



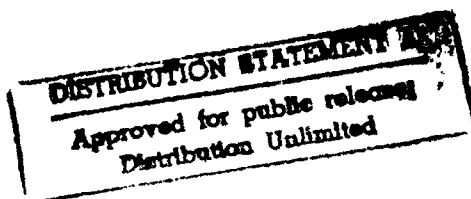
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Watervliet Arsenal: Snapshot of Industrial Base Change

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ABSTRACT

Watervliet Arsenal: Snapshot of Industrial Base Change

LTC Robert F. Dees, USA and LTC Bristol W. Williams, Jr.

Watervliet Arsenal sponsored this research paper as part of an ongoing effort to develop a strategy to direct the corporate energies of that government-owned-government-operated facility. WVA, like much of today's defense industrial base, is feeling the change brought on by dwindling budgets and fewer requirements for military equipment. This report assembles views of a variety of observers and concerned individuals--addressing not only WVA but the industrial base in general. The report analyzes the history, current environment, and future capabilities of WVA. A finding is that the major strength of WVA is its uniqueness as the sole manufacturer of cannon tubes. Like much of the industrial base continued viability depends on movement to new technology--both in product and manufacturing techniques. The leaders of WVA will now use this research effort to further develop their strategy for moving into the 21st Century.

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PREFACE

In the fall of 1992 Watervliet Arsenal (WVA) provided a statement of work for a prospective faculty or student research effort to the Industrial College of the Armed Forces (ICAF). This research request involved input to WVA's ongoing efforts to develop a strategic plan to guide the arsenal through the challenges of the defense drawdown into the 21st Century.

The authors agreed to perform the requested research, assisted by ICAF faculty members, to achieve the following objectives:

- (1) Define WVA's operational environment, describe primary market trends, and provide a strategic forecast for inclusion in WVA's strategic plan, and
- (2) Provide a document to the defense industrial base community which illumines the role of a government-owned, government-operated manufacturing facility such as WVA and, more generally, a document which provides a "snapshot of the tremendous change" occurring in the defense industrial base.

The authors wish to thank a number of individuals and agencies who lent expertise to this project. The Bibliography illustrates the magnitude of the support provided, but the following agencies are listed here for their particularly valuable input: Office of the Secretary of Defense (ASD(P&L)), Office of the Deputy Undersecretary of the Army (Operations Research), Army staff (DCSOPS, DCSLOG, and ASA(RDA)), the Army Training and Doctrine Command, numerous defense contractors (particularly Vector Research Incorporated and Center for Strategic and International Studies), and the Congressional staff for Representative Michael McNulty from the 23d Congressional district of New York. Additionally, numerous ICAF speakers, not cited directly for non-attribution reasons, provided keen insights into the considerable challenges posed by our changing strategic environment. And, finally, ultimate thanks to WVA leadership (COL Michael J. Neuman and Mr. Tom Fitzpatrick) and the project sponsor, Mr. David Callahan, for their confidence, funding, and input during project reviews along the way.

In summary, this research endeavor has been a tremendous learning experience for the authors. We trust that, in turn, this effort will assist WVA in forging a strategy which serves our Army and our nation well in the century to come.

EXECUTIVE SUMMARY

The defense industrial base is undergoing a profound change. The very reason for its existence for the last 40 years--the Soviet Union--is gone. How will the industrial base adjust to this new situation? In this paper, we study one of the installations in the defense industrial base--Watervliet Arsenal--as it develops a new strategy. We suggest that the development of a new strategy for Watervliet Arsenal should be accomplished in four steps. Although the leadership of the arsenal is responsible for the strategy development, we accomplish in this paper the initial three steps in strategy development.

The four steps in strategy development are:

- o Review of the history and present strategy,
- o Analysis of the environment,
- o Review of the present capabilities,
- o Realign the organization in a strategy.

The history of the arsenal is inextricably tied to the production of cannon. We feel that even in a period of decreasing workload the arsenal must stick to its strength which is making cannon tubes. There are many elements in the environment that argue against sticking with the cannon production--decreasing demand, the threat of less money, the danger of closed installation, etc. The cannon production capability, however, is currently the single component that sets Watervliet Arsenal apart from other facilities. It is the unique aspect of the facility that demands attention in DOD and in Congress. The true WVA strategic challenge in the 21st Century will be establishing a new uniqueness--thus transitioning to materials and technologies of the future.

Finally, Watervliet Arsenal is seeking to expand its production capability by modernizing its machinery and buildings. This has taken the form of more computer interface in design and manufacture. The arsenal is now positioned well to compete as a center for flexible manufacturing--a promising trend in the defense industrial base.

Having laid the three initial steps in developing a strategy, the paper leaves it to the WVA leadership to synthesize the three to choose an appropriate direction or avoid a lethal pitfall. To further assist the arsenal's leadership in strategy development, we provide quantitative forecast data in the Appendix.

WATERVLIET ARSENAL:

SNAPSHOT OF INDUSTRIAL BASE CHANGE

"The anticipation and preparation for change is the essence of strategy." (Leontiades, 187) Since the demise of the Soviet Union, it is has become obvious that old ways of doing business are no longer appropriate. Change, in an ever accelerating rate, has become a way of life for virtually every component of the Department of Defense. Many agencies are now asking what strategy must they adopt to ensure survival within the Department of Defense. And, more to the point, how can we develop a strategy?

DEVELOPING A STRATEGIC PLAN

In his work on strategic behavior, Charles Summer suggests that strategy development takes place in four phases. In phase one, an organization looks back at its history to discover the roots of its origin. Why did this agency come into being? And how well is it accomplishing its original intent? Phase two takes an organization outside its walls to study the present environment within which it must function. This phase requires an assessment of the stability of that environment with a prediction of the direction the environment is most likely to go. In phase three, an organization again looks into itself to compare the capabilities it possesses with the environment. Here the

emphasis is on discovering areas where the organizational capabilities do not align with the demands of the environment. Phase four is the actual development of the strategy. The development phase synthesizes the work of the three earlier phases to isolate the current strengths and weaknesses in the organization. (345-350)

This paper addresses the first three elements of strategy development for Watervliet Arsenal. It provides preliminary strategic recommendations for consideration as Watervliet Arsenal completes steps three and four of this strategic planning process internally. To accomplish this assessment--historical/current background environmental and capabilities analysis--the paper addresses the following:

- o the historical and current mission of Watervliet Arsenal,
- o enumeration of the current and future environmental observations--political realities, market opportunities, organizational alternatives and modernization challenges impacting the arsenal and in the future, and
- o strategic considerations based on the existing arsenal capabilities.

Watervliet Arsenal has a long, productive history of service to our nation that dates to just after the Revolutionary War. In the first step of strategic development, we will look at the origins of Watervliet Arsenal.

1813 to the Present

Throughout this century a cannon marked "Watervliet" has meant quality. The 142-acre facility on the Hudson River has equipped fighting forces in every war since the War of 1812. While in its early years Watervliet Arsenal provided the Army with ammunition and artillery accessories, in 1883 a Congressional board selected the arsenal for cannon production. The decision was influenced by the access to superior transportation networks of the nearby railroads and waterways--Erie Canal and Hudson River. In the pre-World War I years, Watervliet was gradually expanded until in 1918 it could boast, "Arsenal guns beat the Huns!" (WVA Arsenal, 101) Watervliet Arsenal produced a total of 450 guns of varying caliber during the final year of the war. During the inter-war period--1918 to 1939--workload at Watervliet fell substantially; but, the cannon producing capability remained intact. By 1939, the cannons were again rolling out of the production lines. Watervliet Arsenal expanded rapidly to provide armaments for the growing armed forces. As United States entry into World War II became a foregone conclusion, construction rapidly expanded the capability of the arsenal. By the end of the fiscal year (June) 1941, the yearly production exceeded 7,000 guns. December 1942 represented the peak of WVA's production. In that month alone, workers produced 3,458 cannons. Post-World War II accomplishments have been many--manufacture of the first atomic cannon (280mm), 20,000 cannons for the Korean War, and support to the Viet Nam War.

Current Mission and Capabilities

Watervliet Arsenal is a government-owned, government-operated (GOGO) industrial plant which produces thin and thick walled cannon--the only facility of its kind in the United States. It has the unique capability to produce guns with bore diameters 40mm to 16-inches that are as long as 70 feet. The nation and our allies depend on Watervliet Arsenal to manufacture cannon weapons during times of peace and crisis (WVA, 4).

During periods of national crisis the arsenal is responsible also for supervision of supplemental production. Seven private production facilities have laid away machinery capable of making small cannon--155mm and 105mm--and mortars. These planned producers require activation of Plant Equipment Packages (PEP) to begin active participation in meeting the wartime requirements. Watervliet retains the bulk of the production load. (WVA, 2)

Located in the upper New York state town from which it derives its name, Watervliet Arsenal provides a variety of cannon products. These cannons and mortars are the teeth of such well known weapon systems as:

- o Abrams Tank M1 and M1A1,
- o M109 Howitzer 155mm,
- o 16-inch naval gun (battleships),
- o Mortars (4.2 inch, 81-mm, and 120-mm)
- o 8-inch howitzer,

o 105-mm howitzer.

These systems are manufactured in a facility which combines the old with the new.

Much of the physical layout--composed of six manufacturing buildings--is pre-World War II. The equipment inside, however, has undergone frequent modernization. Most recently in the mid-1980's, REARM--Renovation of Armament Manufacturing--brought in sophisticated manufacturing equipment while enlarging the facilities to accommodate change. Planners estimate that the REARM program will expand the mobilization potential from 680 to 1,250 tubes and result in a peacetime return on investment of 17%; wartime 30%.

In addition, a \$31 million program brought Computer Integrated Manufacturing to the arsenal. Now 200 of the 1,430 machine tools in the facility are controlled by computers. These automated machines provide the arsenal with a diversity of manufacturing options. Not only can it produce its staple--the cannon tubes--but also the arsenal can produce machined parts. The arsenal can produce these parts in large or small lots. In the future, computer-to-computer technical data packages will allow Watervliet to provide on-demand machined metal components.

This automated process--called Flexible Computer Integrated Manufacturing (FCIM)--has a potentially high payoff throughout

the Department of Defense. Such a capability will have application for spares production, prototype production, initial low quantity item manufacture, non-developmental item (NDI) verification, and reverse engineering. The overall benefit for such a process is reduced costs and lead time. Watervliet Arsenal is one of several government facilities competing to be the service designated FCIM center. Each service--Army, Navy, and Air Force--will have one manufacturing center. (Bachinsky)

To further understand the current capability of Watervliet Arsenal, you must be familiar with the complexity of cannon production.

Cannon Production Expertise

The steps in the production of a cannon provide an insight into the overall orientation of the facility. The following steps summarize the process:

- o The arsenal receives a "billet" of rolled steel up to 22 inches in diameter. These "billets" are provided by several domestic suppliers.
- o The labor force uses the arsenal's rotary forge to heat and shape the steel into the cannon configuration. Computers controlling the forge can dictate a variety of shapes and internal dimensions. The rotary forge is one of the few of its kind in the world. It allows a process normally requiring a half hour to be accomplished in less than ten minutes.
- o After rotary forging, the cannon is heat treated. This process produces the desired mechanical properties in the cannon metal. Watervliet uses a unique horizontal process which reduces the time of treatment by allowing a continuous operation.

o The next step is autofrettage. This process creates improved strength and fatigue life. Watervliet developed the system currently used at the arsenal and it is a patented process. This technology involves use of a hydraulically driven mandrel and requires only about one hour.

o Next the tube is bored to produce an acceptable diameter. The system used at Watervliet Arsenal is a unique process developed in-house. This process reduces the required time and labor for the overall tube manufacture. It also reduces the need for the tube straightening operation.

o Workers place the tube in a chrome plating immersion tank where electro-deposits are added to the internal tube and powder chamber. Throughout the process, laser measuring devices gauge the fidelity of the cannon tube dimension and chrome plating.

o If required by specification, the final step includes machining of evacuator holes and painting. Also, the arsenal manufactures breech mechanisms which are mounted to the tube prior to painting.

o Finally, the workers paint and package the cannon for shipment to weapon system assembly plants. The arsenal tests some tubes hydraulically. Other tubes are fired before acceptance.

Valuable Partner: BENET Labs

In addition to the physical manufacturing facility at the arsenal, there is an independent Army laboratory--Benet Labs--located on the grounds. This organization is the center of excellence for tank autoloaders, tank turret engineering support, and tank gun recoil mechanisms. In addition, Benet Labs conducts research into the mechanics of cannon technology. (BENET, 1-3) Co-location of the arsenal and the lab has contributed to Watervliet's innovation and responsiveness throughout its history.

From a review of the history and current capability of Watervliet Arsenal, it is apparent that the reason for its existence is the production of cannons and mortars. Although the modern manufacturing systems located at Watervliet offer the potential for varied production, in the near- and short-term it is the cannon that appears to offer the base of its workload. Any strategy must account for the fact that thick-walled cannon and Watervliet are nearly synonymous.

This completes phase one of the model--a review of the manufacturing background of the facility. Let's proceed to a study of the environment--an environment that is complex and varied.

WATERVLIET ARSENAL--THE STRATEGIC ENVIRONMENT

In phase two of the Summer model, the planner must critically analyze the environment in which the organization operates. For any defense industrial base facility, the environment in which it must operate is multi-faceted. The players include not only the normal commercial suppliers and customers found by every industry but also the much more complex players in the government. Government players are in both the executive branch and the Congress. They represent both state/local and national concerns. In this paper, we will study Watervliet's environment--and by extension the environment of any defense industrial base organization. Before turning to a discussion of the varying

perspectives of the key players, it is important to understand what has changed in the environment. Much has changed over the last three years. These changes have set in motion dramatic adjustments for the post-World War II industrial base.

Winds of Change--A New World

General Colin Powell captures the essence of the new environment in the introduction to the recently published National Military Strategy of the United States. He states:

The community of nations has entered into an exciting and promising era. Global war is now less likely...

The implied task of this statement--and the challenge that has occupied planners for the last three years--is to develop a transition. DOD has developed the Base Force, a force design more accurately reflecting the new international and domestic situations. This new force structure is likely to be a matter for Congressional debate over the next several years. Few people, however, have addressed the transition of the defense industrial base. (OTA, 30) Much of this inertia reflects the administration's philosophy of free market--no federal industrial policy. As the industrial base and force structure transition to a new form, change must take place within the context of the new strategy. The principal changes of the new strategy are:

- o A regional orientation,
- o Threat of the uncertain and unknown,

- o A smaller total force (the Base Force),
- o CINC's drive the planning process. (JCS, 26)

Each of these changes has implications for the defense industrial base--and Watervliet Arsenal. Let's look at the first three.

The first change--a regional rather than global orientation--is probably the most profound. This change has resulted in the reduction of resources appropriated by Congress. With less money, it is unlikely that the industrial base will retain its current composition. In the private sector, many companies are rapidly restructuring to accommodate less work and over capacity. William Anders, the CEO of General Dynamics, advocates the restructuring of firms to establish improved financial viability to take advantage of future opportunities in the defense industry. He believes that many firms will be best served by leaving the defense industry in recognition of the diminished work. (15)

Government-owned industrial facilities will also restructure. The ammunition plant capacity is an example. There already is overcapacity in that portion of the government owned sector. The Army will reduce the number of active ammunition plants from 17 to 9 with further cuts to be driven by the budget. (Janik, 19) Preparation for a regional conflict does not demand as many resources as preparation for a global war. We can expect

Congress--in recognition of this reality--to appropriate less money for defense activities.

The second change reflects the uncertainty created by the dissolution of the Soviet Union. Who will the US be most likely to fight? The fact is no one knows. And this unknown creates downward pressure on the budget. The Department of Defense has attempted to shift the dialogue from threat identification to analysis of the required capabilities--a paradigm shift. This approach advocates a force structure and industrial capacity built on the diversity of demands that the US defense establishment may face. A capability-driven requirement has not sold in Congress. The legislators have continually striven to define the defense demands in threat terms.

The loss of a clearly defined threat has had an impact for the industrial base. The loss has allowed the US leaders--both in the executive branch and legislative branch--to consider smaller defense requirements. But the lack of a clear threat is not the only impact on the industrial base. The new strategy asks the industrial base to prepare for two kinds of war--the regional and the global.

For the regional war the defense industrial base must be vibrant and capable of rapidly surging to increase the production of current items. This requirement assumes a short lead time where

the forces in place and equipment already produced are the major factors considered. To meet such a requirement each segment of the industrial base--shipbuilding, combat vehicles, electronics, etc.--must be actively producing or have stocked sufficient products to sustain a short duration war.

In the global war, the defense industrial base will be given a long period of preparation. During this time, the force structure, as well as the massive production potential of the US, will be activated. This period of reconstitution will turn the peace time industries to producers of war-making goods. The assumption underlying this idea is that no global threat on the horizon can form without substantial warning time--normally expressed in years. The focus in the global scenario is the maintenance of a sound technological and production potential.

The third element of change is the designation of a base force. This force is the minimum required to provide a capability to perform crisis response for regional contingency operations while forming the basis for a reconstituted military in case of global war. The base force is smaller than the military force we have currently. The challenge for the industrial base is to equip the force with items that are technologically superior to those of any enemy it is likely to face. This task is made more difficult since fewer forces require less equipment. With less demand for

equipment, there is less incentive for firms to remain in the defense business.

Department of Defense has developed several schemes for retaining the capability of each segment of the industry. The key is the continuous funding of research and development to feed the industry as well as preclude technological surprise. Production will be limited to sufficient end items to allow adequate testing. Services will achieve system modernization through insertion of new technology into existing platforms. Better capability will accrue by making improvements on the margin--making ammunition more lethal rather than designing a new system.

This review of the new strategy provides a macro-analysis of the environment that faces Watervliet Arsenal. The dialogue between Congress and the Department of Defense will continue until the elements of a national strategy are accepted and resourced. In the meantime, however, it is important to understand the fundamental changes that are now occurring in US strategy because these changes are likely to affect Watervliet for the foreseeable future. Chart 1 summarizes key strategic transitions and considerations. This discussion of the changing strategy does not represent a complete analysis of the environment. To continue the environmental analysis, we look at the impact of the key players and the politics that guide their actions. What are the political realities that affect Watervliet Arsenal?

POLITICAL REALITIES

There are many key players and agencies which affect the environment surrounding Watervliet Arsenal. Chart 2 depicts the nesting of organizations within which Watervliet operates. The following discussion addresses the source and nature of the political realities which determine Watervliet's freedom of action as a DOD production facility.

Congress

Congressional involvement with Watervliet is both direct and indirect. Direct in that Watervliet is a tenant of New York state. As such, WVA has several "friends" in Congress. In particular, Representative Michael R. McNulty, Democrat-New York(D-NY), represents the 23d Congressional District of New York which contains WVA. WVA employs a sizeable number of Representative McNulty's constituents and he characteristically endeavors to preserve their well-being by preserving and promoting WVA. Although the Prodigy Political Almanac indicates a strong liberal bent, he pursues defense production initiatives in the direct interest of WVA. Examples include:

- o efforts to streamline WVA's ability to bid for selected civil sector production requirements consistent with WVA's production capabilities (10 USC 2208) and,
- o his support of an FMS initiative to co-produce with friendly foreign nations (Swiss and South Koreans). (Vigianni, 17 Jan 92) These initiatives will be discussed further in Section III, Market Opportunities.

Representative McNulty's direct impact upon Watervliet is further expanded through his membership on the House Armed Services Committee (HASC). On this committee he has strongly supported the Light Armored Vehicle (LAV) 105mm gun (EX 35), the upgrade of M1 tanks to M1A2s, and the continuation of the Paladin artillery system; all of which provide workload for WVA. As a participant on the Defense Policy Panel, he frequently networks with fellow Democrats to obtain mutual defense procurement objectives. Finally, in a broader sense, there is networking with other Congressmen with defense interests such as Representative Dennis Hertel, D-MI, M1 Tank Production. (Vigianni)

Senators Alfonse D'Amato, R-NY, and Daniel Moynihan, D-NY, are also interested in the maintenance of WVA's current role as a New York State employer. Of note is Senator D'Amato's October 1991 visit to WVA, which he used as an opportunity to announce Senate defense fund approvals providing future work for WVA. (Salvo, p.1) Overall, actions by New York's Congressional delegation to garner "pork" for the state significantly improve WVA's market possibilities.

Congressional actions indirectly impacting Watervliet spring from the ongoing debates regarding "How much (defense) is enough?" and "To what degree should Congress 'prop up' defense industrial capability?" The Congressional Office of Technology Assessment (OTA) possesses considerable "information power" through its

study efforts. Their recent Redesigning Defense recommends the long-term retention of government-owned, government-operated (GOGO) facilities which "...preserve unique military technologies that would be too costly or risky to produce in the private sector." (OTA 14,15) Watervliet's role as the nation's only thick-walled cannon producer and holder of a number of protected technologies certainly fits in that category.

To summarize, Watervliet is influenced by conflicting Congressional interests--namely the "pork" considerations endemic to Congress contrasted with the tremendous pressure within Congress to further downsize defense, to include the Defense Technology and Industrial Base (DTIB). It is essential for Watervliet to maintain active and vital communication with its Congressional "sponsors", being careful to be totally candid with intervening Army and DOD headquarters elements. As will be seen in this next section, however, Congressional support of politically advantageous defense programs often runs counter to DOD resource priorities.

Department of Defense (DOD)

As alluded to above, DOD resource priorities often conflict with Congressionally supported defense programs. Several of these programs have components produced at WVA. Secretary of Defense (SECDEF) Cheney has opposed the M1 tank upgrade program. OSD support for the Light Armored Vehicle (LAV) (using the EX 35 gun

produced at WVA) has eroded since the Marines dropped their requirement. The Armored Gun System (AGS) (also using the EX 35) remains high on the Army Long Range Research, Development, and Acquisition Plan (LRRDAP), but only 300 units are currently proposed for production. Consequently, significant Congressional support to produce larger quantities of AGS and EX 35 conflicts with the Army's need to prioritize budget-constrained programs. Hence, it is extremely important for Watervliet leadership to be well informed regarding changing priorities to avoid being caught in the middle of disputes between Congress, OSD, and HQDA. The Watervliet Commander and Civilian Executive Assistant (CEA), in particular, must complement and protect one another as they seek to maintain direct Congressional support while showing proper allegiance to Army/DOD policy.

Regarding fiscal realities, the decade of the eighties is over. No longer will producers be able to spread significant program overhead over a large number of production units, thus allowing for relatively low per unit costs. Low production rates, such as with the AGS, will result in extremely high per unit costs which may initially cause significant resistance in OSD and Congress. It will take time for decisionmakers to adjust to higher unit costs as lower acquisition rates become a reality.

We now turn to a discussion of how DOD (including OSD, OJCS, and the sister services) impacts upon the Watervliet environment.

Regarding the Army's sister services, WVA performs a limited amount of work for the Navy and Air Force. These interactions appear straightforward and cooperative with minimal political implications. The Air Force does not have an equivalent GOGO arsenal system, choosing instead to contract for heavy production capabilities in the COCO mode. The Air Force provides minimal demand for Watervliet services.

The Navy, on the other hand, does have a similar arsenal structure. There exists redundancy between WVA and the Naval Ordnance Station at Louisville. (Williams, 14 FEB 92) Additionally, WVA's Flexible Computer Integrated Manufacturing initiative dovetails with the Navy's long-standing RAMP (Rapid Acquisition of Manufactured Parts) program in the newly-formed Joint FCIM office. (A more complete discussion of FCIM follows in section III, Market Opportunities.)

In the future there will be DOD increased efforts to gain efficiencies from "jointness", such as the FCIM cooperation, and to eliminate redundancies within the services, such as the Watervliet and Louisville redundancies. It is not too far-fetched to suggest that these pressures to consolidate functions within DOD could lead to a "national arsenal system" in the next twenty years. Numerous consolidation precedents already exist as a result of the ongoing Defense Management Report (DMR) initiatives. For an analogous situation, consider the ongoing

depot maintenance consolidation decision in June 1990 (DMRD 908/908C) (credited in the President's FY 92/93 budget as saving \$3.9 billion over FY 1992-1995). (OASD(P&L), Defense Maintenance Consolidation Fact Sheet) Because of its unique capabilities and reputation for excellence, WVA should be a strong contender to be an arsenal consolidation focal point, but such down-select decisions will undoubtedly be determined in Congress, not in DOD.

Having considered the minimal political considerations posed by the Navy and Air Force, we now turn to consideration of the Office of the Secretary of Defense (OSD). The impacts upon Watervliet are again direct and indirect. Indirectly, the entire DOD and Army acquisition system determine acquisition procurement items and quantities which drive Watervliet's primary workload of cannon and artillery tubes. Some type of formal "producibility prove-out" procedures will undoubtedly become part of the new acquisition system proposed by the Deputy Secretary of Defense, Mr. Atwood, on 29 January 1992. Specifically, the proposed acquisition approach is as follows:

- o Greater emphasis upon Technology Base funding. Focus on technology demonstration, experimental prototypes, and manufacturing technology(MANTECH).
- o Limit the number of large development programs leading to costly new production starts.
- o Major emphasis upon procurement funding to support the insertion of new technology into existing platforms.
(Cheney)

This approach will force the DTIB to greatly reduced production levels which will undoubtedly force many civil sector companies

to divest defense production capabilities or go under entirely. Watervliet's possible responses to such an environment will be discussed in Modernization Challenges, Section III.

The branch of OSD which most directly affects WVA is the Deputy Assistant Secretary for Production Resources under the Assistant Secretary of Defense for Production and Logistics (ASD(P&L)). He, in turn, supervises Directors of Manufacturing Modernization and Production Base. These latter offices represent the focal points of OSD actions which would potentially impact upon WVA. For example, the Production Base Division has been responsible for staffing the proposal from AMCCOM to streamline commercial bidding procedures for Army arsenals. (DuBreuil)

Additional perspectives from the ASD(P&L) Production Base Division are useful:

- o Watervliet's future as the nation's uniquely qualified producer of thick-walled cannon is assured. The degree of required equipment layaway, however, will clearly depend upon the arsenal's workload requirements.
- o Any proactive OSD DTIB initiatives will be several years in coming. DTIB impacts are being studied at all levels in DOD and in Congress. The HASC has chartered two committees, Manufacturing and Industrial Base, to investigate DTIB impact of the defense drawdown and new acquisition approaches. Additionally, the FY91 Defense Authorization Act required OSD (ASD(P&L)) to produce a report assessing "...effects of defense budgets/plans on industry's ability to meet national security objectives." (ASD(P&L), ES-1) Findings from this optimistic report are shown in Chart 3. Chart 4 shows the many players who participate in the ASD(P&L) DIB working group.
- o The concept of reconstitution is still in its infancy. This new stem of our national defense strategy has, for the

first time, been included in the POM Preparation Instructions (PPI) as TAB H. TAB H states "The purpose of this tab is to consolidate information on this concept so the programmed implementation of the President's strategy can be reviewed next year." This means that dollars will not be programmed against reconstitution for two, possibly three years (two-year budget), or longer. Additionally, implementing top-driven mobilization plans, similar in nature to existing (and obsolete) plans, will not be available to WVA for years to come, if ever.

To summarize these comments, ASD(P&L)

- o agrees that WVA performs a unique function,
- o maintains that our country does not have extreme problems with the defense industrial base, and
- o concedes that mobilization planning and resourcing to replace extinct Cold War mobilization provisions will be a long time coming.

Although OSD(P&L) is the primary industrial base focal point, a number of other OSD Agencies and J5 and J8 in OJCS, have action officers working reconstitution and industrial base issues. OSD (Net Assessment) and OSD (Competitive Strategies) are conducting significant studies to determine the impact of the defense drawdown on the Defense Technology and Industrial Base (DTIB), including GOGO facilities. There is not a coordinating agent to synchronize these various OSD study efforts, however. In light of this lack of DOD reconstitution and DTIB policy guidance (in part understandable because of the rapidity of strategic change), the Military Departments have an even tougher time assessing potential impacts and establishing policy. We discuss the resultant political realities within the Army environment next.

Department of the Army (DA)

The Army environment is likewise characterized by the need for rapid transition to the new strategic environment. The Army Chief of Staff, General Gordon Sullivan, is committed to "breaking the mold that cast nearly every post-war Army in the shadow of defeat at the first battle of the next war." (Army Posture Statement, 7) The FY93 Army Posture Statement elaborates further, identifying four enabling strategies to meet future challenges:

- o Ensure a trained and ready Army--maintain the edge,
- o Reshape the force to best accommodate the National Military Strategy,
- o Achieve greater efficiencies in how we provide resources for the force, and
- o Strengthen the total force---Active and Reserve---Achieve Total Force readiness in word and fact.

Finally, the Army Posture Statement expands the "resourcing" enabling strategy with the following explanation:

To Provide Resources to the Force by improving the force structure to preserve readiness despite budget constraints, by making tough management decisions, and by becoming ever more efficient stewards of America's treasure. (9)

Note the key words: budget constraints, tough management decisions, and ever more efficient stewards. These words aptly describe the emerging Army environment in which WVA resides.

Regarding budget constraints and tough management decisions, Chart 5 illustrates Army resource challenges and the rapid

curtailment of Army modernization trends. Chart 6 shows the ensuing prioritization requirement caused by these severely constrained resources. (Adams, 38,39) Note that Procurement, Infrastructure/Facilities, Industrial Base (future capability and environmental clean-up) are listed "in jeopardy."

In order to squeeze every available drop out of limited dollars, the Army in the next decade will take stringent measures to achieve the efficiencies alluded to and will examine "overfacilitized capacities." The momentum to consolidate exists in the Army as well, with the Army Lab system consolidation being one of the early examples. Specifically, consolidation of arsenals is a current area of investigation with ASA(RDA) (Mr. Shelley) in the lead and DCSLOG supporting. This action is imbedded in a much larger beehive of analysis regarding DTIB preservation, revised acquisition strategies, reconstitution planning, mobilization planning, and overall force structuring which includes key players from ASA(RDA), DCSOPS, DCSLOG, DCSPER, and numerous supporting contractors.

One example of this flurry of analysis was the "Integrated Army Mobilization Study (IAMS)." This large and lengthy study effort, however, was unable to identify tangible policy recommendations as a result of its industrial analysis, illustrative of the complexity and rapidly changing nature of the DTIB (including GOGOs like WVA). Hence, the Army chose not to make any

"industrial base" related adjustments to the 1994 POM. (Wolfehrt) Clearly, Army leadership is concerned about gaining efficiencies and preserving industrial capabilities related to national security, but the current environment dictates that specific policy adjustments will be slow in coming.

WVA should not expect comprehensive mobilization or production guidance to flow from HQDA or OSD in the near future. WVA must, therefore, aggressively pursue its own future and continue to stress quality. The current POM Preparation Instructions direct the services to develop reconstitution issues for the next POM--scheduled for publication in three years. This period of uncertainty can be a stimulus to self-generated improvements and innovation by WVA.

Special Interest Groups/Think Tanks

Having discussed Congressional, OSD, and Department of the Army players, it is now appropriate to discuss a body of players which contributes to the policy process at all of these levels--the public policy think tanks, defense analysis contractors, and special interest groups. Although these types of organizations are distinctly different, some generalizations are useful. First of all, DTIB issues are being studied by virtually every beltway prognosticator. In some cases, these organizations will have a significant impact in the policy formulation process. An example is the Center for Strategic and International Studies (CSIS), a

public policy think tank. CSIS has formed a number of working groups of distinguished policy analysts to conduct a long-term analysis of the DTIB. These working groups possess bi-partisan Congressional representation with Senator Christopher Bond, R-MO, and Representative Dave McCurdy, D-OK, as co-chairmen. The CSIS "Defense Industrial Base Project" will culminate in a November 1992 conference in Washington, DC, to address the following:

- o strategic requirements on the base,
- o budget and force structure supporting the base,
- o sectoral structure comprising the base (to include GOGOs such as WVA), and
- o policy and investment recommendations.

Although the real legislative impact of this analysis will not be realized for over a year, this longer term approach will still fit well with the next DOD POM cycle. The strength of this approach, unique in its magnitude and Congressional involvement, is its potential for rapid legislative implementation.

(Blackwell)

Defense analysis contractors represent a second body of players who affect the policy formulation process. Vector Research Incorporated (VRI) is an example, performing supporting contract work for DCSOPS and others. VRI, under Dr. Peter Cherry's project leadership, is seeking to determine the impact of Army policy decisions upon the DTIB. (Cherry)

Finally, a number of defense-related special interest groups affect the policy formulation process. For example, the Association of the United States Army (AUSA), the Air Force Association (AFA), and the American Defense Preparedness Association (ADPA) have standing committees which perform significant recurring analysis of the DTIB. Overall, public policy think tanks, defense analysis contractors, and special interest associations play a key role in the Washington policy formulation process. The credibility, political tendencies, and focus of these organizations vary widely, but their input is usually valuable and their influence is widespread.

Army Materiel Command(AMC)

Army Materiel Command (AMC) is the Army Major Command (MACOM) responsible for industrial base planning and supervision. AMC unilateral efforts to establish an industrial base strategy for the Army have been thwarted for several years. Significantly, recent progress has been the result of the combined efforts of AMC, ASA(RDA), and the Association of the United States Army (AUSA). Mr. Jack Millett, Acting Director of AMC's Integration and Analysis Division, provided the following summary:

- o The series of AMC Industrial Base Whitepapers represent a continual refinement of AMC industrial base recommendations. The three key areas of focus are product and process technology, manufacturing infrastructure, and management paradigm shifts (to include dual-use capabilities). The latest version, dated 18 February 1992, was distributed to Army and industry leaders at the AUSA Industrial Base Symposium in Orlando, Florida.

- o The overarching AMC requirements, as enumerated by the Deputy AMC Commander in "The Acquisition Challenge," are four-fold:

- o Manage the required downsizing,
 - o Integrate the three areas of focus,
 - o Protect certain critical industrial base elements,
 - o Overcome barriers to defense sector business.

- o ASA(RDA) and AMC are currently integrating their "Modernization White Paper" and "Industrial Base White Paper", respectively. This coordinated effort will be available for the next AUSA Symposium at the Army War College in May 1992. Subsequent briefings of the industrial base strategy will culminate in a Secretary of the Army decision brief, currently proposed for late May 1992.

The developments cited above are positive. The manner in which the strategy will be implemented in the Army POM remains to be seen. For instance, the funding of surge and mobilization capabilities will be subject to competition with other equally pressing issues, such as force readiness. Whatever the result, WVA will be affected by the final industrial base strategy.

A second AMC function impacting upon WVA is coordination of foreign military sales and direct transfer programs with foreign nations. Specifics are discussed further in the Market Opportunities, section III.

To wrap up discussion of AMC, the plan to activate the Industrial Operations Command (IOC) in October 1993 is a significant reorganizational effort, designed to unify the Army's GOGO and GOCO industrial base under single management. The current Armament, Munitions, and Chemical Command (AMCCOM) and the Depot System Command (DESCOM) will cease to exist, to be replaced by

the Industrial Operations Command (IOC) (based at Rock Island, IL) and the Missile, Armaments and Chemical Command (MACCOM) (based at Huntsville, AL.). (Salvo, p.6)

The formation of IOC will not directly affect WVA, but the indirect impacts will be significant. First of all, tremendous AMC organizational energy will be required to execute this change; thus, degrading normal working relationships with industrial base contacts. Hence, WVA must closely monitor changing procedures and responsible agents to insure proper coordination of production activities. In fact, WVA should establish an IOC liaison office and closely monitor the changes.

Secondly, the composition of IOC runs somewhat counter to the ongoing implementation throughout industry of concurrent engineering techniques. Although still possible, concurrent engineering will be degraded with product designers and engineers working in MACCOM and manufacturers (WVA included) working in IOC. Concurrent engineering will not happen automatically; WVA will have to press even harder on this in the new command structure.

The purpose of this discussion is not to critique the IOC decision, but it is appropriate for WVA to be sensitive to the challenges it presents. IOC is being formed during a time of great flux in the entire Army and DOD. Other reorganization and

consolidation efforts may supercede IOC before it is fully in place, or worse yet, soon after it has been put in place.

Additionally, fiscal constraints may mandate fewer major shifts of workers and capabilities than AMC currently envisions.

Overall, this organizational change will have been worthwhile if it preserves necessary capabilities, gains efficiencies through consolidation, and creates a significantly greater unity of effort within the Army industrial base. If these criteria are not met, considerable time, energy, and resources will have been needlessly diverted.

We now turn to AMCCOM, WVA's current next higher headquarters.

U.S. Army Armaments, Munitions, and Chemical Command (AMCCOM)

AMCCOM's primary mission, production and support of weapons systems and ammunition required by field users, is conducted both "in house" and in the private sector. Integral to this mission is the entire development, production, fielding, and support of a system. The M198 Howitzer is an example. Maintenance of the broad industrial base required to support the Army (and other assigned customers) in the event of a mobilization is a key AMCCOM responsibility. (AMCCOM Command Brief)

A number of subordinate AMCCOM commands complement the cannon-producing role of WVA. The Armament Research, Development and Engineering Center (ARDEC) located at Picatinny Arsenal, NJ,

performs research, development, and engineering on direct fire close combat systems and on indirect fire support systems. This includes development of precision and smart munitions. Of particular note to WVA, ARDEC is involved in liquid propellant and electromagnetic gun technology (see Modernization Challenges, Section III). In short, ARDEC is the primary design center which provides manufacturing specifications to WVA. ARDEC will be moved under MACCOM in the upcoming IOC realignment. As emphasized earlier, it is critical for WVA to continue to work closely with ARDEC to achieve the payoffs of concurrent engineering.

The other AMCCOM subordinate which directly complements WVA's mission is Rock Island Arsenal (RIA). Billed as the "largest manufacturing arsenal" in the free world, RIA produces recoil mechanisms and gun mounts for most of the U.S. howitzers and tanks now in the field. It also performs the carriage manufacture and assembly of the M119 and M198 howitzers.

Thus, the production of a M198 howitzer requires the combined efforts of ARDEC, RIA, WVA, and the supporting efforts of a multitude of sub-tier producers and suppliers. Regarding maintenance of such industrial base capability, ARDEC and WVA appear most unique in their missions and most diversified (among Army GOGOs) in peacetime product markets. This will help

considerably in maintaining critical skills necessary for potential surge and mobilization requirements.

RIA, on the other hand, appears more vulnerable to impacts of the defense drawdown. It is an example of the "overcapacitation-of-facilities" issue currently under study by a HQDA general officer steering group (formed as a result of the IAMS study). (Bregard) Should RIA operations be partially or fully curtailed in the next decade, WVA may be required to assume additional manufacturing responsibilities from RIA to insure critical capabilities remain a part of the GOGO base. Although not politically pleasant to address, WVA planners should assess their capability to pick up missions from other AMCCOM facilities, such as RIA, which may not survive drawdown and consolidation pressures over the next 20 years.

In an effort to maintain critical manufacturing skills for future years, AMCCOM has directed the arsenals to be "self-supporting" by seeking alternative markets. This will be addressed in Section III, Market Opportunities, following summarization of this section regarding the political realities which surround WVA.

In summary, WVA operates within a complex environment, made even more complex by the unprecedented pace and extent of change internal and external to the Army. The perspectives of the

players and organizations in this environment are varied and often conflicting. Operation across the inevitable seams between these major players and organizations is a difficult challenge for all concerned. Chart 7 summarizes key political realities for WVA strategic planners to consider as they look into the 21st Century.

We now look at projected WVA markets.

MARKET OPPORTUNITIES

A complete discussion of the environment in which Watervliet Arsenal must function requires a detailed look at markets.

Watervliet Arsenal is concerned with three markets. They are:

- o The traditional market within the US Army and Department of Defense. This market involves producing mortars and cannon to be fitted on ground and naval weapon systems.
- o A supplemental market within the Department of Defense. This involves the production of spare parts and other components which are producible at Watervliet Arsenal.
- o A potential market for commercially useful items.

The arsenal has not fully developed this market.

At this point we will expand on each of these markets by addressing the viability and the current health of each. First let us consider the traditional market--cannon and mortars.

As we discussed earlier, the traditional market is the staple--the reason for Watervliet's existence. During periods of rapid military growth, this market booms. When there is no growth this market languishes. The US is now coming down from a period characterized by high defense budgets. Chart 8 shows the relative significance of the so-called "Reagan Buildup." Labeled as "Build up", this period was indeed a time for massive spending

on new systems . Watervliet Arsenal--just like the other defense producers--has flourished in this sort of environment. Chart 8, showing the total Army procurement, also indicates the "Bow wave" of the 1980's is over. What exactly does the end of this spending mean for Watervliet Arsenal's market?

The impact is significant. A more detailed look at the market reveals that there are two significant types of weapon systems that drive the workload of the arsenal. These systems are the tank and all artillery weapons. The Army procures these weapon systems from an appropriations category known as Weapons and Tracked Combat Vehicles (WTCV). Chart 9 shows that, like Army procurement in general, WTCV is going down at a steep rate. Chart 9 also indicates that, compared to other categories of weapons, the rate of change for combat vehicles is much greater. Combat vehicles carry weapons made by Watervliet Arsenal. Why is this category of weapons--so important to Watervliet Arsenal--decreasing at such a rapid rate?

Tank Gun Projections

The answer lies in a review of the tank which provides, by far, the biggest portion of the work for the arsenal. During the period 1986 through 1989, for example, the Army budgeted for a total of 2,724 tanks. (DA FY 88-89, 27) By 1991 there were over 7,000 M1-series tanks in the US Army inventory. This is a much higher density of equipment than the M109 howitzer which is the

most common howitzer in the US Army. Thus, during the rapid build-up period of the 1980's, the tank was the driver. The M1-series tank production, however, ends in 1995. This includes the end of the M1A2 version of the Abrams series tank.

Where is tank production--Watervliet Arsenal's major production item--headed in the future? Will a new tank or massive modification fill the void left by the decline of the Abrams series? The answer appears to be no. Elements in the Department of the Army have attempted to create some demand for the tank production line and the multitude of suppliers who support the production. Both proposals have failed to win approval within the Department of Defense. The first proposal involved the follow on system to the Abrams series tank--known as the Block III.

The Army planned to begin producing the Block III tank in 2003. This tank would incorporate current weapons technology. The Block III was to be part of a larger family of vehicles sharing common components for a variety of tracked weapon systems ranging from a tank variant to an air defense system. During the President's Budget development process of winter '91-92, the family of armored vehicles--Armored Systems Modernization--lost support. The Block III tank is no longer planned for production. A second proposal for tank production involved modernizing the fielded Abrams series tank. The significant upgrade included the

addition of 120mm cannon for each tank. This upgrade would begin in 1994 and extend until 2003; thus, it would span the period from the end of production of the planned tanks--1995--until the beginning of the Block III modernization in 2003. This proposal had as a major selling point the industrial base benefits. Since it involved over 2,000 tanks, it would not only provide work for Watervliet Arsenal but also for many of the agencies that support tank production such as the General Dynamics Land System plant run for the Army in Detroit, Michigan. This proposal, however, was considered unaffordable and never developed support within the Department of Defense. The end result of the failure of these two proposals for stretching tank production is that after 1995 Watervliet Arsenal will have no production for tank cannons. Thus, the major production item in the DOD market is lost after 1995.

Artillery Tube Projections

The outlook for the second production driver--artillery weapons--is more favorable. Currently the two artillery systems that promise to provide workload for the arsenal are the Paladin and Advanced Field Artillery System. Each represents a requirement of 824 systems. Paladin is a modification program which puts a new cannon on the existing M109 chassis. (There are many additional improvements that give the Paladin significant capabilities beyond the current M109.) Advanced Field Artillery System (AFAS) appears to enjoy a high priority. The future for

these systems represents a total requirement of 1,648 tubes with 824 cannons scheduled for Paladin followed by an additional 824 tube production of AFAS beginning around 2000.

In summary, the market for the traditional products of the arsenal will hinge on production of artillery tubes in the near term. At present there is no forecast for a new cannon demand to replace the production of tank tubes. Overall this market diminishes since the requirement for the artillery is the smallest of the two traditional products--tank cannon and artillery cannon.

Supplemental Markets

In addition to the production of cannons--which we have termed the traditional market--Watervliet either produces or has the potential to produce products for other customers. We will address two of these additional or supplemental markets. They are:

- o Foreign markets for cannon,
- o and, spares or parts production for DOD.

Many publications, including the Congressional publication Redesigning Defense, have suggested that the increased sales to foreign customers is a useful strategy for maintaining industrial base vitality. In fact, Watervliet Arsenal has followed such a policy for some time. Chart 10 shows the

breakdown of work at the arsenal during a recent year. Sales to foreign consumers make up about a quarter of the total workload. The facts, however, seem to indicate that the opportunities to expand this segment of the market are limited.

In an interview with Mr. Doug Leach of the US Army Security Assistance Command, we discovered that, contrary to what the popular press has indicated, there has not been a significant increase in the orders for US cannon products. An impending sale of a large quantity of howitzers to Switzerland is the only significant increase in Watervliet Arsenal products on the horizon. This particular sale is far from an established fact. Why are the foreign sales not increasing work for the industrial base?

There appear to be several reasons. The most pertinent are:

- o Much of the rest of the world is also suffering through an economic slow down. There is simply not enough capital to spend on upgrading or adding to national arms.
- o There is a glut of equipment on the market. This glut has been created by the former Warsaw Pact nations who have a bountiful supply of military equipment and growing need for hard currency. There are bargains on the market. US equipment, on the other hand, is relatively expensive--quality notwithstanding.

o Finally, there are so many regulatory and oversight requirements to accomplish a single sale that much business is lost. Potential customers are forced to use a more streamlined seller.

All these factors lead to the conclusion that foreign markets will not offer a major new growing market for Watervliet products. Status quo seems to be the most likely situation.

If foreign sales appear to offer little growth potential, the opposite is true of parts production. This potential market has vast possibilities for Watervliet Arsenal. Technology offers a new way of filling parts requirements called Flexible Computer Integrated Manufacturing (FCIM). Under this system, computers linked to machines make spare parts for the Department of Defense. A joint committee will select two centers for each service to be the FCIM producers. A review of the procedures in place at Naval Ordnance Station, Louisville can provide an idea of the market possibilities for Watervliet Arsenal. Under the capstone program called Rapid Acquisition of Manufactured Parts (RAMP), Louisville has positioned itself to take best advantage of the FCIM idea. The Naval Ordnance Station actively seeks out markets that require long lead time, hard to procure parts. These markets are especially lucrative for government-owned facilities since the whole question of competition becomes moot. Most private producers are not interested in manufacturing these

items because the profits are not available. Louisville, however, can produce the parts because it has a reduced overhead due primarily to two factors--old capital machinery and low labor costs. Many of the machines still in use at Louisville are World War II vintage and have been depreciated. The local area is a low cost area that is being tapped by other firms such as Toyota. From these basic tenets of low cost and a specialized niche, Louisville has created a strategy that seeks to maximize these advantages.

Some of the elements that spring directly from this concept of a parts producer are:

- o Louisville has established an automated cataloging system for parts technical data. This system--a model for the Department of Defense--allows the user to locate the repository of many Navy technical parts descriptions. This is important since the manufacturing of parts through the FCIM design requires a detailed specification of the desired part. If a computer can read the technical specification, it can convert the data to numerical controls needed by the actual manufacturing machine. The process is complicated and requires skilled operators to facilitate the production.

- o As an adjunct to the cataloging system, Louisville is now developing its own repository for technical data packages. Thus, in the future the Naval Ordnance Station will be able to service a customer by identifying the required part and retrieving it from a repository at Louisville. The bottom line is a rapid response to a customer's need. But what if a technical data package does not exist? Louisville has that eventuality covered also.

- o When the data is not available, someone must reverse engineer the part. Normally this is a labor intensive job requiring multiple caliper measurements. Louisville, however, has purchased a machine that uses lasers driven by a computer to rapidly measure the dimensions of a required part. This device develops a set of technical data to allow the manufacturing machine to build the part without going to a repository to find the original specifications.

Thus, Louisville has stretched its market by seeking a specific niche which drives the type of machinery it buys and type of customer it seeks. This approach, though not entirely applicable to WVA, offers an example of what focused effort can achieve.

The third market is the commercial market. The possibilities seem enormous; the hurdles are just as large. Although the US Congress gave Watervliet legislative authority to perform commercial jobs, the work is slow in coming.

In recent times WVA has enjoyed Congressional support from the local representatives. Both Representative McNulty and Representative Stratton before him have initiated legislation to protect the interests of WVA. In the 1980's, Representative Stratton successfully sponsored an amendment to the Defense Authorization Act which precluded transfer of WVA's special capabilities overseas.

As it became obvious that WVA could prosper by working in co-production--especially with Egypt--Representative McNulty modified the law. The new legislation enhanced WVA's ability to compete internationally. Most recently Representative McNulty has again pushed through a law that will assist WVA in expansion to other markets. The latest legislation authorized WVA to bid on commercial work under certain conditions. Although Congress has passed the law, the executive agencies--DOD and Department of

the Army--have not developed implementing instructions. When these instructions are published, the commercial world will open to WVA.

The pressure to go commercial is one of survival. In this period of a shrinking military budget, many agencies are seeking ways to maintain their share of the money. The discussion of Naval Ordnance Station Louisville showed an organization seeking a niche in the Department of Defense parts business. Anniston Army Depot is exploring the possibility of using its excess capacity for commercial overhaul work. Converting military arsenal\depot capacity to commercial work offers the chance to supplement the decreasing workload. Will it work?

There are two problems with the conversion of excess Department of Defense capacity to commercial:

- o The first is a government facility is not organized to market its products. There is no expertise in the organization to seek work, position the organization in a particular market, or make business decisions benefiting the commercial work.
- o A government agency is bound not only by law but also by the rules of the Department of Defense. Although Watervliet has Congressional authority to engage in commercial business, Department of Defense has not produced the implementing instructions. The competitive edge for any

government arsenal/depot will be dulled by the rules established within the bureaucracy.

Watervliet Arsenal has established a market with General Electric to produce turbine shafts. This arrangement promises to offer work in the \$6,000 to \$10,000 range per shaft. The actual quantity of shafts demanded is unknown. Both the proximity to the GE plant and the ability to produce on a 30 day cycle make Watervliet Arsenal an attractive supplier for GE. As of this report the arsenal has supplied no shafts because the guidance from above is not available. At best, however, this work will not replace the loss of cannon and mortars. Watervliet Arsenal must find other markets for commercial production to be a significant piece of its workload.

Chart 11 summarizes observations and recommendations regarding WVA's Market Opportunities.

MODERNIZATION CHALLENGES

The past decade has been a good one for WVA. WVA continued to refine state-of-the-art thick-walled cannon production techniques and invested heavily, through REARM funding, in computer integrated manufacturing and other facilities upgrades. This modernization and innovation mentality must continue into the 21st Century. The challenges of modernization over the next thirty years will be significant, but modernization is imperative. With smaller active force levels and a greatly reduced defense industrial base, our country will have to accept greater risk against the possibility of a major conflict requiring surge or mobilization levels of production. Hence, arsenal repositories of unique, defense-critical expertise become even more important. For this arsenal's expertise to be useful, it must be focused upon pertinent weapons technologies and it must involve modern production techniques which insure first-time quality and rapidly expandable production capabilities. In fact, Lifeline Adrift cites these same two areas as key to the national debate over the defense industrial base.

The high-visibility federal effort on the defense industrial base has gravitated to two broad initiatives, both of which are getting a big push from Congress:

- o An effort to identify critical technologies and to promote US growth in those areas.
- o A concept that goes by "flexible manufacturing" and other names. (AFA, 18)

After a look at emerging doctrinal concepts, this Modernization discussion will focus upon critical weapon technologies and flexible manufacturing.

Emerging Doctrinal Concepts

Clearly this is a time of doctrinal introspection in our armed forces. Airland Battle doctrine served us well in Operation Desert Storm, but changing world conditions require an expansion of current doctrinal thinking. On 1 August 1991 the Army Training and Doctrine Command (TRADOC) published Airland Operations- the framework for our next generation of doctrine. Key facets of this new doctrine, summarized in a 6 January 1992 Army Times article, are as follows:

- o the Army will be required to operate over a wider operational continuum in the future,
- o operations abroad will include "peacetime engagement,"
- o Airland Battle principles will be retained, but adapted to new threat environments;
- o Airland Operations treats the entire Army as a contingency force (hence, far greater emphasis upon strategic mobility and deployability of weapons systems), and
- o even greater reliance on emerging technologies such as stealth, precision munitions, and night vision.

"ARMY 21" planners at TRADOC HQ (MAJ Bowden) and ODCSOPS Long Range Planning (COL Fess) confirm that Airland Operations broadens Airland Battle, but will not mandate any major force design changes or require radically different technological pursuits.

In considering emerging doctrinal concepts, strategic forecasters must achieve a long-term perspective which generates useful visions of the future. Studies performed by RAND and the Institute for Strategic Studies (INSS) are relevant to our discussion. RAND Corporation utilizes "assumption based planning" as a means to generate alternative futures. The process identifies "sign posts" along the way which represent the opportunity to shape the future to more desirable outcomes. For example, RAND provided the following technological sign posts to help TRADOC think through a vision of the future (30 years out):

- o Have robotic systems been fielded that generally replace soldiers for many dangerous battlefield applications?
- o Have there been substantial technology breakthroughs in firepower, mobility, and C3I?
- o Have there been any technological advances that changed the nature of warfare?
 - o Tanks that produce their own "munitions" (therefore sustainability is not an issue),
 - o Hand-held effective antiarmor weapons,
 - o Autonomous robotic people killers, etc.?
- o Is it true that technology has reached the stage that if you are seen on the battlefield you are dead, and it is highly likely that you will be seen?
- o Has technology significantly changed the nature of conventional warfare (e.g.- reliance on unmanned ground combat equipment or SDI)?
- o Has the role of land combatants been made obsolete by technological advances in weapons?
- o Have there been any significant technical breakthroughs in ground warfare? (Dewar, 22)

More specific visions of future warfighting environments which have considerable credibility within DOD is the classified

Project 2025, chartered by the Vice Chairman, OJCS, and the futures research being conducted at the Institute for National Strategic Studies (INSS), National Defense University. Martin Lubicki provided this short summary of the INSS work:

- o for the next 20 years, "pop-up warfare" will be characterized by a refinement of existing sensor systems coupled with ever precise and lethal munitions. In short, "nails that stick out will get hammered down." Although technological "silver bullets" may be developed, they will not be integrated into revolutionary warfighting concepts.

- o in the 20-50 year timeframe, "fire ant warfare" envisions complex, distributed networks of "small" items, microbots and mini-projectiles. Man is generally a detached observer and familiar weapons systems such as the tank become largely obsolete because of vulnerability. Tubelike dispersing systems, possibly able to self-bury or self-hide, will still be required.

- o in the 50-100 year range, a "convergence of mechanical, electrical, and biological" mechanisms, applied with unprecedented efficiencies.

This view of the future, coupled with the nearer-term implications of Airland Operations, have considerable implications for WVA's future products (weapon technologies) and production capabilities. We turn to these subjects next in our discussion of WVA modernization challenges.

Critical Weapon Technologies

On 2 August 1990, the day Iraq invaded Kuwait, President George Bush said the following:

Time and again, we have seen technology revolutionize the battlefield. The US has always relied upon its technological edge to offset the need to match potential adversaries' strength in numbers. (Defense, 21)

The quest for technological advance in weapon systems is as important as ever. We now discuss two areas of critical technology which will directly affect WVA's future: Propulsion Technology and Composite Materials.

Propulsion Technology is a subset of the "Hypervelocity Projectiles and Propulsion" critical technology identified in the Defense Critical Technologies Plan (DCTP) of 1991. Specifically, the projectile propulsion R&D objective is as follows:

Develop electric gun and rocket technologies necessary to propel the required projectile masses to the velocities required for specific tactical and strategic weapon applications. Specific areas to be addressed include barrels, armatures, and plasma cartridges for electric guns and propellants for rockets. (DCTP, 16-3)

The authors strongly recommend further reference to Annex B, Section 16 (Hypervelocity Projectiles and Propulsion), DCTP, for an in-depth unclassified discussion of technologies, programs, milestones, projected funding (through FY97), industrial base capabilities, related R&D in the US, international assessments, and exchange agreements. The authors also note that the DCTP was:

...the product of a lengthy coordination process involving the combined efforts of the Military Services, Defense Agencies, the Office of the Secretary of Defense, the Department of Energy, and three National Laboratories to assess and identify those technologies seen as critical to the 'long term qualitative superiority of US weapons systems,' and to set forth plans for their timely development. Valuable inputs and comments were received from the Defense Science Board, the National Science Foundation, the National Aeronautics and Space Administration, and the National Institute of Standards and

Technology. . . (and the) detailed and careful review by three industry associations, the Aerospace Industries Association, the Electronic Industries Association, and the National Security Industry Association. (DCTP, B-1)

In short, the DCTP is an authoritative and comprehensive document; it is the most useful single source of forecast data currently available.

Regarding promising propulsion technologies, electro-thermal (ET) or electro-magnetic (EM) gun technologies are expected to replace conventional solid or liquid propulsion technologies. ET technology, which converts electrical energy into projectile kinetic energy via a working fluid, would likely employ existing cannons. The difficulty with ET technology, according to the Jet Propulsion Laboratory (JPL), is that "...the extra conversion step required of ET guns, from electrical to mechanical energy, makes the technology fundamentally less efficient than EM guns." (Kelly, D-3294) Mr. Larry Johnson, Director of Benet Labs, agrees with this assessment, maintaining that ET technology is not a sufficient leap to warrant production in such an austere budget environment. Hence, we predict that ET technology will not be carried beyond prototype into production. If ET technology is actually produced, WVA's role will be minimal.

EM technology, on the other hand, appears to have more long-term promise. Although not expected to be available in a deployed weapon system until 2007 (DCTP 16-5), EM guns would provide the following advantages (RAND R-3837, 32):

- o Increased Lethality
- o Higher rate of fire
- o Reduced logistics need
- o Better platform integration
- o Increased range
- o Improved accuracy
- o Improved survivability

This same RAND study, conducted for the Defense Advanced Research Projects Agency (DARPA) in 1991, maintains that, despite EM benefits, it is currently not a serious contender because of power supply problems. Essentially, current power generation technologies would require a large gas turbine generating 8000 hp to allow a six shot per minute duty cycle. Such a large turbine would exceed feasible weight and volume (survivability) limits. EM remains a strong long-term contender, however, assuming that SDI spinoff technologies and other power generation advances will provide a reasonable power supply. The DCTP projects that this will occur by 2006. See DCTP, B-15 (Pulsed Power) for an in-depth discussion of the status of this critical technology.

If EM guns are developed and eventually produced, the impact on WVA will be significant. Either WVA will adapt to the new product line, or WVA will lose their unique niche in cannon production. The EM Gun Barrel Technology/Development program addresses issues such as railgun: barrel strength, stiffness, lifetime, multi-shot, composites, and cooling. Current (forging, heat and chemical treatments, and plating) and potential (composites, power generation, and advanced metallurgy)

manufacturing processes at WVA could definitely play an integral role in production of EM guns.

WVA must work closely with Benet Labs and Picatinny Arsenal to contribute its capabilities to the development of EM guns. If WVA is to maintain its uniqueness in the 21st Century, it must develop production processes compatible with upcoming generations of cannon products. Aggressive involvement in current EM gun prototyping will foster future production possibilities.

Before departing Propulsion Technology, a mention of the near-term implementation of liquid propellant (LP) technology in cannons is necessary.

The Army is developing LP guns for antitank use, with funding provided as part of the Balanced Technology Initiative (BTI). Two industrial teams, one led by Royal Ordnance and the other by General Motors, recently completed an integration study as part of the development effort. Both contractors concluded that main battle tanks with LP guns possessed several significant advantages over tanks with solid propellant guns. (RAND R-3837, 31)

Although a promising technology for near-term gains in lethality, LP will likewise fall subject to austere budgets and lack of a driving threat requirement. Implementation will only take a technology insertion role; WVA will not receive new cannon production requirements from this technology.

Composite Materials Technology is the second critical defense technology which has direct application to WVA. There is increased pressure to make weapon systems lighter and smaller

because of the strategic mobility requirement inherent in our national defense strategy. According to the DCTP, B-18 (Composite Materials),

...the creation of new structural materials is revolutionizing the development of vehicles, buildings, systems and components, and structures around the world. Composite materials technology also promises significant improvement for weapons performance, design, and affordability. (DCTP, 18-1)

The DCTP further indicates that by 2006 there will be "...widespread use of advanced composite materials in US weapon systems and platforms." (DCTP, 18-7) Indicative of an on-shore production capability shortfall, "...one area of concern is US industry's reliance on foreign sources for computer-controlled hot rolling mills, hot isostatic presses, and specialized heat treating furnaces." (DCTP, 18-3) In response to this need, WVA's heat treatment and rotary processing capabilities may be adaptable to certain areas of composite manufacturing.

When asked what technologies WVA should pursue in future years, Mr. Walt Hollis, Deputy Undersecretary of the Army for Operations Research, replied, "EM propulsion and composites." At the risk of being dramatic, WVA's ability to shift to manufacturing techniques applying to the future material of choice, composites, will be key to its long-term viability as an arsenal.

We now address the other category of Modernization Challenge: Flexible Manufacturing.

Flexible Manufacturing

WVA must also modernize its production capabilities if it is to maintain its unique role as a defense manufacturing facility. Although many acronyms are used to describe modern production techniques, "Flexible Manufacturing" is the term selected by the DCTP as a critical defense technology. The report provides the following definition:

Flexible Manufacturing is the integration of the total production enterprise through the flexible use of shop equipment, sensors, information and systems technology, and data communications coupled with new managerial philosophies that improve organizational and personal efficiency. (DCTP, 21-1)

The report continues,

The implementation of flexible manufacturing technology offers strong potential to revolutionize the factory environment to meet the challenges of today- the need to improve productivity, time to market, product quality and reliability, as well as to reduce costs. (DCTP, 21-1)

Overall, WVA has been very aggressive in embracing flexible manufacturing techniques. WVA has made significant investments of money (through Project REARM) and management effort devoted to this critical production technology. The Market Opportunities section of this report addresses WVA's FCIM efforts to date and highlights the Naval Ordnance Station at Louisville as an example of aggressive FCIM marketing. The remaining challenge for WVA is achieving a total integration of flexible manufacturing capabilities. Areas needing continued focus include

- o product data definition for automated manufacturing,
- o CAD/CAM/CAE/CAPP integration,
- o databases and database management,

- o communications and networking, and
- o intelligent software interfaces.

For instance, the WVA FCIM "robots" still have software difficulties which preclude their intended complete integration into the production environment.

Assuming WVA continues their aggressive approach towards implementation of flexible manufacturing techniques, WVA will remain the Army's leader in this critical technology. The Army and DOD will place the nation at great risk if production capabilities are not modernized commensurate with evolving product technologies. This will require resource commitments. WVA and the new Industrial Operations Command must clearly articulate the requirement for such modernization.

Chart 12 summarizes observations and recommendations regarding WVA's Modernization Challenges.

CONCLUSIONS

WVA suffers from the same problems facing many elements of the defense industrial base. It has excess capacity grown during an era when the Soviet Union presented a real, believable threat. That Soviet threat has evaporated. What now should WVA--as well as other elements of the industrial base--do to accommodate the unused capacity?

In dealing with the excess capacity, WVA (like other organizations in the defense industrial base) has broken the issue into three elements. They are:

- o viability--remaining unique,
- o employees--retaining critical skills,
- o production capability--shifting to new products.

In this paper we have begun a process that will result in a strategy for WVA that addresses these elements. In the end, however, the leaders of WVA must develop the strategy--make the decisions that project the organization into the future.

In this paper we have suggested that the leaders develop a strategy in four steps. We have completed three steps and leave the final step--the actual decision on the strategic direction--to the leaders of WVA. Our findings from the initial three steps are:

o History and Present Strategy. Watervliet is a cannon maker. The employees, organization, and pride are wrapped around the unique ability to produce cannons. As the strategists prepare a new strategy, the central focus should continue to be this strength.

o Environmental Analysis. Much has changed in WVA's environment. Defense budgets are shrinking. Systems traditionally providing workload for WVA are no longer a priority in the Army. The size of military force structure is decreasing. All these factors work against WVA; there are, however, positive elements. WVA is a unique manufacturing installation that has no domestic rival (and few international competitors). Politically WVA enjoys Congressional support from the local Representative and the New York Senators. Within the Department of Defense, WVA is recognized as a facility that must remain intact and viable as an active portion of the industrial base. In summary, the environment has changed and a new strategy is needed but there are many strengths that WVA can cling to as the leaders find a new direction.

o Capabilities Analysis. Looking inward, there are many positive factors that bode well for WVA. No other organization--private or governmental--possesses the capability of WVA. This capability includes a modernized

facility that can perform cannon making processes like no other facility. WVA includes a trained workforce. WVA has upgraded its capability to include the latest computer aided machines. Like many government-owned facilities, WVA lacks the commercial marketing experience and organization which could facilitate movement into commercial production. In general, however, the capability to move into other DOD markets or commercial applications is good.

The leaders of WVA must use the results of the above three steps to arrive at a new strategy. The goal is to realign the arsenal by building on the strengths identified in the first step of the analysis. This realignment addresses the environment to read the handwriting on the wall--a forecast of the future. (In Appendix 1 we quantify the forecast using the best projections for system quantities available. We link these quantities to the key events we see in WVA's future.) The strategy seeks to use the current strengths to take advantage of the opportunities offered by the environment or to find new strengths within the capabilities of the arsenal. In either case the leaders must find a strategy that avoids the pitfalls and maximizes the advantages. A sound strategy is the best vehicle to insure that Watervliet continues to produce "a quality product at the right price, on time, safely."

APPENDIX

WVA STRATEGIC FORECAST: QUANTITATIVE ASSESSMENT

The Section III Modernization discussion referred to a RAND "sign-post" methodology for determining future options. We have adapted this approach to assessing feasible and probable solution sets for WVA's future. The choice of the signpost events are the result of research, personal interviews, and visits to numerous armaments industry production facilities. As is typical, the data associated with the near-term events is more reliable. Far-term estimates are far more subjective, representing a collective "gut feel." The attached charts show

- | | |
|--|---------|
| o strategic sign-posts, | Chart A |
| o likelihood and quantity assessments, and | Chart B |
| o assumptions. | Chart C |

Finally, a caution regarding quantitative strategic assessments. Mr. Robert Gates, Director of Central Intelligence, stated the following:

The point is that we see a world of more, not fewer, mysteries. It seems imperative to change our approach to doing intelligence estimates by building in our judgements alternative possibilities--what if we're wrong. We must help the policy makers think through the problems, in addition to supplying our best judgement. (Gates, 61)

Thus, WVA strategic planners must avoid the danger of "point estimates" and must use the quantitative assessments judiciously. The numerical estimates will change rapidly, particularly in the current environment of constant flux.

Disciplined strategic thinking, made better by the occasional rigor of quantification, will place and keep WVA on solid ground in the 21st Century.

WVA STRATEGIC SIGN-POSTS

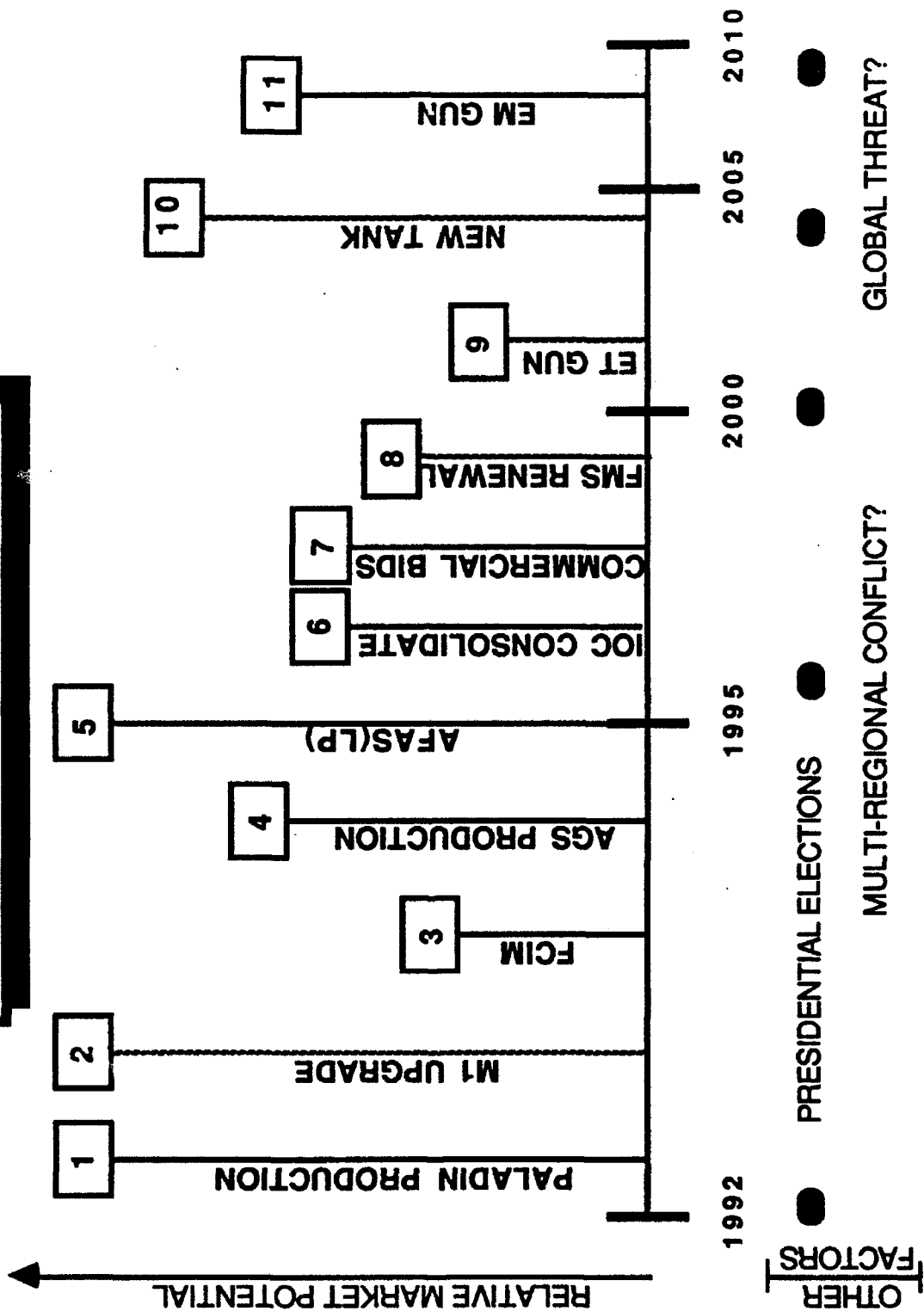


CHART A

WVA STRATEGIC ASSUMPTIONS/DATA

SEE CHART C FOR
ADDITIONAL ASSUMPTIONS
AND EXPLANATIONS

1

PALADIN PRODUCTION(1992)

P(OCCUR) = HIGH # = 824

CMTS: CURRENTLY IN PRODUCTION
PROGRAM SECURE

5

AFAS(LP) (1996)

P(OCCUR) = HIGH # = 824

CMTS: ASSUMES NEW TUBES REQ'D
HIGH PRIORITY IN ARMY LRRDAP
POSSIBLE PROTOTYPE STRATEGY
CANDIDATE/LIMITED PRODUCTION

2

M1 UPGRADE (1993,1994)

P(OCCUR) = LOW # = 3000

CMTS: DOD DOES NOT SUPPORT
CONGRESSIONAL PRESSURE MAY BUILD

6

IOC CONSOLIDATION(1997)

P(OCCUR) = MOD # = 40 MAN YRS

CMTS: DOD PRESSURES TO CONSOLIDATE
BUDGET REALITIES WILL LEAD TO
SHRINKAGE OF ARSENAL/DEPOT BASE
WVA WILL PICK UP ADD'L MISSIONS

3

FCIM (1994+)

P(OCCUR) = MOD # = 20 MAN YRS
(1/2 WVA ESTIMATE)

CMTS: WVA NOT SELECTED AS DA FCIM SITE
WVA WILL STILL BE TECHNICAL LEADER
MARKET STABLE OVER OUT YEARS

7

COMMERCIAL BIDS(1997)

P(OCCUR) = MOD # = 20 MAN YRS

CMTS: MARKET GROWS AFTER 92 ELECTION
MARKET STABLE IN 97 AND BEYOND

4

AGS PRODUCTION (1995)

P(OCCUR) = HIGH # = 300

CMTS: HIGH ON ARMY LRRDAP
STRATEGIC MOBILITY BENEFITS
CONGRESSIONAL SUPPORT

8

FMS RENEWALS(1997)

P(OCCUR)=LOW #=30 MAN YRS

CMTS: WANING DESERT STORM POPULARITY
INCREASING FOREIGN COMPETITION
NON-PROLIFERATION PRESSURES
MARKET STABLE/LOW- 97 & BEYOND

9

ET GUN PRODUCTION

P(OCCUR) = LOW # = 50 (2002)

CMTS: ASSUMES FEW NEW TUBES REQ'D
ANTICIPATE PROTOTYPE ONLY
NOT SUFFICIENT "LEAP AHEAD"
DURING LEAN BUDGET YEARS

10

NEW TANK (2015+)

P(OCCUR) = LOW # = 3000

CMTS: ONLY AFTER CERAMIC/COMPOSITE
TECHNOLOGIES WEAPONIZED
WILL OCCUR AFTER 2010

11

EM GUN (2007)

P(OCCUR) = HIGH # = 500

CMTS: INITIAL TANK DESTROYER ROLE
LEAP AHEAD
WVA MUST ADAPT PRODUCTION

LEGEND

▲ PROBABILITY OF OCCURRENCE:

P = HIGH = 90%

= MODERATE = 60%

= LOW = 30%

(according to WVA convention)

▲ PRODUCTION QUANTITIES

= WVA PRODUCED UNITS

(given event occurs)

CHART B

WVA STRATEGIC ASSUMPTIONS/METHODOLOGY

ASSUMPTIONS

1. WORKLOAD FOR ANY GIVEN EVENT WILL BE SPREAD OUT, BUT FUNDING PROFILES AND PRODUCTION RATES ARE YET TO BE DETERMINED IN MOST CASES.
2. ALL THE EVENTS "HAPPEN TO" WVA. WVA's PREPAREDNESS TO RESPOND WILL DETERMINE THE MAGNITUDE OF THE IMPACT.
3. IDENTIFICATION AND SEQUENCING OF THE KEY EVENTS IS RELATIVELY ACCURATE. TIMELINE ESTIMATION IS MORE DIFFICULT. POTENTIAL FOR STRETCHING OF TIMELINE IS HIGH.
4. NO GLOBAL THREAT WHICH COULD ENDANGER U.S. NATIONAL SURVIVAL IS PREDICTED BEFORE 2010.
5. MULTI-REGIONAL CONTINGENCY(MRC) MAY OCCUR EACH DECADE. THIS WILL REQUIRE SURGE, BUT NOT MOBILIZATION. LASTING EFFECTS ON WVA WILL BE MINIMAL.

METHODOLOGY

1. RATIONALE FOR PROBABILITY OF OCCURRENCE ASSESSMENTS ARE GIVEN IN MAIN BODY OF REPORT.
2. RATIONALE FOR PRODUCTION QUANTITIES COMES FROM ASSUMED FIELD REQUIREMENTS, DCTP, AND ARMY POM.
3. AFTER WVA ASSIGNS THEIR WORKLOAD FACTORS TO EACH OCCURRENCE, EXPECTED VALUES CAN BE CALCULATED TO EXTEND THE CURRENT WVA PROJECTION OUT TO 2010.
4. THIS PROBLEM LENDS ITSELF TO DECISION ANALYSIS TECHNIQUES. A DECISION TREE SHOWING EACH OCCURRENCE AND SENSITIVITY ANALYSIS OF THE ASSUMPTIONS ARE LOGICAL NEXT STEPS.
5. THIS QUANTITATIVE FOCUS UPON POTENTIAL MARKETS WILL BE USEFUL. THE TRUE STRATEGIC DECISION FOR WVA, HOWEVER, WILL BE TRANSITIONING TO NEW MATERIALS AND TECHNOLOGIES AT THE TURN OF THE CENTURY.

CONSOLIDATED CHARTS

CHARTS 1-12

- CHART 1: SUMMARY OF CHANGE**
- CHART 2: WVA POLITICAL ENVIRONMENT**
- CHART 3: OSD DEFENSE INDUSTRIAL BASE REPORT TO CONGRESS (NOV 91)**
- CHART 4: OSD DEFENSE INDUSTRIAL BASE WORKING GROUP**
- CHART 5: FISCAL REDUCTIONS AND MODERNIZATION TRENDS**
- CHART 6: ARMY PRIORITIZATION CATEGORIES**
- CHART 7: POLITICAL REALITIES SUMMARY**
- CHART 8: DEFENSE SPENDING GRAPH**
- CHART 9: WHEELED COMBAT TRACKED VEHICLE SPENDING**
- CHART 10: WVA WORKLOAD CONTENT**
- CHART 11: MARKETS SUMMARY**
- CHART 12: MODERNIZATION SUMMARY**

Summary of Change

A New World

Transitions

Considerations

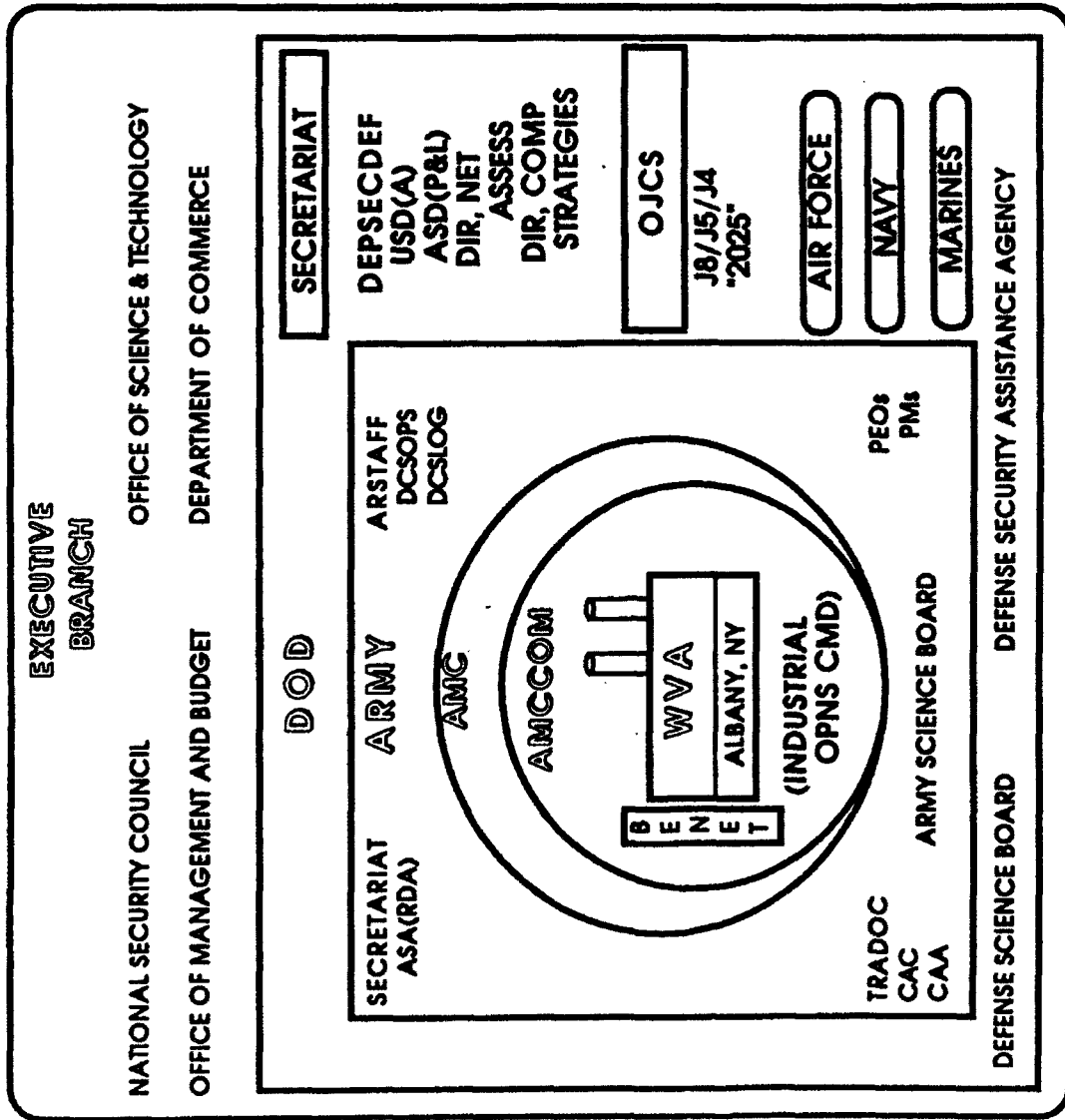
National Strategy

- o Threat vs. capabilities
- o Regional vs. global
- o Small force structure

Industrial Base

- o Reconstitution demand
- o Peacetime production
- o Reduced funds
- o Excess capacity

WATERVLIIET ARSENAL--POLITICAL ENVIRONMENT



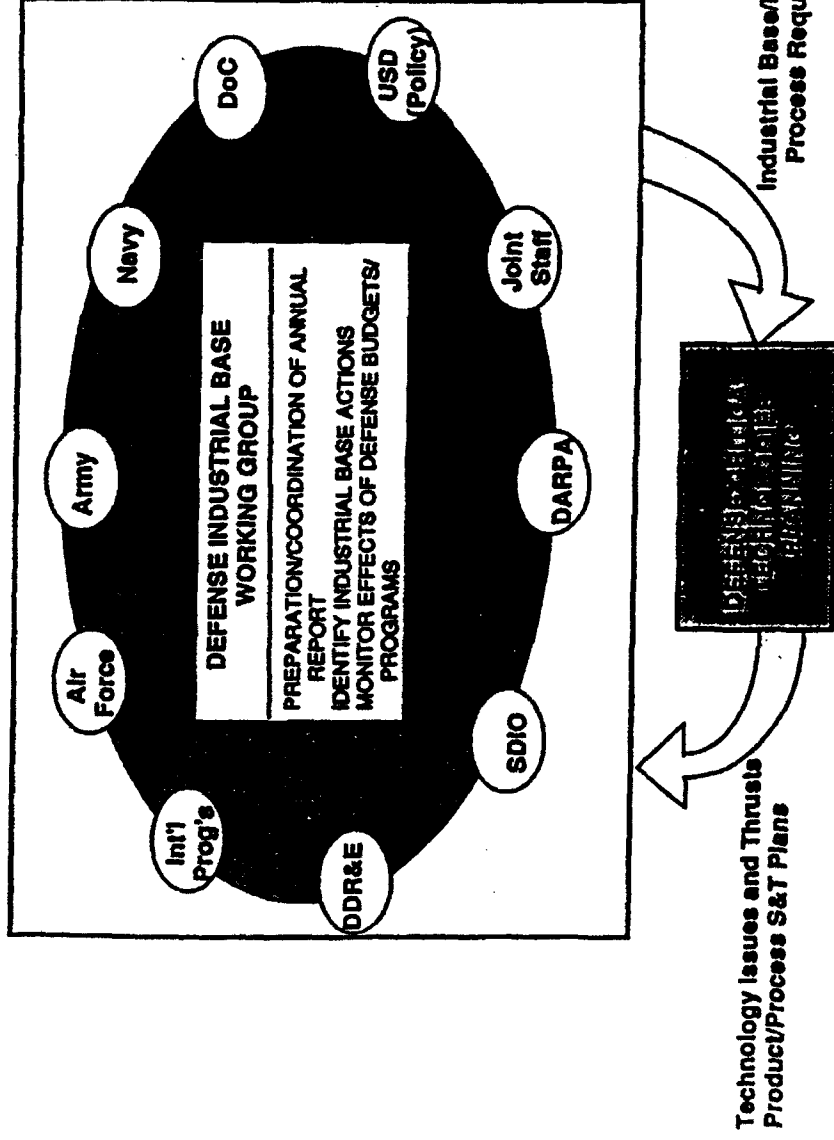
NOTES:
1. SEE ACRONYM LIST FOR DEFINITIONS
2. DIAGRAM IS REPRESENTATIVE, NOT COMPREHENSIVE

OSD REPORT TO CONGRESS (NOV 91)

Defense Industrial Base

- Impacts on key sectors-
 - Aircraft: Weak with large capacity
 - Missiles & Space: Strong
 - Defense Electronics: Dual use/Commercial
 - Shipbuilding: Dependent of DOD
 - Combat Vehicles: Shrinking procurement
- Future defense spending reduced-
 - Remains at 1970's levels
 - Meets DOD procurements
 - Maintains proportional R&D and Production
- Bottom line-
 - DOD relies on free market forces
 - Monitor industrial sector status
 - Maintain markets where DOD is dominant

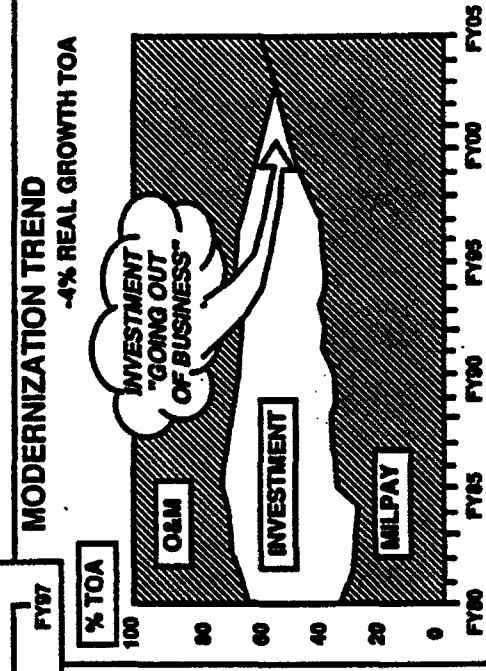
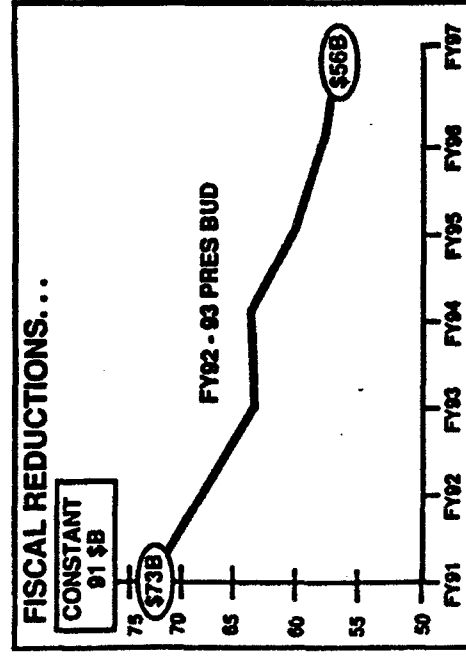
DEFENSE INDUSTRIAL BASE WORKING GROUP ASD (P&L)



SOURCE: DEPARTMENT OF DEFENSE, "REPORT TO CONGRESS ON THE DEFENSE INDUSTRIAL BASE," NOV 91.

THE RESOURCE CHALLENGE

FISCAL REDUCTIONS & MODERNIZATION TRENDS

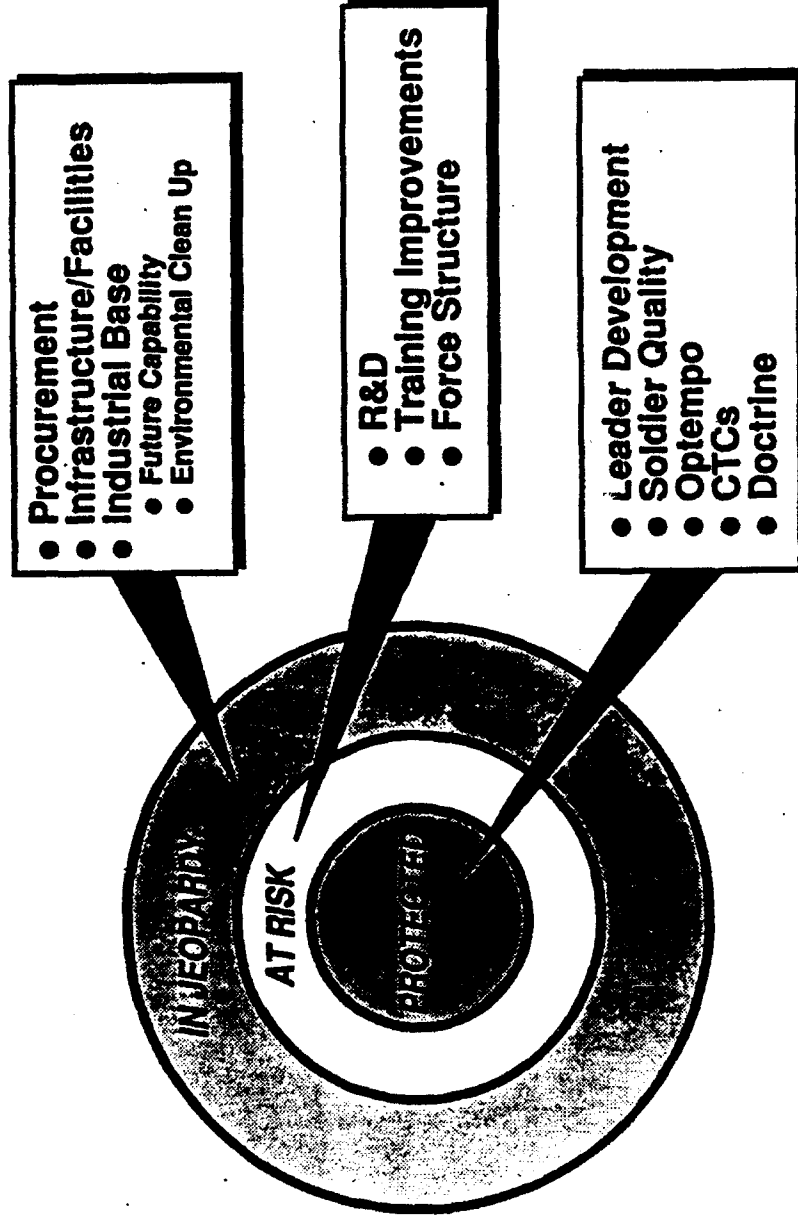


SOURCE: ASST SECRETARY OF THE ARMY FOR FINANCIAL MGMT,
ARMY BUDGET OFFICE, 12/4/91.

CHART 5

ARMY RESOURCE ISSUES

PRIORITIZATION CATEGORIES



SOURCE: ASST SECRETARY OF THE ARMY FOR FINAN MGMT,
ARMY BUDGET OFFICE, 12/9/91.

CHART 6

POLITICAL REALITIES

SUMMARY

Current administration against "industrial policy."

De facto policies exist.

Industrial vision needed.

Congressional support for WVA is strong.

DOD: Numerous players working industrial base issues.

Little integration evident.

Think tanks, defense contractors, and interest groups play key role in the debate.

HQDA, ICW AMC and AUSA, is forging industrial strategy.

Industrial Operations Command will streamline some functions and create some new challenges.

CHART 7

DEFENSE SPENDING

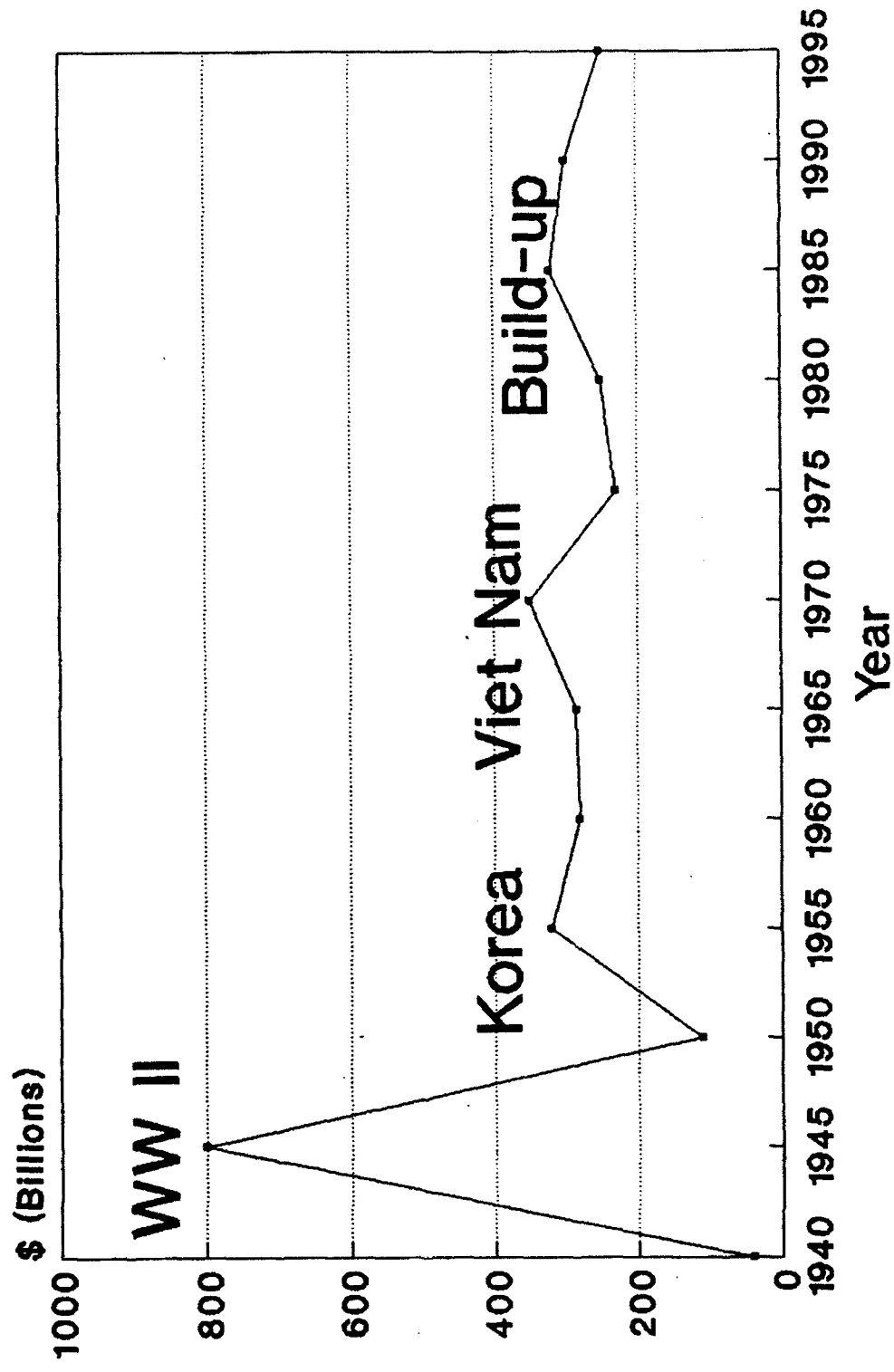


CHART 8

WTCV VS PROCUREMENT

A STEEP DECLINE

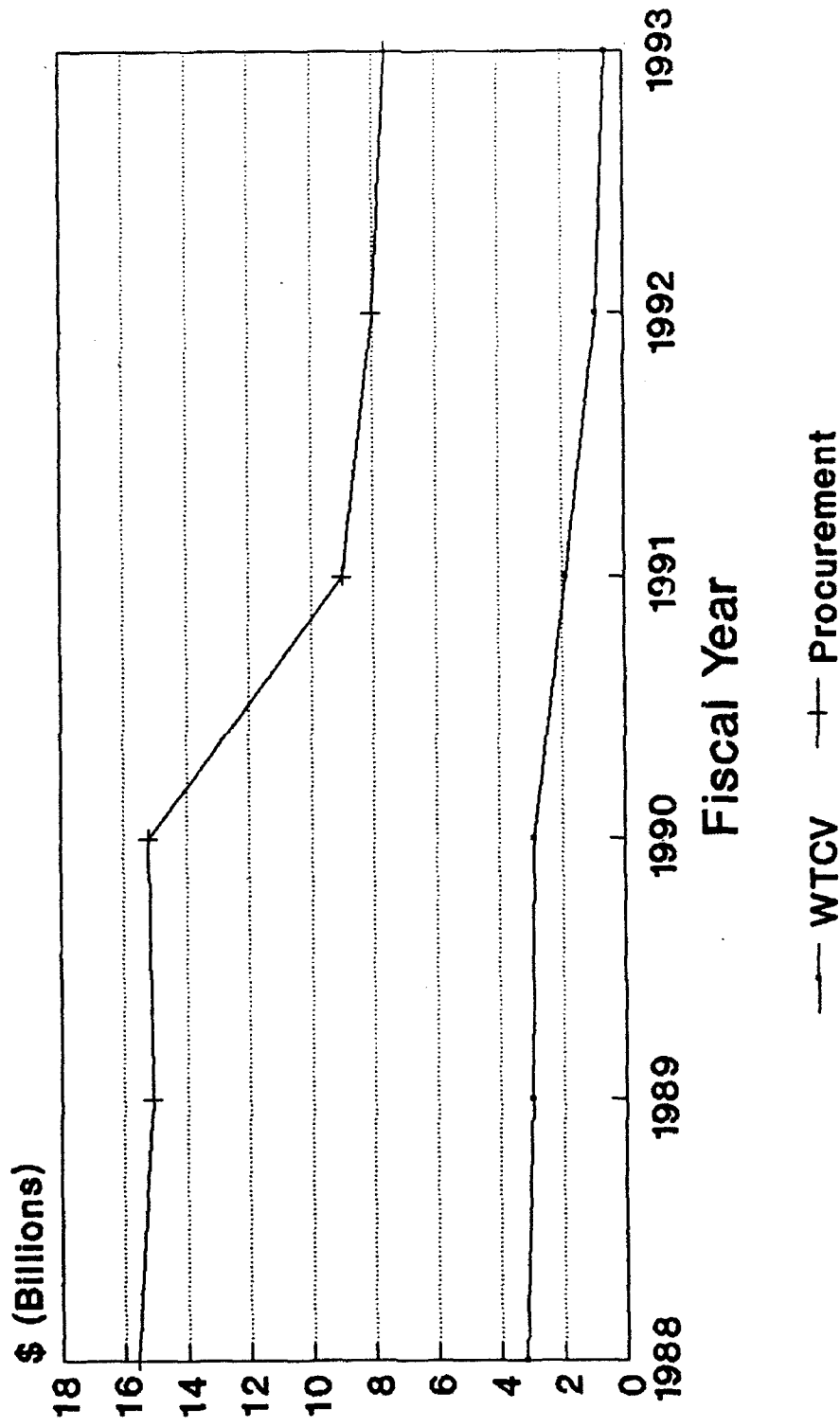


CHART 9

WORKLOAD CONTENT

Watervliet Arsenal

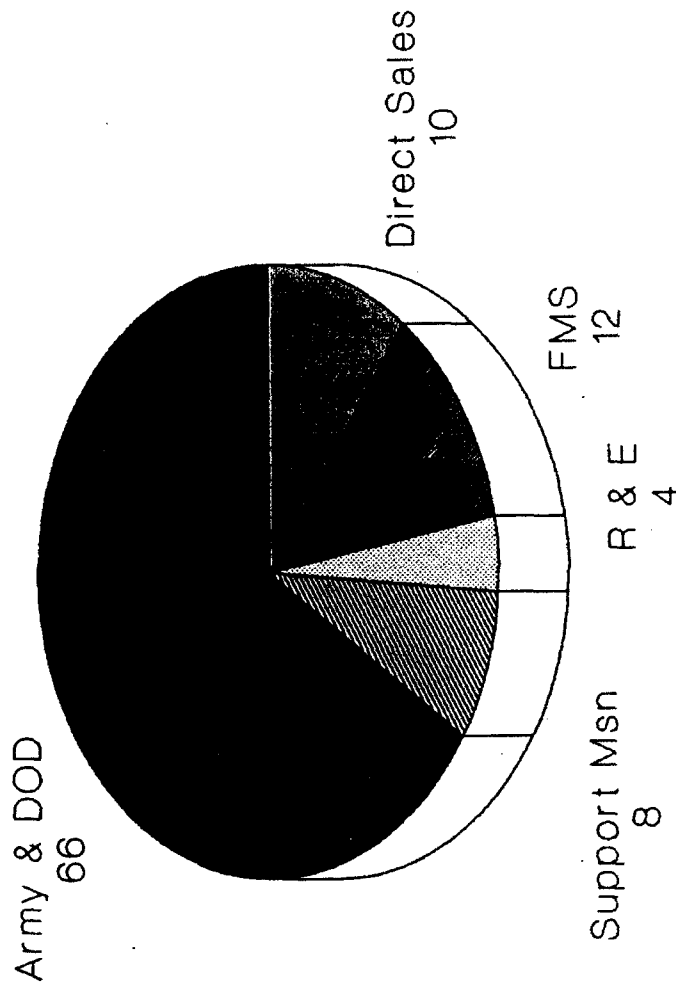


CHART 10

Summary of Markets

Three Categories

Types of Markets Characteristics

Traditional

- o Cannons and mortars
- o Only US producer
- o Viable for 20 years

Supplemental

- o Seek a niche
- o Manufacture of parts
- o Highly automated

Commercial

- o Not fully explored
- o Limited potential

MODERNIZATION CHALLENGES

SUMMARY

Future warfare will require lighter, smaller, and more automated weapon systems.

The challenges over the next 30 years will be significant; MODERNIZATION IS IMPERATIVE.

Technology will remain the U.S. hallmark.

WVA must focus upon:

- o pertinent weapon technologies
- o modern production techniques

Promising technologies include:

- o EM Gun (Propulsion)
- o Composites (Materials)
- o Flex Manufacturing (Production)

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ACRONYMS

AGS	Armored Gun System
AFAS	Advanced Field Artillery System
AMC	U.S. Army Materiel Command
AMCCOM	U.S. Army Armaments, Munitions, and Chemical Command
ARDEC	U.S. Army Armament Research, Development, and Engineering Center(Picatinny Arsenal)
ASA(RDA)	Assistant Secretary of the Army for Research, Development, and Acquisition
ASD(P&L)	Assistant Secretary of Defense for Production and Logistics
BTI	Balanced Technology Initiative
CAD	Computer Aided Design
CAE	Computer Aided Engineering
CAM	Computer Aided Manufacturing
CAPP	Computer Aided Production Planning
CEA	Civilian Executive Assistant
CINC	Commander-in-Chief (Geographical Area)
COCO	Contractor-owned, contractor-operated
CSIS	Center for Strategic and International Studies
DARPA	Defense Advanced Research Projects Agency
DCSLOG	U.S. Army Deputy Chief of Staff for Logistics
DCSPER	U.S. Army Deputy Chief of Staff for Personnel
DCSOPS	U.S. Army Deputy Chief of Staff for Operations
DCTP	Defense Critical Technology Plan
DESCOM	Depot Systems Command
DIB	Defense Industrial Base

DMR	Defense Management Review
DMRD	Defense Management Review Directive
DSAA	Defense Security Assistance Agency
DTIB	Defense Technology and Industrial Base
DUSA(OR)	Deputy Undersecretary of the Army for Operations Research
FCIM	Flexible Computer Integrated Manufacturing
FMS	Foreign Military Sales
GOCO	Government-owned, contractor-operated
GOGO	Government-owned, government-operated
HAC	House Appropriations Committee
HASC	House Armed Services Committee
HQDA	Headquarters, Department of the Army
IAMS	Integrated Army Mobilization Study
ICAF	Industrial College of the Armed Forces
INSS	Institute for National Strategic Studies
IOC	U.S. Army Industrial Operations Command
J5	Director, Strategic Plans and Policy, OJCS
J8	Director, Force Structure, Resource, and Assessment, OJCS
LAV	Light Armored Vehicle
LRRDAP	U.S. Army Long Range Research, Development, and Acquisition Plan
MACCOM	U.S. Army Missile, Armament, and Chemical Command
MACOM	Major Army Command (Eg-FORSCOM)
MANTECH	Manufacturing Technology
NDI	Non-Developmental Item
OJCS	Office of the Joint Chiefs of Staff

OSD	Office of the Secretary of Defense
OTA	U.S. Congress Office of Technology Assessment
POM	Program Objective Memorandum
PPI	POM Preparation Instructions
REARM	Renovation of Armament Manufacturing
RIA	Rock Island Arsenal
SAC	Senate Appropriations Committee
SASC	Senate Armed Services Committee
SDI	Strategic Defense Initiative
SECDEF	Secretary of Defense
TRADOC	U.S. Army Training and Doctrine Command
USC	United States Code
VRI	Vector Research Incorporated
WVA	Watervliet Arsenal
WTCV	Weapons and Tracked Combat Vehicles(a DOD Appropriations category)