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THESIS

USING THE
INDUSTRIAL MODERNIZATION INCENTIVE PROGRAM
TO PRESERVE CRITICAL PROCESSES

by

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This thesis attempted to justify using the Industrial Modernization Incentive Program (IMIP) to meet Government needs. Its primary objective was to demonstrate maintaining critical processes by using IMIP. A secondary objective was to demonstrate the flexibility of IMIP and how it can be tailored to meet individual Government contract requirements.
Other secondary requirements were: 1. examine the changing Defense acquisition environment, 2. examine Government Return On Investment (GROI) and Contractor Return On Investment (CROI) 3. provide examples how IMIP could be used to meet Government needs instead of project needs.
The thesis examined Defense acquisition objectives as identified by leaders of Government and how they applied to IMIP objectives. Information was obtained from written documentation addressing IMIP and the Defense industrial base, with feedback from knowledgable and experienced Government contracting personnel. Broad examples were used to apply conversion to IMIP.

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Using the Industrial Modernization Incentive Program to Preserve Critical Processes

by

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ABSTRACT

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Other secondary objectives were: 1. examine the changing defense acquisition environment, 2. examine Government Return On Investment (GROI) and Contractor Return On Investment (CROI) 3. provide examples as to how IMIP could be used to meet Government needs, instead of project needs.

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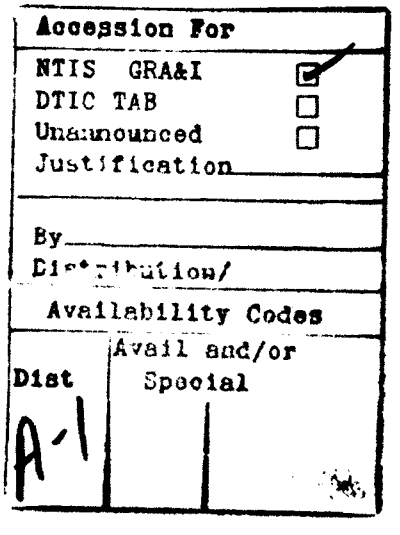


TABLE OF CONTENTS

I. INTRODUCTION 1

A. AREA OF RESEARCH 1

B. RESEARCH QUESTIONS 1

C. OBJECTIVE 2

D. SCOPE OF THESIS 3

E. METHODOLOGY 3

F. ORGANIZATION 4

II. BACKGROUND 5

A. IMIP DEFINED 5

B. THE IMIP PROCESS 7

C. GOVERNMENT RETURN ON INVESTMENT (GROI) 10

III THE NEEDS OF DEFENSE 14

A. DEFINITION OF DEFENSE INDUSTRIAL BASE 14

B. EROSION OF THE INDUSTRIAL BASE 14

1. DOWNSIZING 14

2. INTERNATIONALIZATION 15

a. OPEN MARKET 16

b. FOREIGN INTEREST 17

C. THE NEEDS OF GOVERNMENT 20

IV. CONVERSION AND IMIP 23

A. INTRODUCTION 23

B. PRESERVING ELEMENTS OF THE INDUSTRIAL BASE . . 25

1. CRITICAL PRODUCTS/TECHNOLOGIES 25

2. CRITICAL PROCESSES/PRODUCTION METHODS . . . 27

3. PRODUCTION BREAKS/FOLLOW-ON PRODUCTION . . . 29

a. DISCUSSION 30

b. DEFINING 32

c. VALUING 34

d. CONTROLLING 36

e. TANK EXAMPLE 40

f. CONCLUSION 42

4. CRITICAL PROCESS VS CRITICAL PRODUCT 43

C. TRANSFERRING SKILLS SURGE/MOBILIZATION 45

1. FLEXIBILITY 45

2. CONSOLIDATION 46

3. COMMERCIALIZATION 51

4. MULTIYEAR CONTRACTING 53

D. DEVELOPING AND ENCOURAGING NEW PROCESSES . . . 53

1. IMPROVED PRODUCT 53

2. SAFETY/HAZARDOUS MATERIALS 54

3. REDUCED LEAD TIMES 55

4. FUTURE INVESTMENT OPPORTUNITY 56

E. CONCLUSION 56

V. IMIP AND THE CONTRACTOR 58

A. INTRODUCTION 58
B. APPLYING IMIP TO SMALL COMPANIES AND SUBCONTRACTORS 59
C. IMIP PROCESS 60
D. FACTORS OF CONTRACTOR IMIP 62
E. CONCLUSION 69

VI. CONCLUSION/RECOMMENDATIONS 71
A. INTRODUCTION 71
B. CONCLUSION 71
C. RECOMMENDATIONS 73
D. ANSWERS TO THE RESEARCH QUESTIONS 75
E. AREAS FOR FURTHER RESEARCH 78
LIST OF REFERENCES 79
INITIAL DISTRIBUTION LIST. 83

I. INTRODUCTION

A. AREA OF RESEARCH

The Industrial Modernization Incentives Program (IMIP) is undergoing changes recommended by the IMIP Guide Committee and the Aerospace Industries Association (AIA) White Paper. This research will examine Government Return on Investment (GROI) and its ability to measure utility gained by Government investment. This research will also assess IMIP's ability to incentivize the contractor. Finally, the expected value of the qualitative benefits derived by implementing an IMIP will be analyzed and discussed.

B. RESEARCH QUESTIONS

Primary Research Question:

1. As the Defense acquisition environment changes, can IMIP effectively incentivize Defense contractors to make capital investments to improve their operations and benefit the military?

Subsidiary Research Questions:

1. What are IMIP's goals and objectives?

2. What are the Government's and DoD's goals and objectives with respect to Defense procurement?

3. Are all benefits, including those that are difficult to quantify, assessed according to their military value when measuring GROI?

4. Are IMIP successes rated on these benefits?

5. Can IMIP reduce the decline of manufacturing capability in the Defense industrial base?

6. What IMIP changes can further its benefits to the Defense industrial base and the Government?

C. OBJECTIVE

The objective of this thesis is to justify the qualitative GROI factors which will maximize the utility derived by the Government. IMIP has already proven itself effective in reducing weapon systems costs and contributing to maintaining the United States' Defense industrial base. [Ref. 17] The purpose of this thesis is to determine whether the newly revised IMIP can effectively meet its objectives and contribute to maintaining the industrial base despite the anticipated changes in both future acquisition processes and the new world environment. Effectiveness will be based on its accessibility to Defense contractors, funding, program awareness, as well as acceptability. Acceptability is the extent to which contractors would use IMIP for capitalization if it was readily available.

D. SCOPE OF THESIS

This study was specifically limited to incentives for the Government and contractors, and how these incentives should be weighed to fully measure the utility derived by an IMIP. It drew on the expertise of the DoD Components IMIP guide meeting attendees, as well as written documentation addressing IMIP and the Defense industrial base. The select group of personnel interviewed provided assistance and information on future IMIP goals and objectives. The attendants of this meeting included a mix of military and industry IMIP experts.

GROI criteria and measures of program effectiveness were analyzed as to their ability to meet IMIP objectives. Justification for considering alternate criteria will be presented.

E. METHODOLOGY

This study consisted of two phases. The first phase was to combine extensive literature review with personal interviews from appropriate DOD and private sector personnel attending the IMIP guide meeting in April 1992.

The second phase analyzed this information to determine whether IMIP is being used as efficiently as possible. The needs of Government and Defense will be presented, along with IMIP's role and mission in meeting

these needs. The results of the thesis include recommendations to make IMIP more acceptable to both Government and Defense contractors.

F. ORGANIZATION

The thesis is organized into the following chapters:

II. BACKGROUND: Discusses the IMIP process, and how it is being used today.

III. THE NEEDS OF DEFENSE: Examines the needs of the Government and the military in relation to procurement and the Defense industrial base.

IV. CONVERSION AND IMIP: Analyzes the factors that should be used in determining facilities modernization.

V. THE NEEDS OF THE CONTRACTOR: Reviews the contractors needs and how IMIP can effectively supply them incentives.

VII. CONCLUSION/RECOMMENDATIONS: Provides a conclusion to the research, recommendations to improve the program, answer thesis questions, and recommend future research areas.

II. BACKGROUND

A. IMIP DEFINED

The Department of Defense established the IMIP in 1982. The purpose of the program is to reduce weapon systems acquisition costs and encourage Defense contractors to plan to modernize their operations by implementing new equipment, processes, or management techniques. [Ref. 1]

> IMIP incentivizes the contractor to make capital investments and productivity improvement efforts beyond that required to meet contractual requirements. [Ref. 2: p. 5]

IMIP was developed to encourage contractor financed investments to refine production efficiency, reduce cost, improve quality and increase reliability. It is a joint venture between Government and industry to reduce acquisition costs, accelerate the development of modern equipment and management techniques, and broaden the industrial base. The Nation's economic condition, international competition, rising acquisition costs and the potential for technological improvements made it of paramount importance to improve acquisition efficiency in the 1980s and 1990s. [Ref. 2]

> The primary purpose of IMIP shall be to motivate Defense contractors to make investments in modernization projects that are beneficial to their company and to the Government. Modernization of the Defense industrial base will result in the following:
>
> a. More cost effective or flexible production capability for quality DoD weapon systems, equipment software, and material.
> b. Accelerated implementation of DoD-developed manufacturing technologies minimizing the impact of technology obsolescence.
> c. Reduced operation and support costs
> d. Improved responsiveness to emergency production needs. [Ref. 7:p. 1]

The primary incentive for both the Government and the contractor is the savings throughout the project life cycle resulting from the modernization effort. The savings is shared by both the Government and the contractor. In recent years, the military has started to integrate Total Quality Management (TQM) into its acquisition process. Even though IMIP existed before the military implemented TQM, it shares many TQM goals. IMIP and TQM can potentially assist both the contractor and Government in achieving their objectives. They focus on team work, continuous improvement and a quality product. The following represents background information on IMIP, its history, objectives, and the degree to which it is being used. Implementing IMIP into an existing acquisition, or writing a stand alone contract, is a partnership and cooperative effort between the Government and the contractor. [Ref. 14:p. 2]

In the last decade, IMIPs have been implemented by over 200 contractors in 36 states. According to an AIA White Paper, since IMIP's inception, for a $2 billion contractor investment, over $630 million of DoD savings was documented. [Ref. 17]

B. THE IMIP PROCESS

The following discussion is a summary of a process description taken from the new IMIP guide draft. An IMIP can begin as part of a weapon system acquisition or as a stand alone contract. During the opening stages of an IMIP program, Government and industry representatives explore program application and discuss potential investments and the resulting benefits. Eventually, a formal business agreement is established based on discussions about required productivity improvements, necessary capital investments and accrued benefits. Program managers establish goals and objectives to ensure the IMIP's success. These objectives are built on proper and thorough planning, development of program milestones and scheduling, cost management and periodic performance status reviews. [Ref. 14:p. 3] The Government Program Manager (PM) draws on support from contracts, program control, contract administration, pricing and members of the technical community. By fully utilizing the resources at his disposal, the PM can make an accurate decision.

There are three funding sources for IMIP, Government Industrial Base Program Element funds, acquisition funds, and funds invested by industry. The decision regarding sources is based on cash flow, availability of funds, risk, Return on Investment (ROI), need and technology transfer. [Ref. 14:p. 4] It is important to note that IMIP can fund facility analysis, design and integration of technologies. It cannot directly fund actual capital acquisitions. [Ref. 14:p. 6]

If the technical or financial risk is high, the company's investment can be protected through what is called "Contractor Investment Protection." The Government assumes part of the investment risk on an unfunded, contingent liability basis. It is seldom used and requires special approval and Congressional notification.

The benefits and rewards to be shared by the Government and contractor are estimated by comparing the "as-is" and "to-be" baselines established during program development. The "as-is" analysis carefully reviews current operations and determines costs, lead time and quality drivers. This is a top-down analysis that is developed to the lowest level as a means of determining performance measures, savings, and benefits derived from the IMIP projects. [Ref. 14:p. 26] The "to-be" analysis provides alternatives for various business sectors where process inefficiencies have been

found. Alternative processes and technological innovations are examined for applicability to the particular business sector.

The analysis process needs to support Cost-Benefit-Analysis (CBA) and models for Discounted-Cash-Flow (DCF), ROI and Government-Return-on Investment (GROI) models. [Ref. 14:p. 26] The goals and objectives of Strategic Modernization Plans (SMP) are developed for the contractor to identify missing and needed technologies and evaluate new technologies.

Both Government and the contractor select projects. The contractor presents prospective projects to the Government in priority order based on the analysis of factory requirements. Candidate programs are further evaluated and prioritized based on preliminary costs and payback. [Ref. 14:p. 29]

The technical approach is then refined, providing greater detail and further analysis. The contractor also develops a preliminary CBA. This includes both technical and business aspects. Data generated through this process are entered into a discounted-cash-flow model to determine break-even period, pay back period, and net present value.

IMIP supports two types of modernization plans: The Modernization Investment Projects (MIP) and the Modernization Efficiency Projects (MEP). MIPs involve contractor investment in production equipment, facilities or

technology. In these projects, implementation costs and other expenses not usually capitalized are eligible for IMIP funding. MEPs enhance contractor productivity without requiring significant capital investment. The resulting contract must be comprehensive. Appropriate milestones and Contract Data Requirements Lists (CDRLs) are defined for each program phase. Clearly delineated deliverables are established for the entire contract so that there is no ambiguity concerning whether the intent of the IMIP contract has been fulfilled or when it was completed. [Ref. 1]

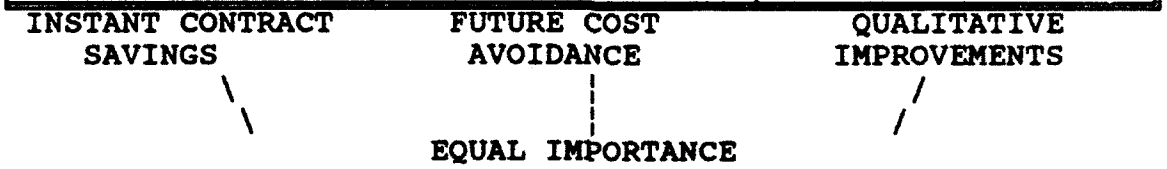
Regardless of the type of IMIP contract, funding and incentives can vary in size and type, depending on the sponsoring Government agency's needs, and the company's strategic modernization plans. [Ref. 12:p. 1]

C. GOVERNMENT RETURN ON INVESTMENT (GROI)

IMIP is designed to assist the DoD in maximizing the value of its investment. The primary tool for determining whether the Government should provide funding for a given project is the CBA. This analysis establishes the GROI, also called the Return On Investment Initiative (ROII). The Government uses GROI to measure the utility derived by investing in an IMIP. GROI is the combined total of all benefits which accrue to the Government under an IMIP project. It is used to establish total benefit. Under

GROI, benefits are divided into three categories: 1. Instant Contract Savings, 2. Future Cost Avoidance and 3. Qualitative Improvements (see Figure 1). [Ref. 14:p. 39]

INSTANT CONTRACT SAVINGS	FUTURE COST AVOIDANCE	RISK REDUCTION
COLLATERAL SAVINGS	FUTURE COLLATERAL COST AVOIDANCE	PRESERVATION OF THE DEFENSE INDUSTRIAL BASE
LCC/LOGISTICS SAVINGS	FUTURE LOGISTICS COST AVOIDANCE	PERFORMANCE
		READINESS
		TECHNOLOGY INSERTION
		OTHER



Government Return On Investment

Figure 1

Source: AIA White Paper [Ref. 14]

INSTANT CONTRACT SAVINGS Price reductions to instant contracts as a result of IMIP improvements. They may include all Government contracts in a given factory, since investments for one program usually lead to price reductions and additional benefits for other programs. This is especially true at the subcontractor level. Logistics programs, through spare parts buys, may also realize these benefits. Significant instant savings and price reductions may be realized from single-year contracts with price options, or multi-year contracts. [Ref. 49]

FUTURE COST AVOIDANCE Cost avoidances that do not result in price reductions to open contracts, but contribute to cost containment. With decreased weapon

systems budgets, IMIP benefits in this area will help program managers identify key industrial base investments needed to keep their weapon systems affordable. [Ref. 49]

QUALITATIVE IMPROVEMENTS Benefits that are difficult to measure using financial data, but no less important in justifying an IMIP. When presented in a meaningful manner, qualitative benefits can boost the prestige of a program that otherwise may show prospects for only marginal financial returns on investment. Qualitative benefits, however, must reflect a real benefit, not just mere description. [Ref. 14:p. 40]

Many programs that may help preserve the industrial base may not be considered because they don't show "actual benefit." Industrial base benefits are generally considered collateral benefits, not primary benefits.

Numerous DoD officials, contractors, and Congressmen have expressed overwhelming concern about effects of the declining industrial base. It has become the focus for numerous Congressional and DoD reports. IMIP has been described as an effective program to help maintain the base. Unfortunately, many important factors that preserve the Defense industrial base are qualitative and difficult to show financial benefit. For this reason, Government Program Managers and their departments have focused on the instant contract cost benefits.

Previous IMIP successes were measured primarily by cost savings and cost avoidance. The AIA Industrial Modernization Committee recommended a "reduced emphasis on cost savings validation and greater emphasis on implementation." [Ref.

17:p. ii] IMIP is a program to help preserve the Defense industrial base. Certainly cost savings and cost avoidance are extremely important in the effort to keep contractors in the Defense market. But other factors, particularly those that are difficult to quantify, are of equal or greater importance. Emphasizing cost encourages manufacturers to seek lowest acceptable levels. Assuming that a contractor's primary concern is long term profit, then the contractor will probably put forth the minimal effort (cost) necessary to meet the Government's specifications and standards, unless there is an incentive for the contractor to do otherwise. Performance based on minimal cost usually results in minimal acceptable performance.

If IMIP is to be successful, many qualitative factors must be given far greater consideration in the future decision making process.

III THE NEEDS OF DEFENSE

A. DEFINITION OF DEFENSE INDUSTRIAL BASE

> The Defense industrial base is defined as: The people, Government, and private firms, whose skills and facilities develop, produce and maintain the weapons and supporting equipment needed by our armed forces in peacetime and in wartime. It is becoming an indistinguishable part of our national industrial base which, in turn, is part of an increasingly global industrial base. [Ref. 50:p. 1]

B. EROSION OF THE INDUSTRIAL BASE

The Defense industrial base is becoming increasingly vulnerable to international Defense and industrial influences, particularly military downsizing and the internationalization of the world market place.

1. DOWNSIZING

The Defense industrial base is experiencing dramatic downsizing. The fiscal 1993 request for weapon systems and other hardware procurement is only $54.4 billion, down from $96.8 billion in 1985. [Ref. 20:p. 1] Besides the decrease in the size and number of contracts, other factors have contributed to the escalating exodus of companies in the Defense marketplace. These include: audit procedures, procurement policy, Government attitudes, late payment, Defense specifications and bidding methods. [Ref. 36:appendix b] Administrative difficulties continue to drive vendors away. The number of companies doing military

business has already decreased from 120,000 in 1986, to less than 28,000 today. [Ref. 8:p. 4] The end of the Cold War

> ...brings harsh realities for the workers, businesses and communities that once supported our military establishment in its heyday and that now must grapple with the effects of the massive cuts in Defense spending. [Ref. 50:p. 6]

> Defense conversion is complicated because the world remains a sometimes hostile and uncertain place. We need both a vibrant Defense industrial base... and a competitive civilian industrial base to generate sufficient wealth to provide for an expanded economy that will contribute to our economic security. [Ref. 50:p. 4]

Because of decreasing Defense spending, many Defense contractors are being forced to make dramatic changes in their organizational structure. This may further accelerate the decline in the industrial base, worsening the country's ability to mobilize and defend itself in a future contingency.

2. INTERNATIONALIZATION

As the world market becomes more integrated, it is becoming increasingly difficult to separate American companies with large foreign interests from foreign companies with large American interests. Many countries are also interested in developing and producing the technologies that DoD desperately wants to preserve. In recent years, the U.S. Government has increased its utilization of foreign sources. [Ref. 37] This puts an additional burden on DoD to assist U.S. contractors.

Dependency on foreign sources is risky. Some countries are unstable, or may be allied with a potential future enemy. Supplies from these countries could conceivably be cut off during a crisis. Since World War II, the Government has emphasized maintaining the Defense industrial base with U.S. sources. Legislation, such as the Buy American Act, limits DoD's purchases to American products where possible, and restricts foreign suppliers. In recent years, modifications to existing legislation, and additional legislation have liberalized Government and domestic procurement from international sources. Despite the many significant economic gains that will result from this new open market, some critical technologies may be lost to foreign sources.

a. OPEN MARKET

To ease trade difficulties, many foreign firms have invested directly into the United States, buying minority/majority interests in American companies or establishing their own outlets. This strategy counters protectionist agitation, places a broader range of products into the U. S. market, improves eligibility on Government purchases and secures their own supplier base.

Businesses from many countries are also becoming increasingly receptive to collaboration. Joint ventures, coproduction, technology transfer, training schemes or a

combination of these have become essential marketing tools for many firms successfully competing in the U. S. market. [Ref. 38] Companies have found this to be mutually beneficial, especially on large Research and Development (R&D) projects. This environment of cooperation and collaboration can substantially increase the potential for technology leaks. This makes it extremely difficult to preserve domestic critical technology.

If a U.S. company with a critical technology or process has international branches, or is conducting a joint international venture, the foreign interests may have a market for this technology. Transferring this technology to the foreign interests would be illegal and unethical. But corporate personnel and information can easily cross international borders. It is becoming extremely difficult to keep ideas or technology solely in the U.S. Once a foreign producer emerges, it would be virtually impossible to determine whether the technology was transferred, or simultaneously developed.

b. FOREIGN INTEREST

Japanese companies are excellent examples of companies that are becoming more common as DoD suppliers. [Ref. 35] Japan will continue to enter markets that they can successfully compete in, and will also be a leader in

research and development. Japanese government organizations, programs, and incentives help contribute to this success.

Japan is one of our most valued allies, but their assessment of important technologies is similar to other countries, including the United States. Increasingly sophisticated weapons are appearing in arsenals throughout the world and amongst countries that may ultimately be future adversaries. [Ref. 20]

The Japanese R&D program is very successful. It is expected to allow Japan to enter new technology markets. The Japanese Ministry of International Trade and Industry (MITI) works closely with industry to identify promising technologies, establish cooperative research programs and to select a leading foreign company as a model. The private sector and MITI guide Japanese industrial policy to satisfy the needs of the economy. Even though MITI's role is advisory, it has committed itself to high technology and the resulting commercial success. Through MITI, Japan has developed a technology strategy for the twenty first century that calls for Japan to be a world leader in areas such as robotics, artificial intelligence, biotechnology, and aerospace. [Ref. 38:p. 5]

The technologies that Japan desires to develop are similar to the ones the U. S. is ambitiously trying to develop and preserve. The ability for U.S. industry to meet

military requirements is being challenged, particularly in high technology items. This is forcing the military to buy needed quality and technologically advanced parts from the Japanese and other foreign sources.

Japan focuses on producing key technologies better than its competitors. **It does not focus as much on the technology itself!!** There is, and always has been, a diversification of technology. Technology is developed at one place. Eventually other organizations acquire it, either through licensing agreements, industrial espionage, or reverse engineering.

U.S. engineering schools seem to emphasize the importance of design engineering. Because process technology is not emphasized, the U.S. manufacturing workforce is not at the same level as comparable international manufacturing workforces. Engineering programs, should be supported, especially in manufacturing and production processes.[Ref. 50]

When other countries decide to develop a technology, in competition with the U.S., and supply stimulus to their markets, it puts an additional burden on the U.S. Preserving critical technologies necessitates Government support in developing and manufacturing of these products. This requires the Government to provide the manufacturer with greater incentives. It would be very expensive for the military to be completely self sufficient

on domestic suppliers. The Government must decide which Defense technologies are most important to maintain domestic capability (e.g. are some allies more reliable, some technologies available from several sources, etc.).

C. THE NEEDS OF GOVERNMENT

Because of the new world order, the Nation is facing new opportunities and challenges that will determine our continued role as a first class economic, not merely military, world power. [Ref. 50:p. 1] The changing environment has forced the Government to maintain a viable Defense industry when spending is being dramatically cut. The work force must also be redirected to compete economically with other nations.

The House Armed Services Committee set up a Panel "to identify steps that Congress might take to help ensure the existence of a stable competitive base that is capable of meeting U.S. national security needs." [Ref. 50:p. 2]

> The Global Security Project of Georgetown University, which conducted an independent review... stated that the DoD is making major policy decisions without knowing their long term consequences. In other words, the administration's free market approach will not take care of dislocated Defense worker or ensure industry survival. [Ref. 50:p. 3]

The Panel determined that policies and plans were needed that enable

> ...the remaining Defense industrial base to continue to invent and build affordable systems that meet our military needs and to create new commercial

opportunities for the idled portion of today's Defense complex." [Ref. 50:p. 4]

"Conversion" is a concept for transforming the Defense industrial base. It means

> ...new opportunities for Defense companies, and workers alike; using the Defense dollars saved, it means making major capital investments in national infrastructure programs such as the environment, energy or transportation to name a few. It also means having the skills available to respond to future military threats should they emerge. [Ref. 50:p. 4]

IMIP could provide an effective means of coordinating the conversion process within DoD. IMIP and the conversion strategy have very similar objectives. IMIP focuses on maximizing the benefit derived by DoD; conversion concentrates on benefiting the country. The objectives for preserving the Defense industrial base through conversion are:

1. Developing quality management programs-Defense firms and the Defense Department must foster a commitment of increasing productivity and promoting a world class industrial base.
2. Transferring skills-Successful Defense conversion requires not only transferring skills and facilities away from Defense, but being able to transfer them back to Defense when necessary.
3. Promoting technical education-Educational programs in engineering, especially in the areas of manufacturing and production processes should be supported.
4. Encouraging new manufacturing techniques-The United States must not only maintain its weapons superiority, it must seek ways of increasing its national competitiveness.
5. Preserving elements of the Defense industrial base-Unique Defense systems critical to national security should be retained. As an example, heavy industries, especially ships submarines, are of particular concern.

6. Changing acquisition policies-Regulatory barriers to commercial/Defense integration should be eliminated, thus maximizing the use of commercially available components and production facilities. [Ref. 50:p.5]

IV. CONVERSION AND IMIP

A. INTRODUCTION

By implementing a Government conversion strategy, a constancy of purpose could be maintained throughout the DoD and be reflected amongst all Defense programs. Secretary of Defense Cheney, Deputy Secretary of Defense Atwood, and members of the House Armed Services Committee have emphasized manufacturing in their concern for maintaining the Defense Industrial Base. Conversion is a way that the Government can ensure the existence of a stable Defense industrial base.

The Defense market is different than the commercial market. In most competitive markets, it would be unreasonable to capitalize when current facilities are not being used to their maximum potential. Similarly, DoD contractors will not capitalize when they have access capacity and demand is decreasing. However, this may not be in the National interest. The DoD market place must overcome many unusual factors such as: it is essentially a monopsony (one large buyer with many sellers), that is highly regulated, requires state-of-the-art technology, and is under intense public scrutiny. Also the cost of failure of Defense to the country is significantly greater than that of commercial markets.

The rapid changes taking place in the Defense market environment justify a conversion strategy. The DoD concentrates its needs on emergency requirements which are dependent upon the perceived threat. The Government's conversion strategy focuses on meeting the DoD needs and must be sensitive to preserving the national economic infrastructure and labor markets. [Ref. 50:p. 4]

There are many factors of a conversion strategy that could be applied through IMIP. The objectives of conversion are directly related to the GROI factors used in developing an IMIP. Figure 1 illustrates qualitative GROI factors as they apply to conversion objectives:

Preserving Elements of The Defense Industrial Base	Transferring Skills and Facilities	Developing and Encouraging New Manufacturing Techniques
Critical Products	Flexibility	Improved Product
Critical Processes	Consolidation	Safety Hazardous Materials
Production Breaks	Commercialization	Reduced Lead Times
	MultiYear Contracting	Future Investment Opportunity

Conversion and IMIP Qualitative Factors

Figure 2

Source: Dr. Gates and Researcher [Ref. 8]

B. PRESERVING ELEMENTS OF THE INDUSTRIAL BASE

Defense critical technologies are identified, but not applied to the U.S. Defense industrial base. Defense critical technologies are those that are determined to be necessary to preserve the country's defense. Past Government policy has reflected that certain skills and abilities that apply specifically to the military must be maintained solely by the U. S. and are considered vital to national security.

The potential threat, the technology's ability to meet that threat, the ability to apply the technology to other divergent threat situations and the degree of immediacy and necessity must be measured. Critical technologies are more important to modernize than less critical technologies. These factors can be broken down into critical products/technologies and critical processes/production methods.

1. CRITICAL PRODUCTS/TECHNOLOGIES

The risk of U. S. involvement in a full scale conventional or nuclear war has supposedly declined since the breakup of the Soviet Union. Still, threats exist and the U.S. continues to focus heavily on research and development, and preserving critical Defense technologies. To maintain the world's strongest military, the United States must maintain technological superiority.

A key factor to the United States military's success during recent conflicts has been superior advanced technology weaponry. As proven in the Gulf war, the importance of technological superiority over numerical superiority was obvious. The United States was able to completely control the war largely because of superior weaponry.

There are many DoD programs that support and encourage R&D and product improvement. Deputy Secretary of Defense Atwood gave testimony to the House Armed Services Committee on DoD's approach to meeting Defense needs given decreasing spending. His plan consisted of investing heavily in R&D. The plan also called for limited production of new weapon systems. Manufacturing will be lean. Many systems may only be produced through prototypes. Instead of developing a whole new weapon system to meet threats, existing weapon systems may be extensively modified. [Ref. 20:p. 22]

There are many Government programs designed to preserve different areas of the industrial base. Examples include: Value Engineering, Best Value, In-plant Quality Evaluation (IQUE), and Small and Disadvantaged Business programs. These programs focus on specific aspects of the Defense industrial base such as: R&D, developing new technologies, product improvement and stimulating small business/small disadvantaged businesses.

2. CRITICAL PROCESSES/PRODUCTION METHODS

In the past, many Defense programs have heavily emphasized product technology development, with considerably less emphasis on the aspect of manufacturing. [Ref. 20:p.23] Conrad Peter Schmidt, an economic policy analyst with the private Defense Budget Project cautions,

> ...if you're protecting your technology base while allowing your manufacturing base to decline, then you're protecting only one of your pillars. [Ref. 20:p. 23]

IMIP is a program that is uniquely tooled to advance manufacturing capability. IMIP allows the Government to examine a Defense program throughout its life cycle and analyze the contractor's ability to produce the item on demand. Through IMIP, the company has an opportunity to increase its profits and reduce the military's costs. It supplies companies with opportunities to invest, with less risk, so they can modernize in areas that would not have otherwise been possible.

Preserving critical processes is most important to meet military manufacturing needs. The new acquisition process will require equal attention to both actual product development and process development. Secretary of Defense Cheney said:

> We well understand that the process of developing a new weapon system involves not only developing the technology and engineering into a weapon, it also involves developing the manufacturing process that would allow you to produce it in significant numbers.[Ref. 52:p. 40]

Defense manufacturing needs to be able to produce an item when it is needed. A greater manufacturing focus, particularly in the product design phase, would provide for lower costs, designer quality and reliability and faster marketing and utilization of newly developed products. We have been guilty in this country, both in industry and Government, of emphasizing "product" not "process" technology.[Ref. 20:p. 39]

If a production process does not have a strong ROI, the contractor will probably discontinue it and focus the organization's energies on market areas supplying sufficient ROI. Many Defense critical technology processes are solely military based and have no commercial counterparts. Using IMIP to preserve this type of technology to meet mobilization requirements may require considerable contractor and Government creativity.

> The Defense industry is already undergoing realignment. As current contracts close out and no new business is offered, companies will restructure to rid themselves of nonproductive assets.[Ref. 53]

Because the need to mobilize is uncertain, expected ROI on maintaining mobilization capability is also uncertain. If there is no mobilization, the contractor would not recapture the investment. However, having the capability to mobilize, if required, may have benefits to the nation that exceed the company's costs. For certain

critical processes, the Government may consider an "insurance like" investment justifiable regardless of its ROI.

3. PRODUCTION BREAKS/FOLLOW-ON PRODUCTION

Maintaining Surge/Mobilization capability involves the unknowns of restarting the production process after initial production has stopped. The value of IMIP should not be actual cost savings, but potential savings if the need to mobilize arises. According to Deputy Secretary of Defense Atwood:

> ...given the current inventories of high technology weapons relative to the smaller force, there will probably be a gap in production requirements for some systems. [Ref. 52]

Restarting production on prototype acquisitions will also have similar production breaks. Limiting production to prototype models implies a time lapse between technology development, and usable product manufacturing. When production stops, there is a loss in an organization's ability to restart the production process. [Ref. 23:p. 34] Maintaining the ability to restart production is essential to maintaining the industrial base.

One possible future role for IMIP could be for Defense critical technology processes that are used today, but may be lost if DoD should decrease or stop purchasing the item. Current platforms lacking sufficient inventory

for repair and upkeep may require the DoD to reorder parts from the contractor. It is unlikely that the contractor will be able to supply these parts on demand if the production line has been closed. Contractor facilities may have been sold off, scrapped (because no alternate use could be found) or retooled to meet another need.

There are a number of factors that effect the rate of learning during a production break for manufactured products. Production breaks may occur either as demand for an existing system declines or when the contract calls for producing only prototypes or limited numbers of weapon systems. The IMIP negotiator needs to evaluate these factors. If the weapon system cannot meet a threat because it cannot be fielded in sufficient time, it is essentially useless. The contractor must consider start up costs; including production delays in designing the production process.

a. *DISCUSSION*

Any interruption in the orderly and continuous flow of work from one work station to another is accompanied by an increase of labor hours and other costs when production is resumed. These costs are directly related to loss of improvement. Figure 3 shows the impact of a production break on unit cost. "Production1" represents the average direct labor costs per unit of the original

production process. The Z value represents the start up cost. Z measures the cost of the manufacturing interruption by comparing the cost of the last unit produced in the original production run to the cost of the first unit produced in the new production run. The magnitude of Z will

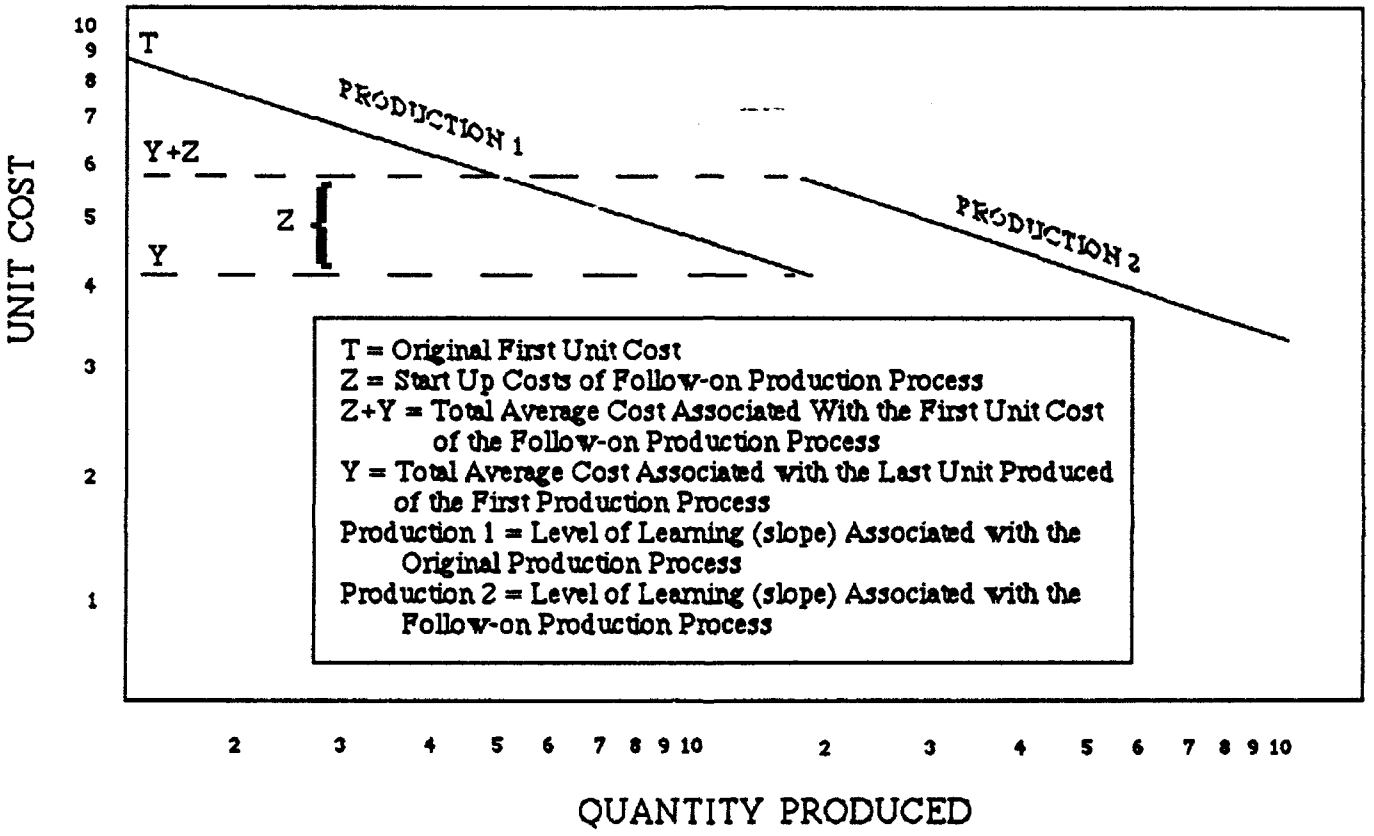


Figure 3

Source: "What Production Breaks Cost" [Ref. 23]

lie somewhere between Y (lowest impact) and T (maximum impact). The rate of learning (slope) should be greater than or equal to that of the original learning curve. This section will focus on defining, valuing and controlling start up costs and delays.

b. DEFINING

George Anderlohr defined five learning factors to identify learning losses due to production breaks. [Ref. 23:p. 35] These factors have been modified and updated into the following six key elements:

1. Personnel Learning This element includes the actual physical loss of personnel during the break. By reviewing personnel records, an auditor can establish this learning loss. Learning loss will also take place amongst personnel that remain in production. People lose their physical dexterity and familiarity with the product. There are losses of momentum, requiring reorientation to the production process.

2. Supervisory Learning This element includes the turnover of supervisory personnel as a result of regular movement. Management will make a greater effort to retain a higher caliber of supervisory personnel, so the physical loss is generally less than with production personnel. However, guidance by those remaining will still be reduced as familiarity with the job decreases.

3. Continuity of productivity This relates to the physical positioning of the production line, the relationship of one work station to another and the location of lighting, bins, parts, and tools within the work station. This also includes position adjustment to optimize the individual workers needs. Another major factor is the work in process buildup. Existing jobs are cleared so the line can be devoted to a new job.

4. Methods This represents process descriptions and written operating procedures that describe the original manufacturing process. As long as detailed reports of the original processes are maintained, method losses will be minimal.

5. Special Tooling New and better tooling are major contributors to learning. In relating loss in tooling to learning, the major factors are wear, physical misplacement, and breakage. An additional consideration may be adjusting for increased capacity. A change over from short run, or so called soft tooling, to long run hard tooling, may also be necessary.

6. Extent to which operations were suspended This element involves planning for follow-on production. If the organization expects follow-on contracts, the effects of

this element can be reduced substantially. This is the particular area where IMIP can aid in reducing the overall loss due to production breaks

c. VALUING

Weighing these elements requires the analyst to look at their effects in the follow-on start-up phase as well as their effect on the rate of learning (slope) in the new production learning curve. The organization must collect and monitor performance data and develop specific parameter values for the results to be useful. The effect of each element or the total loss of experience cost should be estimated. This can be done by analyzing historical data regarding changes associated with production breaks. The analyst can use regression analysis to develop an equation that best fits the set of data points.

The common parameter to determine the values of these factors is time. [Ref. 27:p. 40] Their values vary in magnitude of influence proportionately to the time period of interruption.

Figure 4 is a reproduction of Carlson's graph "Performance Versus Elapsed Weeks for an Interrupted Operation." [Ref. 27:p. 43] It shows how learning relates to time. The "Forget" part of the graph represents the key area to be measured in estimating the loss of learning due

to the break. It represents the forgetting rate (slope). This is the degree to which workers forget (become less productive) over time.

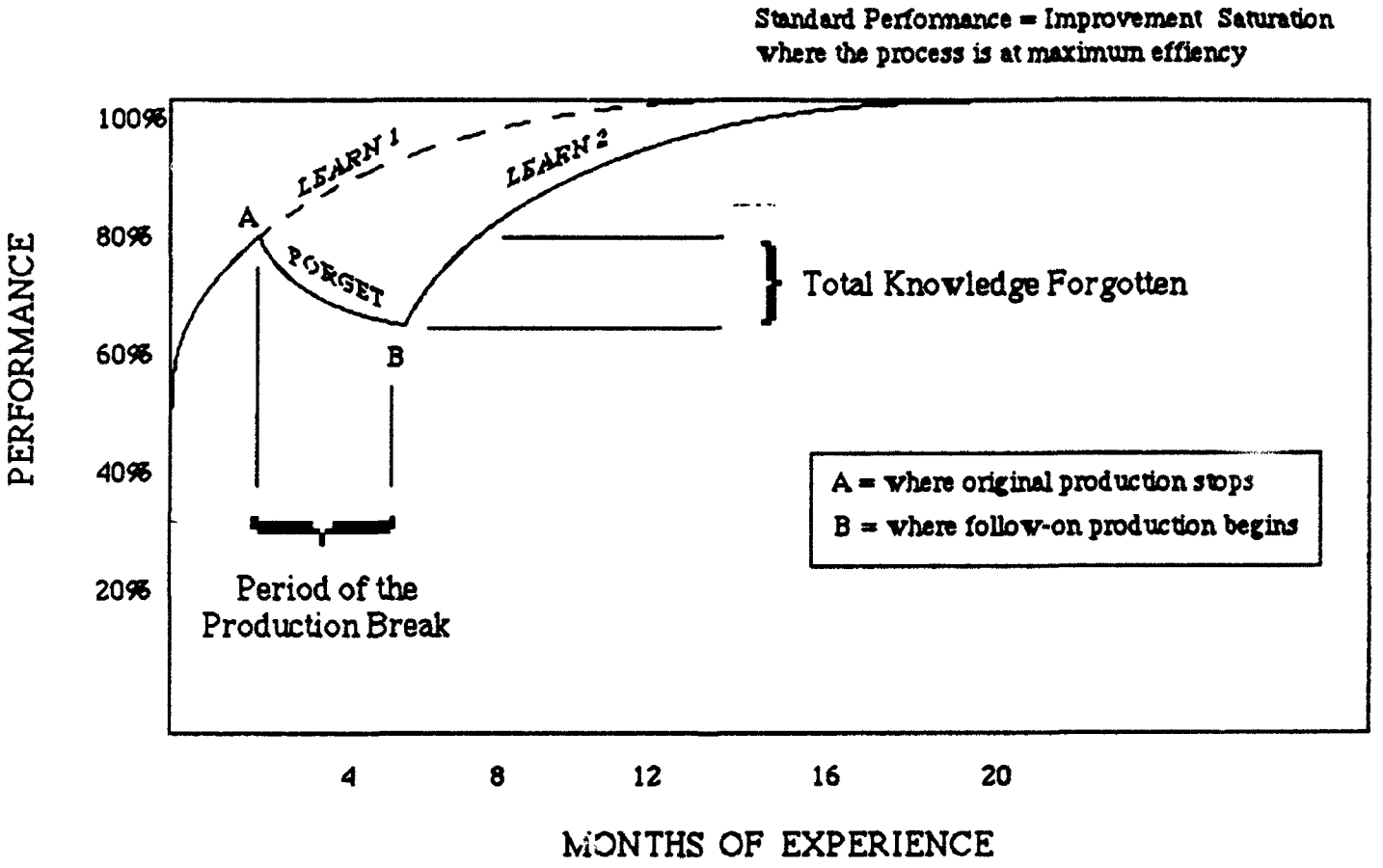


Figure 4

Source: Article "How Much Does Forgetting Cost?" [Ref: 27]

These factors may affect both the start up costs of the new production and the slope of the learning curve. This would give a completely different shape to "Learn2" than that of the process before the break. A successful negotiator should ensure that an organization balance the costs of these effects with the costs of reducing their impact.

d. CONTROLLING

By limiting the influence of these elements, the contractor can keep costs closer to value Y (Figure 3) and possibly improve the slope of the follow-on production process. The possibility for follow-on orders should always be anticipated. As a example, the Grumman corporation received a follow-on order for the C-2A project. "The old production line had been shut down for over seventeen years." [Ref. 26:p. 51] This is probably a highly unusual production break. Still, Grumman should have retained some portion of their previous abilities, so that they would not have to completely reduplicate their initial start-up costs. In Figure 3, the "Z" value would be closer to "T" (inflationary effects not included).

Before the break in production occurs, and as early as possible in the life cycle, the Government should

ensure that the organization's management is anticipating restarting production after a break period. This involves the following steps:

1. **Training.** Maintain an effective training program that includes communicating corporate values and objectives, education and skill development. Many skills are interchangeable from one job to another. Establishing greater line worker proficiency in these areas can decrease the effects of the transition. Concentration should focus on those functions that will not be transferred or used during the break.

2. **Flexible Manufacturing System (FMS).** FMS should be implemented that facilitates transferring capability between production processes. When mobilizing, FMS can ease the transition of the manufacturing facilities from the commercial to the Defense market. FMS involves maintaining flexibility in equipment and the workforce.

3. **Knowledge base.** In general, people resist change. Transferring from one job to another is easier for those who are knowledgeable about the transition and work in an environment that goes through periodic transitions. Develop a "lessons learned" program, where everyone has a chance to supply feedback on completed jobs. Feedback ensures mistakes are not carried over into future jobs. Establish a solid nucleus of knowledge. This can be

effectively accomplished by using teams, making decisions jointly with employees, employing craftsman, and maintaining good communications and flexible working hours, and constantly modernizing production technologies. These all contribute to forming a solid knowledge base which can be applied to various settings. The larger and more extensive the knowledge base, the more it limits the loss of learning during production breaks. [Ref. 25:p. 89]

4. Innovations and Upgrades. It is very doubtful that the follow-on production process will be exactly as it was before the break. Depending on the length of the break, technical innovations or more efficient methods may be introduced. Many procedures may be upgraded. The more complicated the production process, the greater the opportunity for technological improvement. It may not be in the Government's best interest to purchase highly automated equipment to prepare for follow-on production, if anticipated innovations may make that technology obsolete prior to the anticipated need.

It is also important that new technologies and production methods be sought out and investigated before a company restarts the production process.

5. Coordinating Resources. If follow-on jobs are known, the break period can be utilized to find more cost effective means of procurement and inventory control. The

break may give the contractor an opportunity to seek out more cost effective suppliers or upgrade inventory management techniques. Effectively controlling inventory and coordinating a firm's resources can substantially reduce production costs. Also, the volume of production may affect economies of scale. Companies with larger production volumes tend to produce more cheaply than their smaller contemporaries.

Anticipated production breaks are an ideal time to modernize facilities. If the facilities are going to be idle, or retooled to produce another product, improvements can be made for the transition with minimal disruption on the workforce. All of these factors have substantial military benefit to help maintain a responsive industrial base that can meet Defense needs when required.

Resolving potential problems in the negotiation phase can avoid the large start up costs and time delays attributed to follow-on orders. By requiring the contractor to address start up costs, and develop a comprehensive SMP to correct deficiencies, IMIP can help reduce future start up costs.

e. *TANK EXAMPLE*

As an example, the critical components of a tank; the engines, transmissions, armor, fire control and assembly were determined to be critical. But they are not critical enough to offer special support. [Ref. 20:p. 60]

Commercial manufacturers exist for both gas and turbine engines. With fire control systems, there is a great deal of commonality between tanks, ships, aircraft, etc. The more unique the process, the more difficult it is to reconstitute the required production skill should production be stopped. Armor manufacturing process is considered "pretty unique." If a determination is made that the Defense mission needs tanks with high quality armor, then it may be identified as a critical technology. [Ref. 52:p. 60] If there is no need to buy the product, this process is in jeopardy of being lost.

An IMIP could assist in maintaining this technology without spending money to develop a tank. This solution may involve finding an alternative use for the armor manufacturing process that would allow easy transition back to armor manufacturing should the need arise.

Obviously, the need for armor plate outside of DoD is not significant. However there may be processes that are similar enough for the contractor to enter, be competitive and profitable, and return to Defense production

if the need arises. Possible markets may include: foreign military sales, vaults, high security storage facilities and vehicles, ships with ice cutting capabilities, and space/NASA needs. The solution may also involve incentivizing the contractor to train employees and maintain special armor tooling requirements. By offering the contractor sufficient incentives to maintain the critical process, the Government could recall it when a need arises. If the technology is unique and cannot be stockpiled or acquired from other reliable sources, the Government may have to provide financial incentives for the contractor to maintain the process.

IMIP is the only DoD or Government program that is designed to adapt and implement proven process technology. Another program that focuses on the preservation of critical processes is Manufacturing Technologies (ManTech). [Ref. 58] The ManTech program assists the contractor in developing enabling technology projects. IMIP is often used to implement ManTech processes. Because it is not a proven technology, the technological risk is significantly higher for a ManTech program than for IMIP alone. ManTech may also be used to fulfill conversion strategy at the Service level.

f. CONCLUSION

Forecasting the effects of a production break is, at best, a qualitative judgement. Prior to establishing an IMIP, the product and the elements affected should be analyzed thoroughly to identify future potential problem areas. Establishing values for these factors can help identify performance production situations where learning is a relevant consideration. As production changes from multiple units to prototype and limited production, and current platform production processes are halted, planning for the production break is increasingly important.

Because of the transformation taking place in the Defense acquisition environment, many of these measures may not be initiated by the contractor without Government intervention. IMIP can supply the contractor with an effective incentive to implement a production break strategy that substantially reduces risk and start up costs for follow-on orders. To be successful, both parties must benefit by maintaining the surge capability. When a potential break exists, the contractor with assistance from the program manager, should develop a comprehensive SMP. The SMP should be thoroughly reviewed to ensure follow-on costs will be adequately controlled, and the contractor sufficiently benefits from the IMIP to justify the program.

The negotiator's ultimate goal is to bound the uncertainty involved, by controlling the defined factors that effect breaks on follow-on orders. Thus performance on future production will remain efficient. Even though mobilization may never occur, the capacity to mobilize may be required in some areas to effectively meet the needs of an emergency. Prototype production must allow for long term/multiple production even though only one item is being produced. Facilities, training and inventories must be readily available to meet surge requirements.

4. CRITICAL PROCESS VS CRITICAL PRODUCT

In Operation Desert Storm, mobilization time was extremely short. It currently takes about 15 to 20 years to field a new weapon system. [Ref. 5] If this indicates the time frame needed for future manufacturing surge capability, then there must be a significant reduction in start up time to utilize shelved technology.

The lengthy production life cycle may make it difficult for the industrial base to respond quickly to meet military requirements. It could force the military to depend on inventory. Inventory levels on many items are being reduced and a growing number of major weapon systems and components will be produced in insufficient quantities to ensure success in a threatening situation. [Ref. 52] These items are only scheduled for lean or prototype

production, then the process will be shelved until it is needed. The success of technology in Operation Desert Storm shows that the ability to process high-tech systems is even more important today than in the past. More importantly, it is an effective deterrent. In fact, it is arguable that the process is actually more important than the technology itself.

> Wars may be prevented by the threat of weapons under development or "on the shelf" but wars will be won with weapons in the field at the time of outbreak. [Ref. 18]

If current trends continue, other countries will eventually develop these technologies, or technologies which would make the current ones obsolete, whereas it may take years to actually be able to utilize these technologies.

Surge capability is primarily relevant for either long lead time conflict or long duration conflicts. Operation Desert Storm had a lead time of six months. Because the conflict was small (relative to other conflicts e.g. Korea, Vietnam, WWII) and U.S. inventories were large, surge needs were limited. If a similar conflict arises, the U.S. may not have adequate inventory to respond. Through the use of modern and flexible manufacturing processes, time may be sufficient to move from prototype to large scale production and field a usable product.

With the break up of the Soviet Union, the world threat, and risk to the U.S. has changed dramatically. The Government's strategy must include these differences, and

> ...make the most of the Defense dollars saved to benefit the overall economic and industrial health of our society, while maintaining a skills base that can be called upon when necessary in the face of emerging threats. [Ref. 50:p. 5]

This strategy has to meet the country's military and economic needs by developing and maintaining reserve capacity and the ability to apply current commercial capacity to Defense needs, while preserving and generating industrial strength and job security. The strategy must also be integrated into the IMIP determination process.

C. TRANSFERRING SKILLS SURGE/MOBILIZATION

With limited and prototype production processes, the most valuable benefits to be derived for Defense manufacturing are reducing both life cycle times and the effects of production breaks. Meeting surge/mobilization requires that the U.S. manufacturing industrial base be able to respond rapidly and effectively to a military crisis situation by transferring needed skills and facilities to Defense.

1. FLEXIBILITY

The ability to alternate from one product line to another can be extremely important. It can also be an

effective incentive for a contractor to ensure profitability in dealing with Government contracts. Being able to produce multiple products allows for easy transition between products. If one product is in higher demand than the other, the company can expand in the profitable market.

Rapid reproduction to meet mobilization often involves expensive materials and equipment. A company cannot be expected to keep large pieces of machinery and expensive equipment idle until the DoD places an order. "The concept of duel use technology should be aggressively pursued wherever possible." [Ref. 52] Also, the probability of a threat, the type of threat, and the best way to meet that threat is constantly changing. This further substantiates the need for product flexibility. The IMIP could encourage the contractor to purchase flexible equipment that can meet multiple needs in both the commercial and Defense sectors. [Ref 20:p.31] Flexibility also requires that personnel be trained to make the transition as effectively as possible. "The importance of flexibility has not been recognized in past IMIPs." [Ref. 11]

2. CONSOLIDATION

IMIPs are intended to modernize the production capability of selected weapon system programs. As the market becomes smaller, it may become increasingly necessary

to limit the number of production sources for certain critical products and coordinate production across Services.

This would allow the remaining sources to achieve economies of scale and capitalize when necessary. The threat of foreign competition and the degree of oversight by the Government would counter monopolist tendencies by the contractor. It is also vital that the Government utilize the TQM philosophies; particularly that of cooperation versus competition. This environment can assist in getting new technologies into the market faster and ensure the Government is getting the best product at the best price. [Ref. 22]

The benefits of maintaining a small supplier base outweigh those of maintaining a large competitive environment. [Ref. 52] In the past the Government has always expressed the importance of competition in Defense contracting. The more companies competing in a given market, then the lower the price to the Government. Unfortunately, highly competitive companies also tend to be less capable of undergoing capital investment and taking on risk. [Ref. 59] The larger companies, and those that are threatened by competition but not overly so (such as in an Oligopoly) are still incentivized to make manufacturing and technology improvements. These companies have the ability to take on

risks and make capital investments. Through these risks and investments, they will ultimately produce a product more beneficial to DoD.

> The need for DoD to support industry consolidations is real and should be pursued where they make sense.... If we are going to downsize to the point where we have one or two producers for a given type of equipment, we must be certain that we select high quality producers in each source selection, because losers of any particular competition may be forced out of business. [Ref. 52]

As an example, if there are currently five American Defense contractors that produce jet engines, it may not be in their best interests to conduct an IMIP on each one. Despite the increase in efficiency, it may be difficult for all five to stay profitable with small contracts going to each. These contractors would lose money or require other Government incentives to stay in business. Whereas, if an IMIP was conducted on two (or even one) of the facilities, there would be more contracts for each remaining contractor. Instead of five companies struggling to stay in the market, there would be one or two healthy and successful businesses.

Those remaining in the market would have to produce a larger variety of engines, in smaller numbers. They would have to keep their operations flexible to keep their profits high and meet the large variations in DoD needs. The greater their ability to shift production between products, the greater the contractor's potential profits. The benefit

to the Government is that they could consider a larger number of variations to jet engines in developing a new weapon system, or modifying a current weapon system.

Maintaining multiple suppliers for similar products is no longer a viable option for the Industrial base. There has been increasing pressure on the military to do more joint purchases and work closer together than in the past. Many items are similar in design function and process, and are used by more than one Service. In the past, each Service purchased these items individually, and from different suppliers. By combining each Service's purchasing power centrally, the military can still maintain its monopsony power and force suppliers to produce efficiently, and thereby meet conversion objectives.

As the Defense market shrinks, it is also becoming increasingly cutthroat. Large contractors are struggling to survive on the remaining business. The problem is further complicated by many other factors such as uncertainty of future contracts, policy and regulations, and adversity. Defense mission continues to vary from year to year and despite the establishment of long range goals.

Many programs that six months ago were almost guaranteed funding are now threatened with being cut. The effects of this uncertainty towards the military, and its contracts has created a contracting atmosphere that is

becoming increasingly adversarial and risky. No one wants to invest in a program (developing manpower equipment) when the program is in danger.

Also, In the past Defense contractors were some of the most successful companies in which to invest. Today, Defense contractors are avoided by investors. Because of market uncertainty there is major restructuring amongst the large Defense contractors. [Ref: 3]

If we continue acting without considering the implications, we may have multiple sources that produce efficiently but, because of the low scale operations, none of which would be sufficiently profitable. These contractors would eventually leave the market. Those that remained would not have had occasion to modernize. The long term ramifications may be a few inefficient contractors. "If the restructuring continues in the Pentagon's current laissez-faire manner, it could result in the loss of critical design and manufacturing capabilities." [Ref. 50:p. 2]

We must therefore control the decline in Defense production by focusing on key technologies, and key technological suppliers. Some companies have had a highly successful relationship with the Government in the past (i.e., consistently providing best product at best price, responsive and responsible, and providing a professional and

cooperative effort). It may be more beneficial to assist these companies then those that had only a marginally successful relationship with the Government.

The need to manage the consolidation process to best achieve overall goals for DoD and the national economy should be reflected in the IMIP thinking process. Currently IMIP does not address the major national issues in the conversion strategy. Also, IMIP is currently run by each Service, and at the Program Manager level. A centralized DoD IMIP coordinator does exist. However, IMIP is not conveying a clear direction on committing the Services to meeting Government needs. [Ref. 17]

Most program managers do not have the scope or authority to make IMIP decisions based on commonality. Government Program Managers are evaluated on the success of managing a particular phase of a project. It is difficult to quantify commonality benefits or the conversion success because they do not show immediate value to the program. For this reason, a Program Manager may not be inclined to consider these benefits as important and instead focus on short range cost benefit type programs.

3. COMMERCIALIZATION

To the largest extent possible, the DoD should use commercial products and commercial production facilities to maintain its industrial base. Commercial production has

many benefits. There is significant growth in commercial high technology, which complements DoD Research and Development efforts. In addition, the commercial market is significantly more stable and less restricted than the Defense market is by itself. Finally, commercial market competition assures the Government buyer that they are receiving the "Best Product" available. [Ref. 52]

If DoD continues its current procurement policies as demand decreases, including maintaining sources and independence across Services, Defense contractors will have trouble making profits. As a result, DoD may be forced into Government Owned-Contractor Operated (GOCO) or Government Owned-Government Operated (GOGO) facilities if it is unable to stimulate the industrial base to provide necessary goods and material. It would be more cost effective in the long run, and in line with the conversion strategy to provide incentives to stimulate the commercial market and maintain commercial Defense manufacturing facilities. [Ref. 5]

> Noted industrialist Dr. Jacques Gansler stated that "the problem in integrating civil and military options is not technology. Rather, it is the unique way in which Defense business is done." [Ref. 50:p. 4]

Many changes are currently taking place to revitalize commercial Defense production that are not IMIP related: examples include making specifications more commercially adaptable and buying commercially available items.

IMIP could also help by successfully justifying the preservation of the process in a SMP IMIP could also help the Defense contractor find a commercial market niche, where it could be successful, and still transfer back to the Defense market when needed.

4. MULTIYEAR CONTRACTING

The Government needs to consider the long term implications of its actions. In Prototype and lean production, provisions are still needed for surge capability even though no foreseeable threat exists. Multiyear contracting can significantly reduce mobilization time and give the contractor the security of future business, and the ability to plan around the Government's surge requirements.

D. DEVELOPING AND ENCOURAGING NEW PROCESSES

1. IMPROVED PRODUCT

When making process improvements, product improvements are often discovered. Upgrading the process may allow for unanticipated product refinement.

In general, projects that provide quality improvement will result in improved performance and/or reduced life cycle costs.[Ref. 14:p. 40] There will be times when an IMIP improves quality without an associated cost reduction. These quality improvements are defined and measured in accordance with the contractor's quality assurance program. They allow the organization to provide the Government with a better value.

2. SAFETY/HAZARDOUS MATERIALS

In developing Defense products, safety should always be a concern. In the past, inadequate safety procedures have proven to be very expensive to the Government.

There usually are benefits to limiting the risk of future problems associated with hazardous materials. This includes using less hazardous materials and properly disposing of hazardous byproducts. There have been many creative means to dispose of hazardous materials that may ultimately save the Government money and lower future liability.

People are becoming increasingly environmentally conscious and concerned with hazardous materials. Military suppliers produce large quantities of hazardous materials and byproducts. By modernizing, a contractor could reduce any danger associated with the product or process. This

could substantially decrease future litigation costs. It could also avoid having to retrieve and redispose something that was previously disposed of incorrectly.

The military has recently undertaken steps to improve hazardous materials handling and disposal. The Government's liability for the contractor's hazardous material disposal practices is also currently under review. With regulations becoming more stringent, it may be beneficial for both the Government and the contractor to avoid future liability by exceeding current accepted practices. Through IMIP, waste reduction could be substantiated as a benefit to avoid future risk of litigation and damage payments.

3. REDUCED LEAD TIMES

This benefit ties-in very closely with surge capability. Any reduction in lead time, particularly in manufacturing, can ultimately improve the DoD's ability to mobilize in times of crisis.

This factor can be affected most dramatically by inventories held by the contractor. The Defense contractor has greater control over production delays, material quality and cost. It is vital that the Defense contractor have an effective materials management program and be able to get needed supplies when necessary.

4. FUTURE INVESTMENT OPPORTUNITY

Growth increases the potential to grow. Upgrading a facility or a process often has collateral effects/benefits. This factor is based on an emergent strategy. A contractor hopes that greater market opportunities will arise through modernizing. [Ref. 33] These changes may allow the company to enter new markets or make advancements not previously considered. By not capitalizing, the company becomes dependent upon the environment to develop new market opportunities.

If future potential opportunities were the single determining reason for modernization, the financial risk would be very high. Neither the Government nor the contractor could justify it through an adequate ROI. Despite a clear reason for modernizing, many corporations have been very successful from strategies that emerged after modernizing.

If the Government is not satisfied with a current process, but it is the only one currently in existence (a scenario that may become increasingly common), modernizing may allow further advancements not formerly considered.

E. CONCLUSION

Many of these qualitative factors mentioned above are interrelated and can be quantified (with some difficulty) in

terms of cost reduction/avoidance. There are many possible statistical options to develop and measure them. However, the value attributed to each factor, and the process itself, would be different for each person conducting the measurement.

DoD is a large diverse and complex entity. Conversion will depend on the infrastructure as a whole. It is impossible for the Government to control every market aspect, but assistance should be provided in those areas that are most important (critical technologies). Preserving the potential for expanding air ground and maritime forces will require extraordinary foresight and political courage. [Ref. 36:p. 41]

Many of these factors cannot be applied directly to an IMIP, but they all need to be considered in the IMIP determination process. IMIP should work in concert with other Government programs; not as a replacement, or substitute.

When DoD establishes an effective means of weighing these factors, it is important that it consider all potential costs and benefits derived from IMIP. Attention to these factors must begin in the earliest phases of a program's life cycle and continue through product development and manufacturing.

V. IMIP AND THE CONTRACTOR

A. INTRODUCTION

The Industrial Modernization Incentive Program is a joint venture between military and Defense contractors. [Ref. 14] Current Defense market conditions have made it increasingly difficult to make adequate ROI. [Ref. 3] Also, major Defense contractors have substantially decreased capital investment in recent years in reaction to market changes [Ref. 3]. Solutions developed through IMIP will become increasingly important in this changing environment. Productivity partnerships through IMIP will be critical to delivering reduced quantities of hardware at a more affordable cost. [Ref. 14:p.5] Since its inception, IMIP has evolved to meet these needs through streamlined relationships and rules, reduced emphasis on cost savings, greater emphasis on implementation, stronger emphasis on indirect factors, an improved method of reaching the subcontractor base and heightened management commitment. [Ref. 14]

IMIP accomplishes its goals by stimulating private sector capital investment in improved facilities, processes and systems, while Government and private industry share the risk and benefits of those improvements. [Ref. 14:p. 1] The

types of incentives include; savings based, direct incentives which are not savings based, incentives based on market forces, and Government funding. The Government will also protect the investment of private companies in high risk ventures. [Ref. 14]

The type of incentive to be selected is a part of the early discussions between Government and the interested contractor. The negotiations are dependent upon the needs of the sponsoring Government Agency and the strategic modernization plans of the company seeking the contract. For IMIP to be effective in the conversion process, it must be applied to all types of contractors, prime contractors and subcontractors, and large and small companies.

B. APPLYING IMIP TO SMALL COMPANIES AND SUBCONTRACTORS

The subcontractor base is essential to the continuing health of the Defense industrial base [Ref. 14:p.7]. There has been a growing concern that the subcontractor base is shrinking and losing its edge in technology and productivity. [Ref. 14:p. 8] IMIP has proven to be one of the few Government acquisition tools which can effectively reach all tiers of the subcontractor base. It has been successfully implemented at the subcontractor level through

prime contractors such as: General Dynamics, GE Aircraft Engines, Pratt and Whitney, Northrop, McDonnell-Douglas, Hughes, and Grumman [Ref. 1].

Current statistics show that 90% of the companies that make up the U.S. industrial base are small companies with fewer than 150 employees. Typically 65% of weapon system production is subcontracted, and many times to those small companies [Ref. 14:p. 4].

In general, most small subcontractors do not have the staff or the expertise to deal with complex contractual requirements. Revisions to IMIP have decreased documentation and reporting requirements and reduced turnaround in the decision making process. This has improved and expanded its benefits for the second and third tier suppliers, making IMIP much more attractive to the small businesses. [Ref. 14: p.5]

C. IMIP PROCESS

Contractors can receive IMIP approval by submitting a qualifying SMP. The SMP represents the company's vision and identifies specific improvements, long range goals, objectives and other pertinent information. It also identifies projects that merit investment. The contractor SMP must show quantifiable Government benefits from these investment opportunities, before it will be considered a

worthy IMIP opportunity. The contractor must provide sufficient justification for the Government to provide an incentive. [Ref. 14]

The SMP describes the scope of the facility analysis and how it will be conducted. It discusses duration of the study, provides rationale, and shows in detail what technologies, processes, equipment and facility improvements will be considered. The proposal also provides insight into management philosophy and structure, and other pertinent information. It also specifies how a cost/benefit analysis will be done. The proposal describes economic analysis and the cost/savings tracking modeling to be developed or used to make trade offs between projects. [Ref. 14:p. 22]

The contractor should address as many of the GROI factors as possible, as well as anticipated hardship to be incurred in the process. The Government's intent is to provide the minimum amount of funding required to incentivize the contractor to modernize. Inaccuracies in the SMP may result in one or both of the parties acquiring extra burden. Significant contract risk can be avoided by ensuring a accurate and complete SMP is submitted.

Sub-tier contractors usually deal with the prime contractor. Upon establishing an IMIP program, a prime contractor manages the program at the subcontractor level on behalf of the Government. This method is normally chosen

when subcontractors have one principal prime contractor for DoD business, or a program office does not have adequate personnel to commit to a program. The prime contractor administers the program, establishing a formal program office to provide management, control, financial incentives and technology assistance. Many subcontractors are involved with more than one DoD project. In that case, the IMIP may be managed by a designated Government program office. The Government program manager will establish the guidelines for acceptable IMIP prior to initiating a program. [Ref. 14]

D. FACTORS OF CONTRACTOR IMIP

Both parties in an IMIP contract seek an adequate return on their investment. The contractor hopes to achieve an advantage through IMIP that will ultimately improve its overall market share, earnings, competitive position or decrease risk. [Ref. 15] The program allows for both parties to essentially produce an agreement that will be mutually beneficial. IMIP benefits to the contractor are measured based on a Contractor Return On Investment (CROI). CROI is similar to GROI and shares many of the same benefits.

Contractor capital investment planning involves a number of managerial and financial factors. It is justified if the project can earn a positive net present value. This means that the project's rate of return must exceed the hurdle rate. The hurdle rate represents the minimal level of return required by the company before it will invest in the project. An effective hurdle rate should consider all types of factors including those difficult to quantify (e.g., the value of forgone alternative investments).

The reliability of information and extent of the analysis will determine whether these measurements are useful. The contractor should consider several factors and possible incentives prior to entering an IMIP contract with the Government:

Government Funding This is usually the prime motivator for the contractor to modernize [Ref. 14:p. 57]. The Government may offer award fees at various stages in the IMIP process to include the development of an effective SMP and factory analysis. The Government may also provide considerable up front cash investment. For cash poor contractors and small businesses, this reduces risk and the financial burden of up front funding. The contractor determines if capitalization is in its best interests, with

the costs of the analysis being shared by the Government. In the commercial market, the contractor would incur the full burden of the analysis.

Potential Follow-on Contracts Modernization also increases the potential for follow-on contracts. Once the Government and contractor have conducted a successful IMIP, the contractor should be more competitive in the future.

Through multiyear contracting, the Government could also ensure a long lasting relationship with the contractor. This relationship could further encourage the contractor to invest in long term improvements.

Crossover on Commercial Production The company may be able to use the upgraded facility for non-Government related projects. Improvements in commercial production could also improve the company's overall success.

Commercial crossover can be a very complex and difficult process for a company that has been exclusively a Government contractor. The commercial market is regulated differently, and may also require the company to develop marketing and product distribution skills. IMIP could assist the contractor in finding markets and developing implementation strategies.

Sharing of Risk If benefits derived from the program are uncertain, but the potential for savings is significant, the Government may be willing to share investment risks.

This is a key advantage to using the Government as an investment partner as opposed to another financial institution.

When modernizing, there is significant financial risk. Both the contractor and the Government must realize an adequate financial return in exchange for the level of risk being assumed. [Ref. 14:p. 37] This may depend on the potential for future Government contracts (this can be decreased through multi-year contracting) or the degree to which modernization is transferable to other markets (flexibility). Because the Government shares in the costs associated with the factory analysis, risk burden during the determination process is also shared.

Reduction in Costs Modernizing can help the contractor reduce operating costs. Operations may be streamlined and more efficient. Also, the Government may assist in financing up front costs. The Government would then receive a price reduction for its assistance and the contractor would benefit through subsequently higher profits.

Productivity Savings Reward (PSR) Assuming that profit is a contractor's primary long term objective, the project will be rejected if the contractor estimates that the investment opportunity will not provide a long term return on its investment. The contractor's profit is limited on

Government contracts, so the reduced price would be shared by both parties. This would result in an improved margin over a non-IMIP agreement. [Ref. 12]

Increase in Production Capacity and Efficiency

Improving capacity or efficiency may enable the contractor to improve its present position in the market or enter new markets. Other benefits may include decreases in production waste or lower inventories.

Learning Induced Through Upgrading Organizational change results in learning. The learning may stimulate company opportunities and offer more directions in which the company can grow.

Future Investment Opportunities If a major technology is expected in three years, upgrading the facility now may hinder, delay or supply unwanted costs to implementing the new technology in the future. For example, every year improved personal computers models are available on the market. Purchasing the newest state-of-the-art system may require significant capital outlay and in three years the system may be obsolete. The contractor has to make a determination whether it is more beneficial to buy now or wait for the future improved models.

Upgrading now may also be advantageous and improve investment opportunities by opening more markets. Another option is a partial modernization. Partially modernizing

with further improvements pending on the success of these upgrades allows greater flexibility in the upgrade and decreases the risk of the investment.

Time Value of Money If the benefits to be derived from the capitalization are not immediate, the contractor must consider the time value of the investment and when the benefits will be derived. All other things being equal, the longer it takes to get an adequate ROI, the less beneficial the investment. Both the Government and the contractor strive to see immediate benefits from an IMIP.

Increased Market Share The contractor must consider what effects the facility change will have on the rest of the market. Capitalization/Improvements by some companies can force less efficient companies out of the market, resulting in greater market control for the contractors undertaking the improvements. A large market share allows the company greater autonomy to set industry standards, perform market sampling, achieve greater economies of scale and receive higher profits.

Environmental Protection Modernizing to reduce the amount of hazardous materials used or created may indirectly benefit the company's future Government and commercial contract potential. It may also avoid possible litigation and negative publicity.

Other Capitalization Investment Alternatives A bank or other financial institution may be an optional means of financing. If the contractor has a large interest in the commercial market, it may be more advantageous to use a financial institution. Financial institutions do not share in the savings generated by modernization and tend to have less stringent requirements than do Government Program Managers. If all other avenues are exhausted, Government funding may be the single most important incentive to a contractor.

Large companies usually have established relationships with lending institutions and may have financial resources available for modernization. Small companies may not have the necessary resources to obtain funds for modernization, or an established business relationship with a lending institution.

Disruption From Upgrade The contractor may be hesitant if the modernization will take a long time and disrupt the regular work flow. Modernization may stop or slow down production. It is important to minimize this factor when developing an SMP.

Administration of IMIP The contractor must also consider who will administer the program, the level of oversight, the type and number of reports and the time involved in answering and processing reports.

Revisions to the IMIP include provisions reducing the additional costs and time delays previously associated with administering IMIP programs. Many of these changes have only recently been set in motion. Early results seem to indicate that all parties prefer the new system [Ref.5].

Another consideration is that capitalization opportunities that ultimately increase the company's profitability may fail to meet Government requirements. The contractor should be aware of these requirements so that it can prepare an SMP that properly forecasts the appropriate Government benefits through a CBA. All of these factors need to be discussed, weighed, and agreed upon before entering into an IMIP program.

E. CONCLUSION

IMIP is a very flexible and useful incentive program for all types of DoD contractors. It has become easier and more accessible to them within the past few years. IMIP is not the only means for companies to capitalize, and is usually offered only if all other means of modernizing are exhausted. Before considering IMIP, the company must also consider the Government's position. The Government is also looking for a return on its investment. The contractor also needs to consider other factors such as audit procedures, procurement policies, Government attitudes, late payments,

Defense specifications and submission requirements before entering into any agreement with the Government. Standards set by the Government may be difficult to achieve, or not entirely in the companies long term best interests.

IMIP is one of many options to be considered by Defense contractors. By considering all the factors presented in this chapter and applying them to the decision making process, contractors can determine if it is in their own best interests to modernize, and how it should be accomplished.

VI. CONCLUSION/RECOMMENDATIONS

A. INTRODUCTION

This chapter will first discuss the conclusions and recommendations resulting from the research, followed by answers to the research questions. Finally, recommendations will be made concerning areas for further research.

B. CONCLUSION

The conclusion is based upon research from extensive literature review and interviews with industry and Government experts.

IMIP is underutilized. It is not used for mutually beneficial modernization projects to the full extent possible. A critical assumption of the IMIP is that each savings item has measurable and auditable values. [Ref. 14: p. 29] Even though the benefits are difficult to quantify, IMIP could be effectively applied to maintaining critical processes that would otherwise be lost. This under utilization is due to:

1. Limited Effectiveness of GROI. There is no clear means of determining what processes and products are "critical," and no way for acquisition personnel to make their own determinations. Considering the concerns of

Government leaders, IMIP focuses too heavily on reduced operation and support costs. Its application in the Defense manufacturing process could be far greater, and much more valuable, in preserving the industrial base. [Ref 17] In the past, conversion associated benefits which may have significantly more value to the country, have been considered as supplementary to cost savings.

2. **Inadequate Funding.** IMIP programs are funded through Government Industrial Base Program Element funds, Acquisition funds, and funds invested by industry. The IMIP should focus on centralized Government goals vice project goals and should therefore have greater accessibility to centralized Government funds. Other than funds invested by industry, current funding support is uncertain and diminishing. [Ref. 17]

3. **Mixed Guidance.** With mixed guidance for IMIP from the leadership of the military Services, it is difficult to establish the budgetary and organizational infrastructure necessary to sustain the program.

> Since there is no clear chain of program advocacy, many divergent levels of direction, along with diffused and sometimes contrary instructions, are evident. [Ref. 17:p. 9]

C. RECOMMENDATIONS

By implementing the following recommendations IMIP will be more usable and effectively meet the conversion needs:

1. Jointness. Combined purchasing can enhance DoD monopsony power. All Services are seeing a significant reduction in buying power. Jointness allows for a strong single face to the contractor and greater buying power.

2. Recognition/Reward. Recognize the PM for giving conversion modernization incentives to contractors. The PM should always act in the Government's best interests, which may not necessarily be in the program's best interests.

3. Clear guidance. Government acquisition needs must be clarified. A strict definition of critical technologies and a means of rating their importance is vital to maintaining a U.S. Defense industrial capability.

4. Consistent level support. The Government needs to be both flexible and consistent in adapting to military needs. [Ref. 17: p. 9]

5. Education of personnel. IMIP needs wider recognition in industry and DoD. People need to be made aware of the various options available to them in developing and maintaining an effective Government contract relationship. Acquisition personnel also need to be informed of how to effectively use IMIP.

6. Complete Endorsement. Support for the program must be completely integrated within the Service. For IMIP to be successful, it also needs to have the complete support of Congress, OSD, DLA, and all the Services.

> ...Limited manpower resources are frequently reflected in the contracts area where IMIP is relegated to second class status. This leads to long delays and often tedious negotiations. [Ref. 17]

7. GROI. Conversion factors need to be more important in the decision process. Potential facilities upgrades should be weighed as to their total Government benefit. Extend life cycle costing to include the conversion benefits.

8. Sufficient Funding. Centrally located funding is needed in sufficient quantity to effectively meet conversion.

9. Ratify The Proposed Revisions to IMIP. Recommended changes by the AIA and the IMIP guide committee should be integrated as soon as possible into the newly proposed guide. These changes address many of the researcher's recommendations as well as decrease program complexity. This would make it more usable to all types of contractors.

D. ANSWERS TO THE RESEARCH QUESTIONS

Primary Research Question: As the Defense acquisition environment changes, can IMIP effectively incentivize Defense contractors to make capital investments to improve their operations and benefit the military?

IMIP is a very flexible program that has an unlimited variety of applications in the future acquisition environment. To maximize its usefulness to the Government, IMIP must evolve to further recognize Governmental needs. This new direction should focus heavily on risk reduction/qualitative improvements such as flexibility and surge and mobilization needs. By implementing this Thesis' recommendations, IMIP can effectively maintain critical processes that would otherwise be lost.

Subsidiary Research Questions:

1. What are IMIP's goals and objectives?

IMIP was developed to encourage contractor financed investments to refine production efficiency, reduce cost, improve quality and increase reliability. It is a joint venture between Government and industry to reduce acquisition costs, accelerate the development of modern equipment and management techniques, and broaden the industrial base. The Nation's economic condition, international competition, rising acquisition costs and the

potential for technological improvements made it of paramount importance to improve acquisition efficiency in the 1980s and 1990s.

2. What are the Government's and DoD's goals and objectives with respect to Defense procurement?

1. Developing quality management programs-Defense firms and the Defense Department must foster a commitment of increasing productivity and promoting a world class industrial base.
2. Transferring skills-Successful Defense conversion requires not only transferring skills and facilities away from Defense, but being able to transfer them back to Defense when necessary.
3. Promoting technical education-Educational programs in engineering, especially in the areas of manufacturing and production processes should be supported.
4. Encouraging new manufacturing techniques-The United States must not only maintain its weapons superiority, it must seek ways of increasing its national competitiveness.
5. Preserving elements of the Defense industrial base-Unique Defense systems critical to national security should be retained. as an example, heavy industries, especially ships submarines, are of particular concern.
6. Changing acquisition policies-Regulatory barriers to commercial/Defense integration should be eliminated, thus maximizing the use of commercially available components and production facilities. [Ref. 50:p. 5]

3. Are all benefits, including those that are difficult to quantify, assessed according to their military value when measuring GROI?

No, Government leaders are putting far greater emphasis on conversion factors, and less on cost improvements than is presently reflected in IMIP's

4. Are IMIP successes rated on these benefits?

No, IMIP successes are based on reduced operation and support costs. Its application in the Defense manufacturing process could be far greater and much more valuable to preserving the industrial base. GROI needs to be restructured to properly weigh each factor. The other factors to be considered are extremely difficult to quantify in terms of cost savings and cost avoidance. Greater focus should be placed on other benefits such as flexibility, and surge capability.

5. Can IMIP reduce the decline of manufacturing capability in the Defense industrial base?

Yes, it is important that when DoD establishes an effective means of weighing these factors, that it considers all potential costs and benefits derived from IMIP. Attention to these factors must begin in the earliest phases of a program's life cycle and continue through product development and manufacturing.

6. What IMIP changes can further its benefits to the Defense industrial base and the Government?

While developing a Strategic Modernization Plan (SMP), all factors need to be considered. IMIP is by no means a save-all for every DoD program but it has the capacity to be utilized far greater then present. This should be done to meet the full intent for which IMIP was designed.

The IMIP's flexibility allows for an infinite number of applications. An area where IMIP could make significant benefits would be in limiting the effects of production breaks. By implementing the Thesis recommendations, IMIP's usefulness to the Government could expand significantly.

E. AREAS FOR FURTHER RESEARCH

1. Develop a model by which a Service could effectively weigh and apply GROI factors to limit the effects of breaks in production in a lean or prototype acquisition. Producing a small number of products is lean production. Producing one of a particular weapon system is prototype production.
2. IMIP funds are available for facility analysis, design, and integration of technologies. Determining whether IMIP should incentivize the contractor to commercialize, develop dual uses for their production processes, assist the contractors to seek out ways to stay in the business or preserve critical Defense technology?
3. Determining whether IMIP should be expanded to assist in modernizing GOGO, GOCO facilities.
4. Develop a model to preserve current platform support processes when there is an anticipated break in production.

LIST OF REFERENCES

1. United States Air Force, "Air Force New IMIP Orientation Agenda," Government Printing Office.

2. United States Air Force, "Building A World Class Industrial Base... One Partner at a Time," Government Printing Office, Wright-Patterson AFB OH, 1991.

3. Anders W. A., "Rationalizing America's Defense Industry," Keynote Address for Defense Week Annual conference," 30 October 1991.

4. American Defense Preparedness Association, "Manufacturing Technology: The Key to The Defense Industrial Base," 5 October 1989.

5. Interviews between Davidson R., Naval Ocean Systems Center, U. S. Navy, San Diego CA, Markall J.S., CSC/NRAD and the researcher, Summer 1992.

6. Task Force on Defense Spending the Economy and the National Security, Final Report.

7. Assistant Secretary of the Navy (RD&A), "Acquisition Planning Guide," Washington D.C., April 1992.

8. Interview between Gates, W., Instructor, Naval Postgraduate School, Monterey CA, and the researcher, Fall 1992.

8. Director of Defense Research & Engineering, "DoD Key Technologies Plan," July 1992.

9. U.S. Government Printing Office, Federal Aquisition Regulation, November 1990.

10. Telephone conversation between Gable, J., MAJ, United States Air Force, Wright Patterson AFB OH, and the researcher, June 1992.

11. Interviews between Hering J., Fiorino, T., PM2, Production Technology Inc., and the researcher Summer 1992.

12. Hering, CDR J., Brant L., "Summary and Status of the DOD Industrial Modernization Incentives Program (IMIP)," National Defense, 68:pp. 23-26, January 1984.

13. "Historical Navy Involvement in IMIP Case Study," (draft) Production Technologies Inc. PM2, January 1992.

14. IMIP Guide Committee, IMIP Guide (Draft) Rewrite first cut, May 1992.

15. Webber, J.J., Presentation notes "IMIP Briefing, DOD Components Initiative," 20 April 1992.

16. IMIP Budgets in the Military Departments, circa October 1991 and July, 1992.

17. Industry Modernization Committee, Aerospace Industries Association, "Keeping the Productivity Promise: IMIP," January 1991.

18. Interviews between Warmington, J., CDR, United States Navy, Naval Postgraduate School, and the researcher, Fall 1992.

19. Alberts, W.W., "The Experience Curve Doctrine Reconsidered,"Journal of Marketing, pp 36-49, Vol. 33, July 1989.

20. Morrison, David C., "Base Concerns," Government Executive, August 1992.

21. United States Navy, Navy Acquisition Procedures Supplement (NAPS), Government Printing Office, Washington, D.C.

22. Miller, P.E., "TQM in America: A Perspective on What's Wrong," MCMA Sacramento/Gold Rush Chapter, 24 January 1991.

23. Anderlohr, G., "What Production Breaks Cost," Industrial Engineering, pp. 34-36, September 1969.

24. Gossett, J.L., Variations Intercepting Experience, Army Missile Command, pp. 1-18, January 1971.

25. Bernstein, P., "The Learning Curve at Volvo," Columbia Journal of World Business, pp. 87-93, Winter, 1988.

26. Burns, J.R., A Comparison of Two Methods of Predicting Loss of Learning due to a Break in Production, Master's Thesis, Texas A&M University, College Station, TX, March 1976.

27. Carlson J.G., and Rowe, Alan J., "How Much Does Forgetting Cost?" Industrial Engineering, Vol. 8, pp 40-47, September 1976.

28. Cochran, E.B., "A Generalized Approach to the Improvement Curve," Paper presented at 9th Annual DoD/FAI Acquisition Research Symposium, 9-11 January 1980.

29. Dobler, D.W., Burt D.N., Lee, L., Purchasing and Materials Management: Text and Cases, 5th ed., McGraw Hill, U.S.A., 1990.

30. Everest, J.D., Measuring Loses of Learning Due to Breaks in Production, Masters Thesis, Naval Postgraduate School, December 1988.

31. Pichon, A.A., Richardson C.L., The Development of a Predictive Model for First Unit Costs Following Breaks in Production, Master's Thesis, Air Force Institute of Technology, Air University, Wright Patterson AFB, Ohio, August 1974.

32. Smith, J., Learning Curve for Cost Control, Norcross GA: Institute of Industrial Engineers, 1989.

33. Weis, N.A., Hassett M.J., Introduction Statistics, Addison-Westly, U.S.A., 1991.

34. Fauver, P.H., Nakasome and the U.S.-Japanese Trade Balance: Policy and Perceptions, Washington: National Defense University, May 1987.

35. Gottlieb, D.W., "Japanese as Suppliers/Customers," Purchasing, Vol. 110/NO.7, 18 April 1991.

36. Director of Defense Research & Engineering, Defense Science and Technology Strategy, July 1992.

37. "Maintaining the Defense Industrial Base," National Defense, July/August 1991.

38. Place, C.E.,"International Subcontracting: Vive La Difference!" Contract Management, Vol.30, October 1991.

39. Robertson, J., "Semiconductor Material Witness" Chiltons Electronic News, V.37, NO. 1863, 10 January 1991.

40. Sherman, S., Government Procurement Management, Wordcrafters Publications, Germantown, 1991.

41. Shoven J.B., Government Policy Towards Industry in the United States and Japan, Cambridge University Press, Cambridge 1988.

42. Slade, Kenneth H.,"Beware of Traps for the Unwary: International Contracting in the Pacific Rim," Contract Management, V. 31, October 1991.

43. U.S. Foreign Trade Highlights 1990, Department of Commerce: International Trade Administration, April 1991.

44. Vauter, Roderick L. U.S. Industrial Base Dependence/Vulnerability, Phase I - Survey of Literature, Washington: National Defense University, 1986.

45. Zimmerman, M.A., How to do Business with The Japanese, New York: Random House, 1989.

46. Arroyo, S.A., "Contracting and Purchasing Management in the International Marketplace, "Master's Thesis, Air Force Institute of Technology, Wright-Patterson AFB, OH, September, 1989.

47. Director of Defense Research & Engineering, DoD Key Technologies Plan, July 1992.

48. Naval Air Systems Command, NavAir Efforts to Employ a Streamlined IMIP, Government Printing Office.

49. Air Force Systems Command, "IMIP and the Air Force Industrial Base Program," Wright-Patterson AFB OH.

50. Structure of U. S. Defense Industrial Base Panel of the Committee on Armed Services House of Representatives, 102nd Congress Federal Register "Future Of the Defense Industrial Base," U.S. Government Printing Office, Washington D.C., 7 April 1992.

51. Defense Sysyems Management College, "Defense Procurement Industrial Base Study: Why Firms are Leaving the Defense Market," 5 December 1990.

52. Assistant Secretary of the Army (RD&A), "Shaping The Defense Industrial Base of the Future," Draft working paper, Presented at NCMA Seminar of 6 November 1992.

53. Telephone conversations between Wilson, R. LT, USN, Naval Air Systems Command, Washington, DC, and the researcher, Summer, 1992.

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