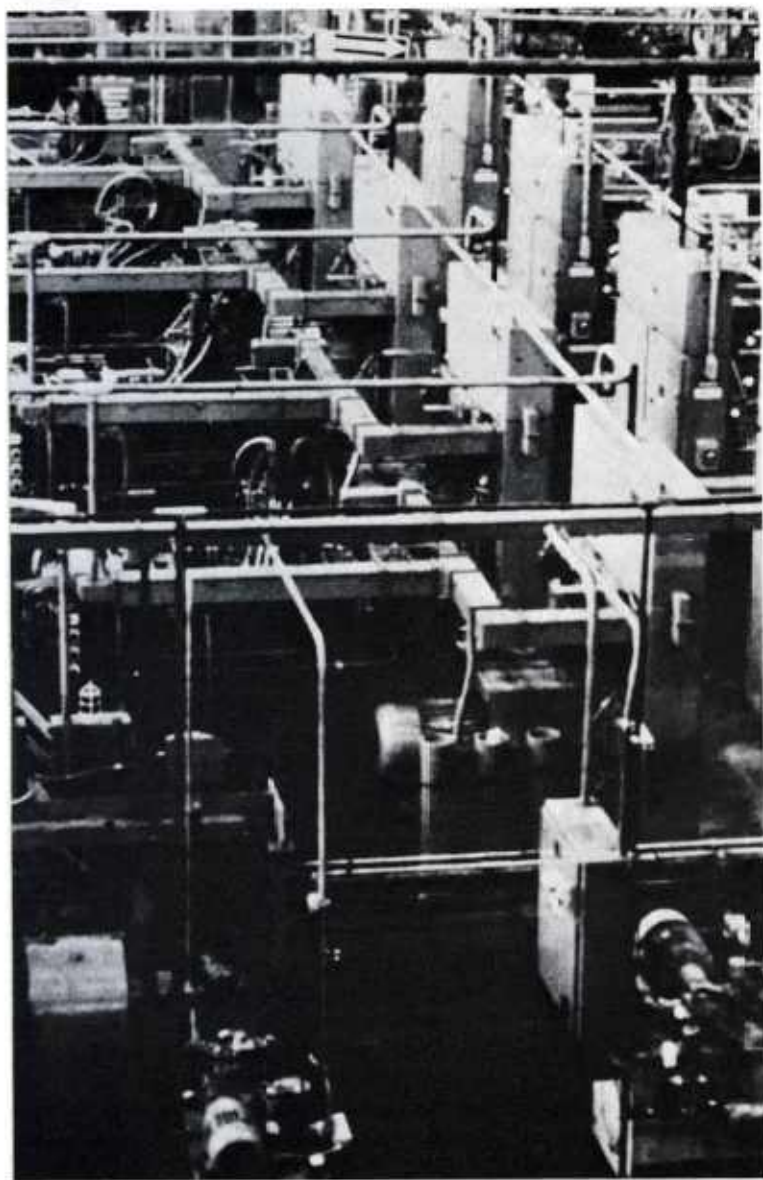


FIGURE 4. Modernized 155mm Machining Line, Scranton Army Ammunition Plant

The Army requested \$9.0 million to place in layaway status (i.e., a preserved state of inactivity) equipment which had been modernized but was not needed to support current production. Congress denied the request.¹⁸ But look a little closer. Originally, the Army request was interpreted by the Congress as a request for new procurement and an earlier version of the House Appropriations Committee Report deleted the \$9.0 million, citing the Army's inability to maintain equipment it currently had on hand as a reason for not wanting to add any more inactive equipment to the inventory. What was lost in this interpretation was the fact that the modernized equipment had already been procured and the \$9.0 million was being requested to prepare the equipment for storage in an inactive state. The denial of this financial support, therefore, resulted in newly modernized equipment beginning immediately to deteriorate by being forced into a "state of limbo." The equipment was neither active, where it could be maintained with current production funds, nor properly laid away where it would be preserved for future use, through the use of inactive maintenance funds. This funding denial came in the same session of Congress, and from the same committee, which provided a \$15 million increase in the Industrial Preparedness Operations account for maintenance of the inactive portion of the base.¹⁹ The Congress giveth; the Congress taketh away.

This incongruous set of circumstances was occasioned, in part, by the fact that the procurement appropriation (Procurement of Ammunition, Army (PAA) bears the burden of new equipment being prepared for layaway, while the maintenance appropriation (Operation and Maintenance, Army (OMA)) provides for the actual maintenance once the equipment is properly laid away. These latter activities include inspection, inventory control, re-preservation, periodical cycling of equipment, etc. The reliance of the inactive portion of the base on the operation and maintenance appropriation highlights a chronic source of the problem of peacetime maintenance of the industrial capability. It is difficult to comprehend and accept increases in expenditures for operations and maintenance of the Defense Establishment when the force levels are declining in peacetime. Therefore, the OMA appropriation is perennially in short supply when there is no war going on. Again, look at the record.

From 1974 through 1979 that part of the OMA appropriation from which the ammunition and weapons industrial base is supported increased in absolute dollar amounts; however, it declined as a percentage of meeting the validated requirement. In 1974 almost 90 percent of the identified requirement was met with appropriate

funding. By fiscal year 1979, the percentage had declined almost unremittingly to 80 percent of the required amount. Within the OMA appropriation, the provision for maintenance of reserve industrial equipment suffered an even greater relative decline. From a nearly complete meeting of the validated requirement (97.9 percent) in 1974, the funding provided in 1979 could only accommodate 70 percent of the requirement²⁰—a disturbing trend.

The Army has recognized for some time the difficulty of keeping unused production facilities in a proper state of readiness. Separately identified projects were initiated to redress these maintenance deficiencies. The projects were appropriately called Backlog of Maintenance and Repair (BMAR) projects since they were intended to "clean up" neglected maintenance requirements which had been deferred under the press of higher priority funding requirements. Unfortunately, however, funding support for these projects has been disappointing also. During the period 1970 to 1976, shortfalls between the validated requirement and the amount of funding received varied from \$150,000 to \$5.8 million. In fiscal year 1978 no funding was provided against a validated requirement of \$10.8 million for BMAR projects for all the GOCO ammunition plants.²¹ The cumulative effect of these annual funding deficits has been a growing maintenance backlog at the inactive ammunition plants, which will now require over \$40 million to rectify.

Another feature of the funding for the retention and maintenance of the inactive portion of the ammunition base which receives scant attention warrants a brief explanation. The inactive facilities have a minimum sustaining overhead requirement to provide for administration, utilities, security, and in some remote locations, fire protection, in addition to the maintenance of plant and equipment. As OMA funds shrink, the maintenance needs are necessarily relegated to the end of the priority pecking order, and often are not attended to at all because the OMA money runs out paying for the overhead.²²

The foregoing discussion focused particularly upon the active and inactive industrial potential within government-owned ammunition manufacturing facilities. To complete the investigation of the first two segments of the industrial base, viz., the ammunition plants and the plant equipment packages, attention needs to be directed to the government-owned PEP's which are situated within private industry for use in expanding the Nation's munitions output.

The Plant Equipment Packages (PEP's) which are held at private industry locations represent a significant industrial readiness asset against a future mobilization requirement. But what is the actual condition of this equipment? In 1975, a Department of the Army study, using historical data from the Defense Supply Agency, estimated that within existing ammunition PEP's only about 31 percent would be usable for their intended purpose without extensive repair. The remaining 69 percent would require either repair or replacement before they could be used for production. Approximately one-fourth of the unusable equipment could be expected to be nonrepairable and would require replacement. On-site inspections of 279 pieces of equipment corroborated these estimates very well; only 79 items (29 percent) were found acceptable for mobilization.²³ Apparently in response to this alarming revelation, the US Army Project Manager for Munitions Production Base Modernization and Expansion embarked upon a study of the condition of PEP's in private industry. A modernization plan was developed which would, if implemented, fill voids in the production lines, improve safety features of existing equipment, and rehabilitate (or, where not possible, replace) industrial production equipment in commercial plants. The program envisioned the expenditure of approximately \$124 million during the period FY 1981-1983 for the modernization. Current projections of the amount of support the program is likely to secure are not very reassuring. According to a program spokesman, only one project valued at approximately \$4 million is likely to be funded in light of present guidance from the Department of Defense which assigns relatively low priority to such activities.²⁴

With regard to the preservation of an inactive munitions manufacturing capability, the national decisionmakers seem to be unmindful of one of the most trenchant lessons of the past. The retention of such capability can provide from a 6- to 18-month headstart on production to support a war should the Nation become involved. The cost of maintaining this capability in peacetime is so small compared with the cost of developing capacity in a crisis that it should be provided for as a regular part of the budget for national defense.²⁵

Benign neglect can cause deterioration of the physical and organizational infrastructure where none is intended. The foregoing review of the condition of those aspects of the industrial base relating to equipment must be followed by a discussion of the institutional aspects of transforming a peacetime economy into one capable of

supporting a war effort. In a free enterprise market economy, munitions are obtained primarily by procurement from private firms which operate either their own or government-furnished facilities. Since this is the *modus operandi*, the mobilization planning which is carried on between the two parties becomes a most important element in the industrial readiness equation.

Mobilization Planning

The mobilization planning process is dependent upon the declaration of a national emergency for its legitimacy. During the Nation's recent history, since neither war nor a state of national emergency has been declared in times of crisis, and in some instances actual warfare, the mobilization planning process has not been exercised as intended. It has thus become the subject of severe and justifiable criticism. To evaluate this criticism objectively, one must ask how the system was intended to work.

Future wartime requirements for combat consumables, ammunition being the most visible example, are derived through a complex process which can be described in brief outline. The computation starts with a projected force list which indicates how many people and weapons systems are expected to be engaged if the United States goes to war. To the user population, consumption rates are ascribed which reflect the nature of the expected conflict (e.g., the intensity of combat, duration, offensive or defensive operations, etc.). These projected requirements are aggregated at the national level. Each military service within the Department of Defense is then expected to plan in detail for the acquisition of the most critical of these munitions requirements. The criteria and total number of items which can be included in detailed industrial preparedness planning is prescribed by the Department of Defense.²⁶ Within the Army, the list of items to be included in detailed planning is prepared by the "commodity command" which has responsibility for the particular class of military materiel. In the case of ammunition and weapons, that command is the US Army Armament Materiel Readiness Command (ARRCOM). The items selected for planning are compiled into what is appropriately called the Industrial Preparedness Planning List (IPPL).

Total requirements are translated into monthly production rates and the commodity commands cast about for sources capable of meeting the required production rates. The monthly mobilization (i.e., projected wartime) production requirements are distributed

among governmental and commercial sources. Commercial sources are preferred as generally more cost effective. Where a commercial source does not exist, the assignment for meeting the prescribed production rate is made to government-owned and -operated (GOGO) or certain GOCO facilities as a workload forecast. If the requirement must be satisfied by private industry, a formal agreement is executed between the Government and commercial contractors. This agreement, mentioned briefly in an earlier section of this chapter, is the focal point of the present mobilization planning system and deserves a closer look.

The agreement is expressed in terms of a planning schedule which meets the portion of the Government's requirement allocated to that particular contractor. The "DOD Industrial Preparedness Program Production Planning Schedule" is recorded on a DD Form 1519. The schedule, once prepared, is authenticated as to contractor's ability to perform by an independent government authority²⁷ and the agreement is consummated by the parties by signing a DD Form 1519. The private firms are then viewed as being willing and able to produce the desired hardware at wartime rates and are designated as the planned producers for that portion of the wartime (mobilization) requirement. It would seem that all the bases are well covered. In practice, however, the system is not nearly so watertight as it appears. There exist serious shortcomings in the ability of the base to rise to the demands for increased production of military materiel to meet a variety of peacetime or wartime contingencies.

The principal shortcoming of the planning process is that a mobilization decision is required to implement the planned actions. Since the Nation has not officially "mobilized" for the last two wars in which it has engaged, the fruits of the detailed planning system have not been harvested. Particularly during the Vietnam war, the Government elected to adhere strictly to peacetime regulations and invited competitive bids for the procurement of needed defense materiel to the exclusion of many of the planned producers. Accepting the low bid from other than a qualified planned producer often had decidedly adverse effects in terms of quality, meeting of production schedules, and, in extreme cases, even failing to secure delivery at all.²⁸ The Defense Acquisition Regulations (DAR) provide an exception mechanism, whereby noncompetitive negotiated procurement from planned producers may be used to enhance the preservation of the defense industrial base. This provision has been infrequently used in defense procurement and more use of it is desired by the Nation's planned producers.

Another weakness is inherent in the existing system; planning agreements are not contracts. Therefore, the contractor is not obliged to perform as agreed nor is the Government required to contract with the planned producer for the items included in the agreement. Because of this feature, neither party seems to take the agreements very seriously. The Government may subsequently contract with other sources; and industrial officials, because they are not paid directly to plan and see no beneficial results of the planning, participate only superficially in many cases.²⁹ Industry has been particularly critical of the planning process because it receives no response from the Government to proposed industrial preparedness measures (IMP's). In many cases the 1519 schedules are only valid if certain IMP's are incorporated (e.g., addition of industrial plant equipment, pre-stockage of component parts). When the Government is unable or unwilling to provide funding support for these industrial preparedness measures, the contractors, with some justification, question the sincerity of the Government's interest in meeting the mobilization schedules. Further, since the agreement is not a binding contract, the interest of the prime contractor in the ability of his subcontractors to support the planning schedule is spotty. The unfortunate upshot of this disenchantment of industry with the mobilization planning process is that many reputable former defense contractors have migrated from the government market and no longer participate in mobilization planning. A striking example is the duPont Chemical Company which, after supplying high quality military chemicals throughout the Nation's history, has virtually withdrawn from defense business and mobilization planning.³⁰

The inadequacies of present mobilization planning have been recognized and action has been instigated during the recent past to turn attention to a new concept, called surge planning. Under this planning concept the declaration of national emergency is not a prerequisite trigger. Surge planning is intended to provide for rapid increases in munitions production to be available: (1) when initial stockpiles are depleted in a short war, (2) to sustain combat until the industrial effects of mobilization can be felt in a protracted war, or (3) to provide for increased inventories during periods of sustained international tension, short of war. Some valuable surge planning studies have been conducted but the implementation is still troubled with many of the same problems as the existing "1519" system. As one frustrated member of industry put it (paraphrased): "DOD can't improve its ability to surge by investing in more surge studies, but it can by investing in long lead time components and special tools and test equipment."³¹ The surge concept must be considered in a broader perspective before its larger implications are manifest.

From the foregoing it can be seen that the function of mobilization planning has suffered from the retention of an outmoded system which was designed to work in a declared mobilization environment. However, mobilization has not been declared in any of the several crises of the "guns and butter" era following the Second World War. Because of the vital importance of the private sector to the meeting of the Nation's munitions need, this weakness in mobilization planning with industry could well have serious consequences to future industrial preparedness for sustaining a war effort. A better method must be found.

With the base and its condition having been reviewed in some detail, it is appropriate next to examine how these conditions are manifested in the ability of the base to respond to increases in the rate of production of certain ammunition items currently being manufactured. Illustrative examples, including an artillery round, a tank antitank round, an antitank guided missile, and an aircraft gun round, will be explored.

ILLUSTRATIVE EXAMPLES

The deficiencies in industrial readiness which could impede the rapid increase in the rate of ammunition production in peacetime or in wartime are revealed by an examination of representative members of the family of ammunition. Four items have been selected for this purpose. They represent a cross section of materiel which is currently in production; they involve considerable manufacturing sophistication and exemplify many of the do's and don't's in structuring the industrial base for mobilization responsiveness. The items of ammunition to be considered include:

(1) The 155mm high-explosive artillery projectile, M483, improved conventional munition (ICM).

(2) The 105mm antitank cartridge, ^{M735}~~M475~~, hypervelocity ammunition.

(3) The TOW (tube-launched, optically-tracked, wire-guided) antitank guided missile.

(4) The 30mm aircraft ammunition (GAU-8) used in the US Air Force A-10 tactical aircraft system.

A brief description of the configuration and purpose of these munitions follows.

The 155mm artillery weapon is the mainstay of the direct fire support provided to the maneuver elements of US Army Divisions. The improved conventional munition (ICM) version of the ammunition combines an antipersonnel and an antimateriel capability in a single projectile. See Figure 5. The projectile delivers 88 submunitions (grenades) to the target area. A time fuze functions over the target expelling the grenades from the projectile. The grenades explode when they strike the ground or other object. The design of the grenades provides for penetration of armor as well as for fragmentation, which gives the ammunition its dual capability.

The M-735 antitank ammunition functions quite differently. A high-density penetrator is propelled to the target (usually a tank) at an extremely high velocity. The velocity of the projectile when it starts its flight approaches 5,000 feet per second. The components of the complete round are shown in Figure 6 and the functioning of the round as it leaves the muzzle of the cannon is shown in Figure 7. The finstabilized penetrator, because of its high mass and velocity, defeats enemy armor solely by kinetic energy.



M42 GRENADE



OGIVE WITH SELF REGISTRATION
FUZE ASSEMBLY



CROSS SECTION
OF PAYLOAD



FIGURE 5. Projectile, 155mm HE ICM, M483

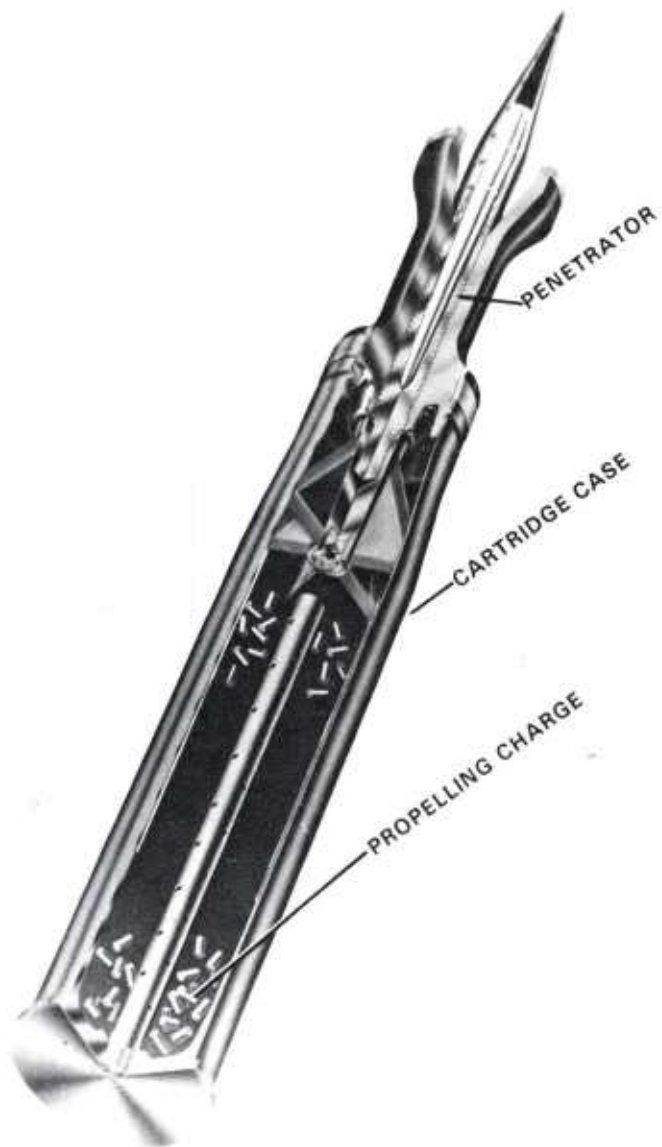


FIGURE 6. Cartridge, 105mm APFSDS, M735

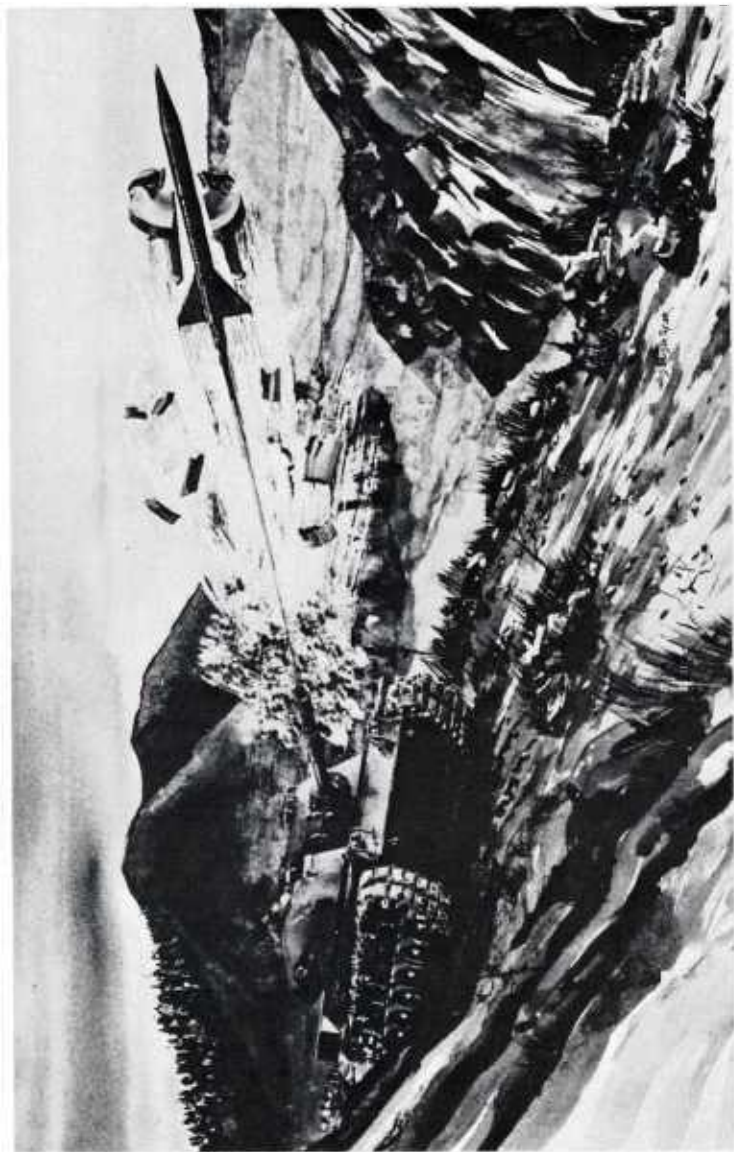


FIGURE 7. Tank Firing the M735 Antitank Round

Another antitank weapon, the TOW missile system, is guided to the target by a gunner, either on the ground or in a helicopter through a wire guidance link. When the missile (shown in a cutaway view in Figure 8) strikes the target, a shaped charge of explosives ignites, and literally burns through the armor plate into the crew compartment, neutralizing the tank and/or its crew.

An Air Force item of ammunition is included to highlight the innovative procurement techniques involved but it also possesses some interesting technical characteristics. The GAU-8 round (in inimitable military fashion, GAU stands for Guns Aircraft Unit) is depicted in Figure 9. This ammunition was designed to defeat materiel targets on the ground from an aircraft which mounts an automatic gun system featuring a very high rate of fire. The 30mm projectiles can be fired at a maximum rate of 4,200 rounds per minute and it is estimated that one second of fire on a target is sufficient to disable it.

As interesting as the military characteristics of these various items may be, more important to the study at hand is an investigation of the present and projected production capability for this ammunition. To facilitate that investigation the artillery and tank round will be discussed first, followed by the missile and aircraft weapon items.



FIGURE 8. TOW Missile

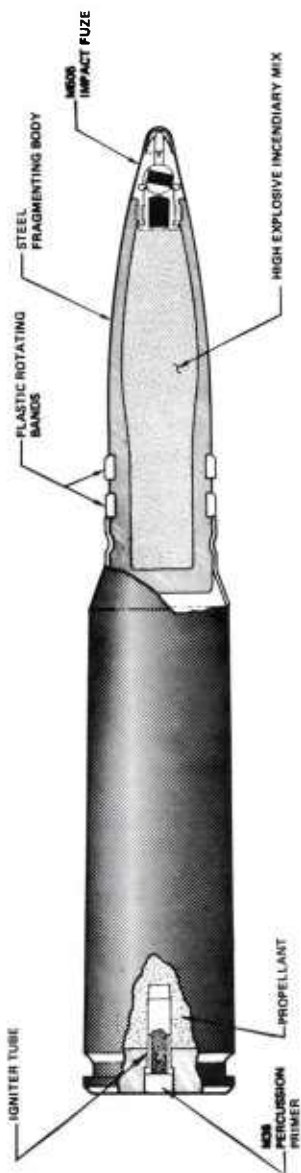


FIGURE 9. The GAU-8/A Family of 30mm Ammunition: The HEI Round

The artillery round (M483) end item is presently being assembled at two GOCO locations. The load, assemble, and pack (LAP) operation is the pacing activity in the production of this round; that is, the component manufacturers are able to stay ahead of the final assembly facilities. Each of the two government-owned plants is presently capable of producing a maximum 42,000 completed rounds per month. The peacetime production rate is significantly below that maximum rate, however, and a substantial period of time would be required to reach the maximum rate from peacetime production levels. The disparity between peacetime production and wartime needs is dramatic. The combined US Army and US Marine Corps requirement for the M483 is 438,000 rounds per month or more than five times the present maximum capability. This sum equates to approximately 8 rounds per tube per day, based on the current quantity (1,669) of 155mm tubes in the US Army. Worse yet, if one wishes to consider a two-front war with a lesser ammunition requirement in a second theater of operations, the total requirement could be as high as 523,000 rounds per month.³² Part of the recognized deficit in the base for the production of this round will be redressed when the Mississippi Army Ammunition Plant comes on line in 1983. The Mississippi plant will be capable of loading 120,000 rounds per month. However, even this enhanced capacity will meet less than half of the expected mobilization requirement.

In the case of the tank round (M735) a two-tier production capacity problem presents itself. The metal parts components are the pacing items and a combined capability of 40,000 of these components per month is represented in the factories of two commercial manufacturers. The GOCO LAP facility has a maximum assembly capability of 78,000 per month if sufficient components could be provided. Even at this rate, however, the production of the end item would fall far short of the mobilization requirement of 147,000 rounds per month for the Army and the Marine Corps.³³

The Army's production base plan for both of these items of ammunition shows an M-day action (i.e., action to be taken upon the declaration of mobilization) of developing the facilities to fill the void with an estimated lead time of 13 months.³⁴ There is little hope of building, in peacetime, the facilities needed to support the full mobilization requirements; however, improvements can be made in the present responsiveness of the base which can provide a valuable cushion of rapid increases in production rates until new facilities are created and brought up to speed if needed.

The TOW antitank missile and the 30mm GAU-8 ammunition also provide useful insights into the dilemma of peacetime industrial preparedness for wartime production of ammunition.

Not anymore!

The TOW missile is procured as a "mission-oriented item" which means that a total number is procured against an anticipated threat and when that quantity is on hand, production ceases.³⁵

Current production of the TOW missile is expected to run out soon. Nearly \$300,000 have been programmed to lay away the PEP's required for the manufacture of the TOW missile system after current production ceases. The viability of the TOW portion of the industrial base will then be dependent upon the care with which the PEP's are maintained and the willingness of contractors to resume production. Before current production ceases, the ability to increase the rate of production of the TOW missile system depends upon the exercising of procurement options with current producers. Expansion from the present production rates of approximately 900 missiles per month to approximately 4,500 per month (after 24 months) is within the capability of the industrial base, without additional production equipment or stockpile of critical components.³⁶ Further expansion of the production capability is estimated to entail significant expenditures to finance industrial preparedness measures. If a warm production base cannot be maintained after current production ends, the stockpiling of the critical components could accelerate missile production from a cold base by as much as 12 months.³⁷ Thus, a recurring theme persists of the necessity for taking appropriate pre-M-day actions.

When the discussion turns to the GAU-8 ammunition, the terms of reference regarding production rates must be multiplied dramatically. Rates in the millions of rounds replace rates in the thousands which characterized the other members of the ammunition sample. The Air Force procures the GAU-8 ammunition at a peak peacetime rate of approximately 11 million rounds per year.³⁸ This quantity is procured from two qualified commercial vendors. To encourage private capital investment and to enhance competition, each of the manufacturing firms has been permitted by the Air Force to acquire active production facilities capable of producing 60 percent of the peacetime requirement. A provision is included in the production contract to indemnify the producers for unrecovered capital investment losses if they were incurred as a result of the production of GAU-8 ammunition.³⁹ This innovative contracting procedure provides for an immediate expansion capability of 20 percent since only 100 percent of the current or peacetime procurement is distributed between the two competing producers. Thus, the ability to expand production rapidly is built into current procurement contracts. Although 20 percent would be a modest expansion if a full-scale war was to be supported, this technique

represents a tangible first step toward what has come to be known as "surge contracting." Surge contracting differs fundamentally from surge planning in that it carries contractual responsibility for performance. The next step the Air Force is taking to bolster its surge contracting for procurement of the GAU-8 is to prestock the necessary long-lead-time components to enable the contractors to take full advantage of their expanded manufacturing capability. With such stockpiling it is estimated that the manufacturers could double the peacetime rate within a year. Nevertheless, even this impressive increase may not accommodate wartime requirements. Although no official mobilization rate has been promulgated for the GAU-8, Air Force personnel are presently examining options to meet extremely demanding short-war scenarios. One such scenario envisions a requirement for 65 million rounds in the first 90 days of the war. Clearly, the military services must allocate their resources wisely to meet both the short-term and long-term requirements in wartime. Extension of the surge contracting techniques pioneered in the GAU-8 procurement will contribute significantly to meeting those requirements.

From the foregoing sampling of the industrial capability for production of ammunition, the major peacetime factors contributing to reaching or not reaching desired mobilization rates can be summarized. First, industrial plant equipment with requisite tooling and special test equipment must be available in sufficient quantities to provide for accelerated production. Further, this equipment must be maintained in a high state of readiness, modernized, and refurbished as may be required to keep pace with the configuration of the items of ammunition they are intended to produce. Second, materials both in the form of raw stocks and finished or semi-finished long-lead-time components are necessary to be on hand to assure the full exploitation of existing industrial capacity. Third, the training needs of operating personnel, especially if new equipment or processes are involved, must be determined and training packages developed during peacetime. Finally, administrative and procurement lead times may be shortened if requisite contractual arrangements are installed (e.g., surge contracting) and appropriate technical descriptions (technical data packages) are in the hands of potential vendors before the mobilization decision is taken.

In summary, it appears from the brief review of the sample of ammunition items that current production needs can be adequately met by the industrial capacity dedicated to that purpose. However, the ability to surge in peacetime or to produce at significantly higher

rates quickly under mobilization conditions is subject to serious question. The response time of the base as it is presently postured is too long to assure the attainment of required production rates by the time they are needed to support a protracted war effort. The following section of this chapter will present an analysis of the costs and benefits of making selective pre-M-day improvements to the ammunition manufacturing base. Since industrial responsiveness can substitute for on-hand inventory, a cost benefit will be shown in the trade-off between investments in industrial preparedness improvements and the cost of end-item stockpiles otherwise required to sustain a war during a buildup in production.

A COST-BENEFIT ANALYSIS

The preponderance of current literature recognizes the inadequacies of the munitions industrial sector to expand quickly to wartime, or significantly higher peacetime, production rates. Unfortunately, most of these analyses conclude that the solution to the problem lies in the infusion of additional financial resources into the Army budget to facilitate corrective action. This portion of the study will suggest finding an economical trade-off between satisfying needs of present-day readiness and long-term sustainability within currently available resources.

Perceived requirements for military materiel dictate the size and responsiveness of the industrial base. Past national experience has shown this perception to be markedly different in periods of wartime and peacetime.

A paradigm is offered in Figure 10 which suggests the relationship between defense materiel demand and the response in wartime of the logistical system (which includes the industrial base). **When a war is going on, the nature of the conflict prescribes the combat demands, exemplified in Figure 10 as combat intensity; attrition as a result of enemy action and waste; and, of course, the duration of the conflict.** These combat demands translate into a demand on national resources. Presuming the Nation is squarely behind the war effort, resources are allocated and the logistical system (in its broadest connotation) converts the resources into war-fighting supplies and equipment. War-fighting ability in the modern context is inextricably tied to materiel. Even though the intangible qualities of leadership, morale, esprit de corps, and elan can still be counted on to spell the difference between success and failure of similarly equipped troops, there is little chance of these qualities

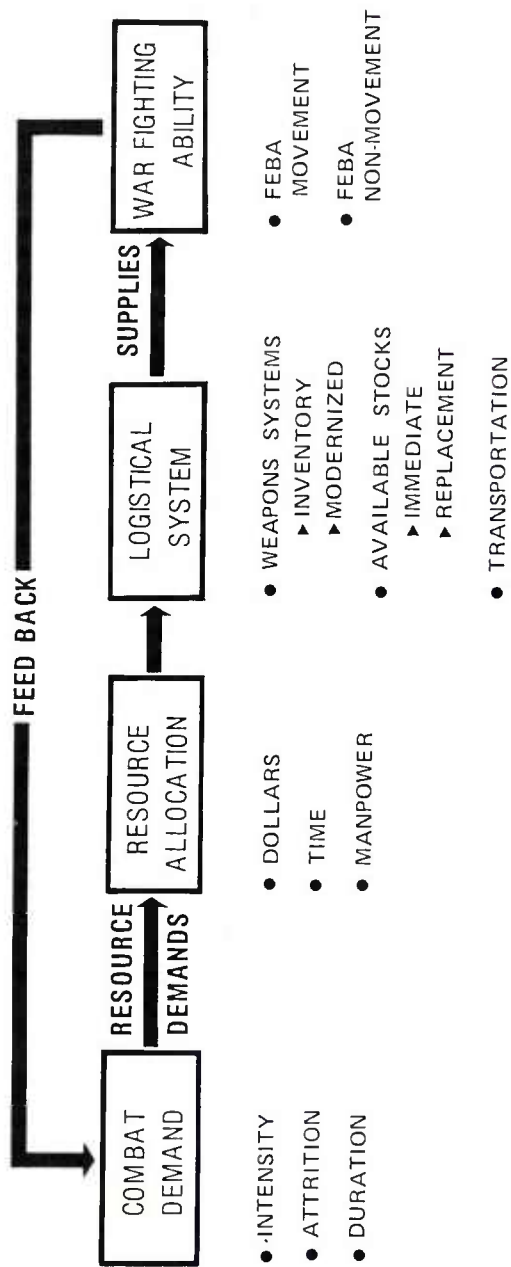


FIGURE 10. Wartime Demand and Supply

sufficing against a severe mismatch of equipment and supplies. The materiel output of the logistical system contributes to the movement (or nonmovement in the case of defense) of the forward edge of the battle area (FEBA) on the conventional battlefield. The efficacy of the contribution of the supplies to the combat effort is perceived and transmitted (via the schematic feedback and becomes a revised statement of combat demand for the next iteration. If the supplies have proved to be inadequate, combat demands rise, greater demand is placed on the logistical system, and output is increased accordingly, or vice versa. In short, in wartime, combat requirements determine resource allocation.

Any paradigm or model which purports to represent reality in its relationships should be tested for validity. The ultimate test of the suggested model would be to wage a war. The history of the Nation's past wars seem to support the validity of this construct. Short of staging a war to show that combat demands drive logistical responses, an exercise could be conducted to simulate the wartime environment. A recent Joint Chiefs of Staff exercise, NIFTY NUGGET, focused on the support aspects of a hypothetical conflict.⁴⁰ Among other things, the exercise underscored some of the shortcomings of the supporting logistical system and might suggest that the peacetime model of supply and demand may be quite different from the wartime model just described. A peacetime paradigm is suggested in Figure 11.

Actual combat demand is noticeable by its absence. No yardstick exists for measuring the effectiveness of the resource input stream. Consequently, reductions in the peacetime allocation of resources to the logistical base are not immediately perceived as adversely affecting combat capability. Operational plans often overlook logistical shortcomings. Therefore, it appears that in peacetime resource allocation is the independent variable upon which war-fighting ability depends.

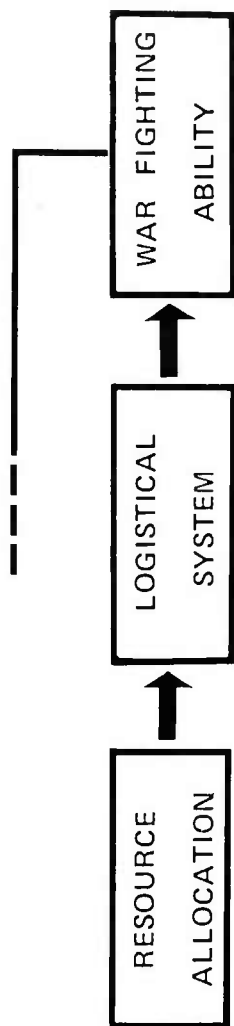


FIGURE 11. Peacetime Supply and Demand

Unfortunately, this peacetime view is susceptible of being transformed abruptly into a wartime reality by world events. In the late 1930's when the Nation was dedicating approximately one percent of its gross national product to national defense, it would have been difficult to comprehend the resources required to bring World War II to a successful conclusion. During the peak years of 1943-1945, upwards of 40 percent of the national wealth was dedicated to the war effort.⁴¹ How then can a logistical planner anticipate future demands accurately and judiciously allocate peacetime resources to provide the necessary war-fighting capability should war come? A cost-benefit analytical methodology applicable to the solution of the difficult planning dilemma, along with some preliminary analytical results, are offered for thoughtful consideration.

In November 1978, a study was released by the Department of the Army entitled the *Ammunition Production Base Leadtime Study*.⁴² This excellent work was performed by Kaiser Engineers in association with Stetter Associates, Inc., under contract with the office of the Project Manager, Munitions Production Base Modernization and Expansion. The study focused on a portion of the ammunition production base which is an important segment of the logistical system depicted in Figure 12.

The Leadtime Study investigated, in detail, the present condition of the base for the production of four representative items of ammunition. Then, through the application of a critical path methodology (CPM), the study identified and analyzed production bottlenecks and suggested cost-effective improvements which could be made to improve the responsiveness of the industrial base to produce the selected items. Critical path analysis is particularly well suited to this application since it assists in identifying, among the myriad tasks involved in the manufacturing of ammunition, the path through the maze which contains the time-constraining activities. That is, if the overall completion time of a project is to be compressed, improvements along the critical path must be found. The study proceeded as follows:

- 1. A standard critical path network was created after an analysis of the production processes (and reactivation processes in the case of inactive facilities) had been performed.** An aggregated schematic diagram of the network is shown in Figure 12. The actual standard network employed in the study contained 63 discrete activities within the overall categories depicted above.

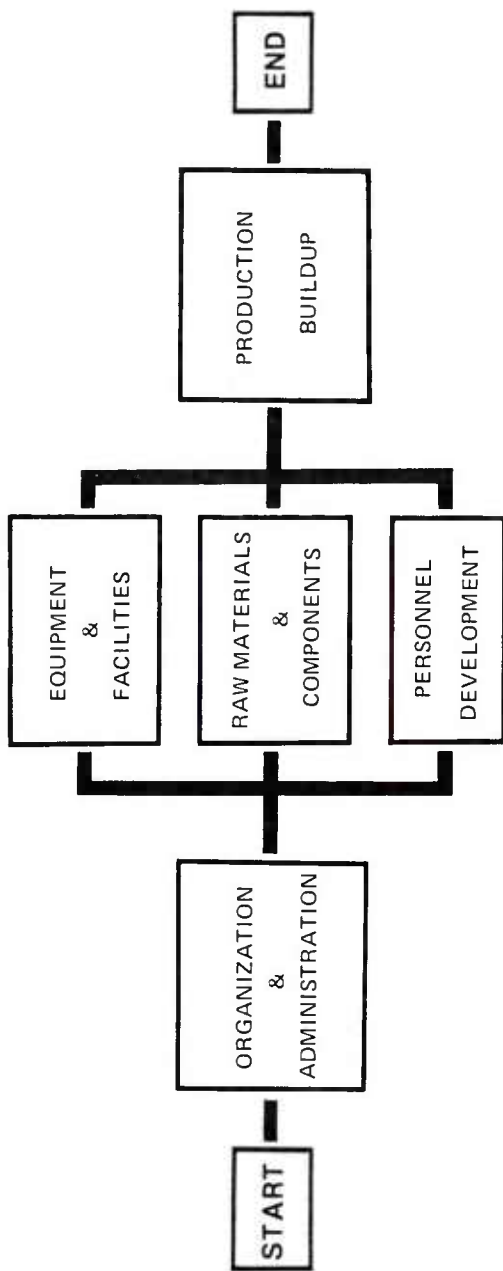


FIGURE 12. The Standard Network

2. Through the disciplined use of a standardized questionnaire, deficiencies in the present base which would constrain individual production lines from reaching prescribed mobilization production rates were identified by plant and study personnel. The goal of the study effort was to identify improvements which would enable the industrial response time to be reduced to 4 months from the declaration of mobilization (M-day). Twenty-eight manufacturing plants were included in the analysis. A representation of the result of this step in the methodology is shown in Figure 13. For a hypothetical monthly mobilization production rate of 90,000 end items per month, the current maximum production capability of components and end items are shown during the period of production buildup after M-day. The component and end-item production deficiencies which constrain the particular plant from attaining the target rate in the early periods of production buildup describe the critical path through the network.

3. With the critical path thus identified, plant operating and study team personnel suggested improvements to eliminate or ameliorate the deficiencies constraining production. Some of these improvements were programmed for implementation under the production base modernization and expansion program. The suggested improvements must, however, actually be applied before M-day to be effective. Examples of beneficial pre-M-day actions include: increasing raw material and component inventories; procurement and installation of industrial plant equipment; development of training, start-up, and inspection procedures. By simulating the application of the suggested improvements to the network, the critical path was theoretically shortened.

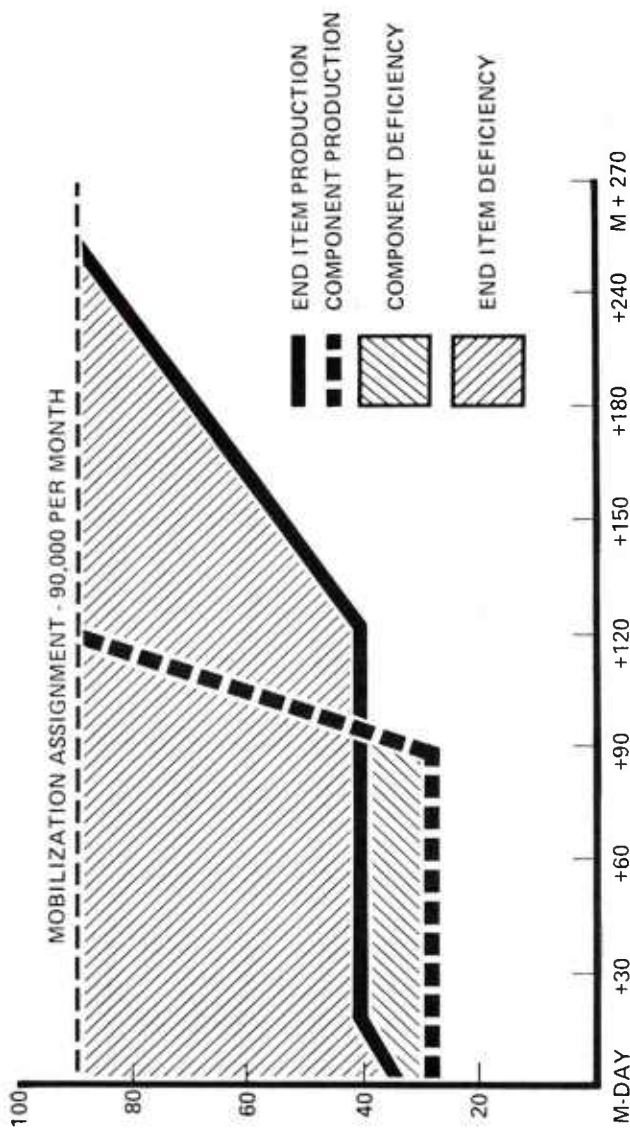


FIGURE 13. Ammunition Production in Thousands per Month

During this process, three elements of pre-M-day costs were recorded for both the present and improved condition of the industrial facility to serve as a basis of comparison: (1) production line improvement costs (obviously zero for the unimproved case), (2) component stockpile costs, and (3) end item stockpile costs. These costs were then used to compute the cost benefits for the improvements recommended for application. The results were tabulated for each production line examined. One such tabulation is provided illustratively as Table 3.⁴³ This illustration is of improvements which could be applied to the production of the M483, 155mm artillery projectile. Notice the costs (negative savings) of the improvement investments total nearly \$9 million. When these costs are subtracted from the possible savings through reductions of pre-M-day stockpiles of \$78 million, a net saving of over \$69 million is estimated. Even this dramatic cost saving might be improved if the network analysis had been performed with the objective of finding and reducing the least cost critical path through the network. Recall the objective of the Leadtime Study was merely to reduce the critical path to 4 months, if possible, and not to search for optimum cost avoidance. This methodological refinement is a likely candidate for incorporation into follow-on analyses. By applying similar analyses to the other selected items of ammunition, the Leadtime Study concluded that \$81 million in net savings could be realized for the total investment in improvements of \$35 million (a better than 2 to 1 return on investment) for the four items investigated.⁴⁴

**Table 3. Investments and Savings,
Projectile, 155mm HE, ICM, M483**

Pre M-Day Stockpile

Item	Line Condition	Quantity	Cost (\$1,000)	Improvement Investment (\$1,000)	Net Savings (\$1,000)
End Item LAP	Current	247,050	113,127	—	—
	Improved	114,180	52,284	583	—
	Savings	132,870	60,843	(583)	60,260
Shell MPTS	Current	24,150	3,427	—	—
	Improved	37,475	5,318	2,494	—
	Savings	(13,325)	(1,891)	(2,494)	(4,385)
M42/M46 Grenade Body	Current	7,294,080	8,352	—	—
	Improved	7,498,560	8,586	386	—
	Savings	(204,480)	(234)	(386)	(620)
Fuze M223	Current	27,315,227	11,390	—	—
	Improved	15,818,400	6,596	1,398	—
	Savings	11,496,827	4,794	(1,398)	3,396
Fuze MPTS M577	Current	407,550	24,506	—	—
	Improved	164,717	9,904	4,034	—
	Savings	242,833	14,602	(4,034)	10,568
TOTAL	Current	—	160,802	—	—
	Improved	—	82,688	8,895	—
Savings		—	78,114	- (8,895)	= 69,219

NOTE: Stockpile Costs minus Pre-M-day Improvement Costs equals Net Savings (78,114 - 8,895=69,219)

Source: US, Department of the Army, *Ammunition Production Base Leadtime Study*, November 1978, Table 3-1.

The conclusions of the Leadtime Study agree substantially with the conclusions of a theoretical approach to the same problem taken over 10 years ago. Lewis Baeriswyl, employing a linear programming methodology, constructed a mathematical model for finding the least cost mix of ammunition inventory and production capacity. The discounted present value of the costs incurred at different times were taken into account. Baeriswyl concluded that in times of increasing interest rates (as in inflationary periods), the cost advantage of providing for a quick reaction manufacturing plant increases over the advantage of keeping a larger inventory.⁴⁵ Further, he held the ability to enter production quickly fully justified high investment and maintenance costs. He observed, "The results of the model strongly suggest that we are spending more on inventory and less on capacity than we should."⁴⁶ Despite these examples of rather compelling evidence, it remains extremely difficult to convince policymakers that it is more prudent and more cost effective to invest in inactive production capability than it is to invest in additional units of hardware for inventory.

A current view of the industrial base for the production of ammunition has been sketched in some detail and the preliminary results of a cost-benefit analysis have been presented in this chapter. In summary, a brief review of the present condition of the base follows.

SUMMARY

As the United States withdrew from the trauma of the war in Vietnam, national consciousness lapsed into its traditional peacetime state. In this, yet another interwar era in US history, interest in mobilization and industrial preparedness has begun to wane.

The national focal point for mobilization matters, the Office of Emergency Preparedness, was abolished in 1973, leaving the effort without effective centralized leadership and without a voice on the National Security Council. Another signal of declining interest in mobilization since World War II was the shift in emphasis in the curriculum of the Industrial College of the Armed Forces toward the broader but less sharply focused subjects of human relations and executive skills. Fortunately in the latter case, the emphasis on materiel acquisition and mobilization is being revived in the curriculum offerings.

The industrial capability for the production of ammunition, as an illustrative commodity, is also showing signs of neglect. The active nucleus of that capability, the GOCO ammunition plants, have benefitted from extensive modernization. However, the inactive portion of the government-owned base representing expansion potential has been deprived of the funding support required to assure adequate maintenance of its capability. Approximately \$40 million worth of deferred maintenance and repair projects are presently unfinanced within the ammunition base. The plight of the inactive base today is not unlike the conditions which Frank Scott, the World War I War Industries Board leader, perceived between the World Wars in 1926. Scott said in an address to the Industrial College: "It is hard to build a structure which may never be used; hard to scheme and plan devotedly for events which may never transpire."⁴⁷

The \$15 million granted by the US Congress in 1979 for industrial preparedness operations at the ammunition plants may be an indication of recognition of a valid need. The "fencing" of those funds by the Department of the Army assures their application to the maintenance requirements of the inactive facilities.

A third element of the industrial base involved in production of ammunition was identified as the private sector. Because of the adoption of a strictly competitive procurement policy by the government, even in wartime, and fostered by a superficial mobilization planning system, former defense producers are migrating from the munitions market and participation in mobilization planning with the Department of Defense.

The general deterioration of the expansion portion of the industrial base for ammunition production was highlighted by a detailed review of four items of ammunition currently in production. Serious shortfalls were seen to exist in the ability of the base to support significant increases in production of the selected items, to meet either mobilization or surge peacetime requirements.

Finally, the results of a cost-benefit analysis were presented which demonstrated that investment in improvements to the industrial base makes sound economical sense. The methodology reviewed offers a useful technique for further and more detailed investigation into the economical mix of end-item inventories and maintenance of the production base.⁴⁸

This brief summary of the present condition of the industrial base ends on two promising notes. The first is the prospect that

through enlightened analyses, such as the Leadtime Study, the Government may learn how to spend money more wisely rather than just to spend more of it. Significant benefits may also be attainable from small marginal investments made from within present resources. Second, the emergence of true "surge contracting" promises enhanced industrial responsiveness by relating surge production to current procurement actions. This technique, carrying a contractual obligation for performance, offers incentives to industry to acquire capital equipment needed for munitions production, assures modernized and well-maintained industrial plant equipment and tools, and provides for the stockage of components through appropriate subcontractor levels.⁴⁹

The following chapter will conclude this study with an overall review and assessment and a brief look toward the future.

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41. US, Department of Defense, *National Budget Estimates for FY 1980* (Washington, DC: Office of the Assistant Secretary of Defense (Comptroller), n.d.), p. 16.
42. US, Department of the Army, *Ammunition Production Base Leadtime Study*, (Dover, N. J.: Project Manager, Munitions Production Base Modernization and Expansion, November 1978).
43. *Ibid.*, Vol I, Part I, Table 1-1.
44. *Ibid.*, Executive Summary Table 2-2.
45. Lewis Baeriswyl, Jr., "Optimal Mix of Ammunition Inventory and Production Capability" (Master's Thesis, University of Maryland, 1968), p. 26.
46. *Ibid.*, p. 1.
47. Frank A. Scott, "Lectures at the Army Industrial College" compiled by the US Army Center of Military History. Lecture given on 26 October 1926, p. 14.
48. Economic analyses of the mix of inventory and base comply with the spirit of Department of Defense Directive 4005.1, p. 3.
49. Prestockage of components must be carefully orchestrated to insure that all long-lead-time components for a given end item are on hand. A partial fill won't improve overall responsiveness (e.g., prestockage of only the guidance wire for the TOW missile without the stockage of other critical components will

not enable the acceleration of production). See US, Comptroller General, *Report to the Congress, Restructuring Needed of Department of Defense Program For Planning With Private Industry For Mobilization Production Requirements*, Report No. PSAD-77-108 (Washington, DC: US General Accounting Office, 13 May, 1977), p. 15.

V

PRAISING THE LORD WILL NOT GET YOU AMMUNITION

He, therefore, who desires peace, should prepare for war.

Vegetius
4th Century AD¹

This study of peacetime industrial preparedness for wartime ammunition production has selected the ammunition commodity to exemplify the present condition of the industrial capability of the Nation to manufacture the materiel needed to prosecute modern wars. The Nation finds itself in an interwar era in which the demand for near-term readiness is obscuring the requirement for long-term sustainability. In this final chapter it will be helpful to review the foregoing discussions for whatever insights may be gleaned, to present in bold relief the conclusions of the study, and to look briefly to the future for actions indicated by the study being concluded here.

A REVIEW OF ROOT CAUSES

The root causes of the lack of attention to the Nation's industrial preparedness for the manufacture of war-fighting materiel appear to be threefold. First is the ascendancy of the short-war philosophy which implies futility in the maintenance of an extensive industrial base. Second, the increasing near-term demands upon the limited defense budget appears to preempt the possible long-term needs which must be accommodated from the same budget. Finally, there is an unwillingness to accept the industrial fact that war production cannot be undertaken instantaneously by an economy, however healthy, geared for commercial production. A corollary to this misperception is the strongly rooted "We did it before and we can do it again" syndrome.

The record indicates that wars have been of uncertain duration and nations prepared to fight only short wars were tragically embarrassed when the wars did not end quickly. Earlier wars have also demonstrated the fact that mobilization of materiel has proved to be far more difficult and time-consuming than the mobilization of manpower. Modern wars revealed the close and incontrovertible

relationship between the Government and private industry. Centralized leadership and control of the gearing up for war has repeatedly proved its worth in the past. Since wars tend to be of uncertain duration, requirements for stockpiling of materiel cannot be accurately estimated. Therefore, complete reliance can never be placed on having a big enough stockpile to obviate the need for a follow-on production capability. Finally, the study of our past wartime mobilization experiences indicated that to be effective, mobilization actions must be taken before M-day to avoid waste and reduce risk.

The review of the current industrial capability for production of munitions suggests certain imperatives for future action. The absence of a centralized programmatic and budgetary authority begs for the reestablishment of a mobilization focal point above the departmental level. Moreover, there is much evidence which argues that such a centralized authority should be returned to membership on the National Security Council. As the urgency of the ammunition requirements to support the Vietnam War recedes further from the national memory, no less pressing is the need to modernize the Nation's aging ammunition manufacturing base. The current modernization of the base should be continued to completion. The present deteriorating condition of the inactive portion of the government-owned production facilities demands attention and funding support in terms of adequate maintenance of the inactive base. Government access to the industrial potential inherent in the private sector of the Nation's economy is emasculated by the ineffective mobilization planning mechanism, which has been perpetuated from an earlier age and has no relation to present-day needs or perceptions. The production planning schedules must be replaced with surge contracting which carries contractual obligation and provides the wherewithal to expand production quickly when needed.

Recall that near-term readiness and long-term sustainability need not be mutually exclusive propositions. Cost effective marginal investments in sustainability complement near-term readiness and may indeed enhance it. What is to be concluded?

OUT OF BALANCE

After an exhaustive study of the logistical experiences of the United States, the historian James A. Huston has suggested, while discussing flexibility (one of his fourteen "Principles of Logistics"):

About the best that can be done is to prepare for the widest possible range of strategic possibilities in order to keep open the opportunity of choice to meet a situation as it develops.²

The preoccupation of the United States with budgetary constraints and short-war scenarios seems to have violated the principle of flexibility and caused an imbalance to occur in national defense considerations in favor of short-term requirements. The ability to significantly expand the production of ammunition and other materiel is dependent on the viability of the government-owned manufacturing base and on mobilization agreements with private industry. Since these two elements have been shown to be woefully inadequate to the task, it may be reasonably concluded that mobilization planning and industrial preparedness for US Army ammunition production are not sufficiently flexible to meet a wide variety of possible peacetime and wartime contingencies.

It does not appear that this imbalance can be redressed by a stockpiling of ammunition and equipment. The Joint Chiefs of Staff acknowledge that present stockage levels are inadequate³ and the expected date for attaining a satisfactory stockage level recedes tantalizingly further into the future with the passage of each succeeding annual budget review.⁴ In an earlier interwar era, the Army Chief of Staff General Leonard Wood estimated it would take 50 years to build up an adequate reserve of field artillery ammunition at peacetime production rates.⁵

The foregoing conclusions do not imply that such conditions must be accepted as the status quo. Employment of the techniques suggested in the previous chapter might aid in the identification of cost-effective trade-offs between stockpiling of inventory and improvements which may be introduced to the noticeable benefit of the industrial base.

LOOKING AHEAD: A LEADTIME CRITICAL PATH METHODOLOGY

Fertile ground may be found in an extension of the cost-benefit analysis presented earlier. The methodology employed in the Ammunition Base Leadtime Study could be expanded to good advantage.

Recall the lack of a completed feedback loop in what was described as the peacetime supply and demand model for production

planning. The portion of the ammunition production base which was analyzed in the Leadtime Study is an element of the logistical system which will provide the ammunition to the consumer in the field. It is suggested that an expanded leadtime methodology be used as the nucleus of a more broadly defined system which includes the simulated combat interactions. Specific expansions to the methodology will be discussed subsequently. A system thus described would provide a surrogate feedback loop which might serve the planner well in the absence of a war to provide actual feedback.

To serve as this system nucleus the leadtime methodology would have to be expanded to describe exhaustively the ammunition production base for all items for which planning was desired. That description, in itself, would represent a formidable task because the present study would need to be expanded to encompass a considerable number of additional items and, more importantly, to include additional industrial facilities, both within the existing base and potential private industry outside the present base as well. Besides this expansion in scope, the previously alluded to methodological improvement of providing for cost optimization between and within the various elements of the base should be incorporated.

How then, even with the enhanced leadtime methodology, could the interrelationship with the combat scenarios be systematized? For the application of the methodology being proposed, the ammunition requirements (expressed in terms of production rates) would have to be estimated for a range of possible scenarios and not only for the one deemed most likely. From such a portfolio of scenarios a family of requirements would be postulated to cover wars of varying duration and intensity. For each of these requirements, the leadtime methodology could be applied and, if the optimization feature were incorporated, the cost-benefit relationships of industrial base versus stockpile would be revealed for various levels of combat demand (i.e., required mobilization rates). What is being suggested is certainly not a "stubby pencil" endeavor. The implementation would require extensive interactive computer systems support. Since computer simulations are presently used to generate combat consumption forecasts, it is conceivable that the output of these simulations, with appropriate preprocessing, may be used as direct inputs to the leadtime critical path methodology, further strengthening the essential feedback loop. Equipped with the information provided by this methodological approach, the planner

could more convincingly articulate the requirement for ammunition industrial readiness in terms of the costs and benefits accruing to the various postulated scenarios.

Peacetime planning for future war is fraught with many imponderables, not the least of which is the problem of determining the nature of the war and the demands which it will place on the supply sector of the Nation's economy. Further, any pre-M-Day improvement actions are viewed with skepticism in peacetime when resource allocation tends to dictate the nature of the supply stream and the true combat demands are necessarily theoretical.

The application of an innovative leadtime critical path methodology may assist in coming to grips with the planning dilemma and would be responsive to the congressional recommendation that a more thorough review of the ammunition industrial base be undertaken.⁶ First, the methodology would have to be expanded in scope to address the entire ammunition industrial base. Then, a tractable method must be found to use the critical path network analysis to reveal optimum cost-benefit mixes within the base and between the base and the stockpile. Finally, an interactive system needs to be created which is capable of performing the critical path analysis for a family of projected demand requirements and displaying the respective costs and benefits.

With the improved information available from the application of the suggested methodology, the decisionmaker will be in a position to size the base and the stockpile not arbitrarily, nor on the basis of outmoded perceptions, but rather with a better understanding of the actual benefit being received from the dollars being expended. The full system analysis may disclose where significant benefits can be accrued for small marginal investment improvements, such as those seen most dramatically in the results of the current leadtime study.

Clearly, the cost-benefit ratio is only one element in the decision equation, but it is one vitally important in peacetime. The leadtime critical path methodology may well provide a vehicle for representing ammunition industrial base requirements in a manner which is credible, economically feasible, and fiscally supportable.

What does the future hold for the national security of the United States? One may consider the pronouncement of I. S. Bloch in 1899: "There will be no war in the future, for it has become impossible, now that it is clear that war means suicide."⁷ Does Bloch's prediction have

even greater meaning today in the thermonuclear age? Or if there is a war, will it necessarily be short as predicted by the respected futurist Sir John Hackett reporting on the anticipated events of the Third World War?

Late twentieth-century war consumed material in such enormous quantities as to put very long drawn-out operations out of the question.⁸

But if war does come again to the United States and it is protracted, there will be little consolation in the knowledge that the Nation was well prepared to fight a short war. It would be sad indeed to reflect on this period in the Nation's history and realize that more could have been done, but was not done, to assure a sustained war-fighting capability. Rather than relearning the lessons the United States learned in Korea or Imperial Germany learned in the First World War, **United States leadership must take advantage of this period of peace and take positive actions to assure preparedness to fight America's next war:**

(1) Reestablish a national centralized mobilization authority.

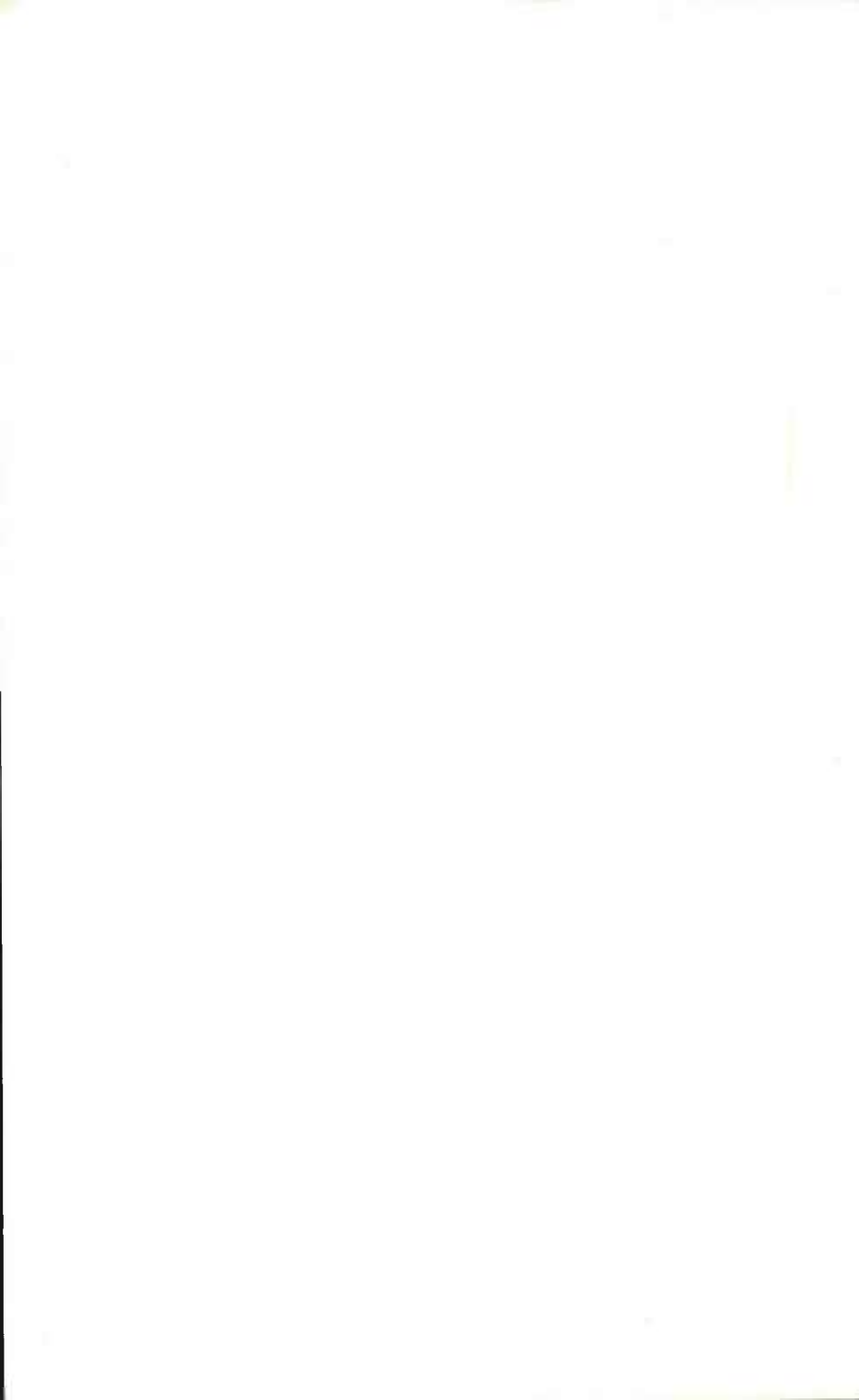
(2) Preserve the present defense industrial base through continued modernization efforts and maintenance of the inactive manufacturing capability.

(3) Combine mobilization planning with current production of defense materiel through expanded use of "surge contracting" techniques.

CHAPTER V ENDNOTES

1. Flavius Renatus Vegetius, "The Military Institutions of the Romans," trans., John Clarke in *Roots of Strategy*, ed. Thomas R. Phillips (Harrisburg: The Military Services Publishing Company, 1940), p. 124.
2. James A. Huston, *The Sinews of War: Army Logistics 1775-1953* (Washington, DC: Office of the Chief of Military History, United States Army, 1966), p. 662.
3. US, Department of Defense, Joint Chiefs of Staff, *United States Military Posture for FY 1980* (Washington, DC: Chairman of the Joint Chiefs of Staff, 1979), p. 79.
4. *Ibid.*, p. vii.

5. Frederic L. Huidekoper, *The Military Unpreparedness of the United States* (New York: The MacMillan Company, 1915), p. 379.
6. US, Congress, House, Committee on Appropriations, *Department of Defense Appropriation Bill, 1979 Report No. 95-1398, 95th Cong., 2d sess., 1978, p. 184.*
7. I. S. Bloch, *The Future of War*, translated by R.C. Long (New York: Doubleday & McClure Co., 1899), p. xxx.
8. General Sir John Hackett, *The Third World War* (New York: MacMillan Publishing Co., Inc., 1978), p. 316.



GLOSSARY OF ABBREVIATIONS

AEF	American Expeditionary Forces (World War I)
ARRCOM	US Army Armament Materiel Readiness Command
ASPPO	Armed Services Production Planning Officer
BMAR	Backlog of Maintenance and Repair
CPM	Critical Path Methodology
DAR	Defense Acquisition Regulations
DCAS	Defense Contract Administration Service
DIPEC	Defense Industrial Plant Equipment Center
DOD	Department of Defense
FEBA	Forward Edge of the Battle Area
FEMA	Federal Emergency Management Agency
FYDP	Five Year Defense Program
GAU	Guns Aircraft Unit
GOCO	Government-owned, Contractor-operated
ICAF	Industrial College of the Armed Forces
ICM	Improved Conventional Munition
IMP	Industrial Preparedness Measures
IPE	Industrial Plant Equipment
IPPL	Industrial Preparedness Planning List.
LAP	Load, Assemble and Pack
M-day	Mobilization day (The day upon which mobilization is declared)
MPTS	Metal Parts
OASW	Office of the Assistant Secretary of War
OEP	Office of Emergency Preparedness
OMA	Operation and Maintenance, Army
PAA	Procurement of Ammunition, Army
P&E	Propellants and Explosives
PBME	Production base modernization and expansion
PEP	Plant Equipment Package
REP	Request for Proposal
TOW	Tube-launched, Optically-tracked, Wire-guided



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