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The Industrial Base and National Security A New Strategy

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Lieutenant Colonel
Garry C. Varney
U.S. Air Force

Faculty Research Advisor
Colonel Herman A. Peguese, USAF

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The Industrial College of the Armed Forces
National Defense University
Fort McNair, Washington, D.C. 20319-6000

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**THE INDUSTRIAL BASE AND NATIONAL SECURITY: A NEW
STRATEGY**

Lt Col Garry C. Varney

ABSTRACT

There is a direct and clear link between industrial base capability and U.S. national security. The weapon systems of the 21st century will require complex manufacturing processes and advanced production equipment. Without a flexible and responsive manufacturing base, the U.S. will not have the means to produce the weapons required for our national security. In the face of a declining defense industrial base and budget reductions, there is concern that the capital and human resources will not be available to meet this future challenge.

In order to ensure that the necessary capital and human resources are available, this research paper champions a new pro-active government/industry partnership for a defense industrial productivity strategy. This partnership supplants the outdated laissez-faire strategy of the previous administrations. It builds on the philosophy of the Air Force's Industrial Modernization Program (IMIP) and focuses on the areas of education, research and development and capital investment to address the productivity issues facing the defense industrial base in the 21st century.

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National Defense University
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CHAPTER 1

A NEW ROLE FOR GOVERNMENT

INTRODUCTION

Education, research and development, capital investment -- these terms are inescapable in today's society. Why? It is because Americans are realizing a decline in their standard of living due to a relative decline in productivity over the last several decades. The American people watched as two market competitors, Japan and Western Europe, captured significant shares of the world's markets -- shares once dominated by American industries. It is no surprise that the 1989 MIT Commission on Industrial Productivity states in the first paragraph of its report:

To live well, a nation must produce well....observers have charged that American industry is not producing as well as it ought to produce...used to produce, or as well as the industries of some other nations have learned to produce....sooner or later the American standard of living must pay the penalty.(5:1)

THESIS

There is a direct and clear link between industrial base capability and U.S. national security.

The weapon systems of the 21st century will require complex manufacturing processes and

advanced production equipment. Without a flexible and responsive manufacturing base, the U.S. will not have the means to produce the weapons required for our national security. In the face of a declining defense industrial base and budget reductions, the U.S. government must reverse its "laissez-faire" approach towards industry. Specifically, government and industry must form a partnership in the areas of education, research and development, and capital investment to establish the institutional and organizational means to remain a "manufacturing superpower."

BACKGROUND

EDUCATION. The federal government has not been an active partner in the educational process for either manufacturing engineering degrees or blue collar training programs. According to Michael E. Thomas, Executive Vice President of Georgia Institute of Technology:

...most of the Federal Government research activities that have been directed toward universities have been directed primarily to basic research....money in the DoD budget that is devoted toward proof of concept...typically has not been spent at universities. (15:230)

State governments have initiated pilot programs in this area. One example is the Georgia Tech Manufacturing Research Center funded by the State of Georgia at a cost of \$15 million. (15:230)

Industry is a more active partner with colleges and universities funding a broad range of research activities. Mr Thomas provides two examples of industry participation:

the computer integrated manufacturing systems program...resulted from a \$4 million grant from IBM, plus continuing support from a number of industrial firms...Four companies have provided \$1 million each to support research activities...targeted toward electronics manufacturing. (15:230)

RESEARCH AND DEVELOPMENT (R&D). The federal government has been most active in supporting R&D activities in manufacturing technology. One highly publicized adventure is SEMATECH, a joint government/industry effort to develop advanced manufacturing processes for semiconductor manufacturing. The Defense Advanced Research Projects Agency (DARPA) concentrates heavily in the area of semiconductor manufacturing technology, not only with its investment in SEMATECH, but also through a much broader program of semiconductor production technology. DARPA also formed a partnership with the Defense Manufacturing Board, a panel of industrial experts, to review investment opportunities for advancement of production technology. (14:201) Another federal government program, the DoD's MANTECH program, invests in the development of advanced technology for defense applications such as composite material manufacturing. Many successes have resulted from these government programs.

Industry, on the other hand, historically funnels their internal R&D budgets toward product development not manufacturing technology development. They primarily rely on the machine tool industry to develop the necessary manufacturing processes for their products.

CAPITAL INVESTMENT. No matter how much education or R&D a nation funds, if industry does not invest in advanced manufacturing processes and integrate them onto their factory floors, our productivity relative to competing nations will suffer. It is in capital investment that the federal government takes its most laizze-faire approach. Today, the federal government sponsors no specific program providing incentives to industry to invest in capital

equipment. Industry is at the mercy of market forces, i.e., sales and interest rate fluctuations in making long-term investment decisions. Due to vacillating sales, more lucrative alternative investment opportunities (not necessarily productivity enhancing), and short-term investment criteria, industry's capital investment levels have been deplorably low over the last decade.

This laissez-faire approach is inappropriate, especially for the defense industry, for several reasons:

- "defense" market forces and government contracting policies do not provide the incentives for capital investment or productivity growth
- without manufacturing innovation industry will not be able to produce the weapon systems of the 21st century
- production disadvantages can negate any technical advantage in weapon system design

REPORT OVERVIEW

This report champions a new vision for an industrial productivity strategy -- an interactive strategy based on the educational, R&D, and capital investment needs of the defense industrial base for the 21st century. Specifically, this report will:

- review the history of productivity investment in the defense industrial sector
- review the Industrial Modernization Incentives Program (IMIP) concept and critically analyze the program's effectiveness
- review the lessons learned of the past decade and offer recommendations for a new interactive industrial base strategy involving education, R&D, and investment reforms.

CHAPTER 2

THE DIRE HISTORY OF CAPITAL INVESTMENTS

EARLY 80'S

The Air Force, the Office of the Secretary of Defense, and the nation as a whole have been concerned about the health of the industrial base for over a decade. Specifically, this concern has been focused on low productivity, old plant and equipment, and low levels of capital investment within the defense industry. There are several reasons for concern:

- these problems are major contributors to rapidly increasing weapon system procurement costs
- they directly affect the growing acquisition lead times
- they inhibit industry's ability to manufacture the increasingly advanced designs using exotic materials (8:1)

In 1980, a comprehensive study on the defense industrial base was conducted by the Defense Industrial Base Panel of the House Armed Services Committee. Its final report, known as the Ichord Report, painted a gloomy picture about the state of the industry. Two specific findings of the report stated:

- productivity growth rates for the manufacturing sector of the U.S. economy are the lowest among all free world industrialized nations; the productivity growth rate of the defense sector is lower than the overall manufacturing sector; and
- the means for capital investment in new technology, facilities and machinery have been constrained by inflation, unfavorable tax policies, and management priorities (12:11)

Captain Richard Heffner and Major John Weimer, in their 1983 masters thesis, painted a vivid picture of the defense industry's health, citing work by Mr Jacques Gansler and the Ichord Report:

The relatively low level of investment in plant and equipment modernization is one of the most striking features of the current U.S. defense industry. During the 1970s, the U.S. aerospace industry invested only 2 percent of sales in new capital, while the average rate of investment for all U.S. industry was approximately 8 percent, and the average rate for all U.S. manufacturing was 4 percent of sales. The lack of investment has resulted in: 60 percent of the metal working equipment used on defense contracts being over twenty years old, the technology base in the industry declining by approximately 50 percent, and the cost per aircraft increasing by roughly 10,000 percent over the past thirty-five years. (8:2)

LAST FIVE YEARS

In opening statements at a 1987 hearing on manufacturing capabilities, Senator Jeff Bingaman, Chairman of the Senate Armed Services Subcommittee on Defense Industry and Technology,

stated:

The central thread running through the hearings...was that the underpinnings of defense, that is the industrial base and the technology base, are deteriorating....Since innovation in those industries which produce the building blocks for our weapon systems is critical to our long-term ability to maintain a qualitative advantage...we need to focus attention on the problems...and try to come up with constructive solutions to them. (13:1)

Two years later, Dr. James Blackwell, Deputy Director Political-Military Studies at The Center for Strategic and International Studies, testifying before the same Senate subcommittee said:

The defense sectors performed worse than U.S. manufacturing overall and, contrary to the rest of the base, capital spending in defense sectors actually declined, falling from a sectorial average of 3.9 percent in 1980 to 3.6 percent in 1985. (14:348)

Yet, no matter how convincing these reports and speeches, they, like the MIT Commission Report, do nothing for industrial productivity unless someone implements action. The Air Force chose to act.

AIR FORCE RESPONSE

In 1978, the United States Air Force formed a partnership with industry to combat the declining productivity of the aerospace industrial base. Over the next decade, this partnership, called the Industrial Modernization Incentives Program (IMIP), grew to significant proportions both in terms of dollars invested and weapon systems cost savings realized. Its impact was so great that, by 1983, it was expanded to encompass the entire defense industrial base.

The program's stated objective was as follows:

Create a top-level partnership between the government and industry to reduce weapon system, subsystem, or equipment acquisition costs; and to accelerate the implementation of productivity enhancing equipment and management techniques

in the industrial base. (3:1)

The Air Force selected two fundamental concepts as the foundation for its productivity enhancement efforts:

- contracting for productivity
- technology modernization

These efforts were designed to overcome two problems cited most frequently as inhibiting modernization in the defense sector.

- program uncertainties - a risk that hinders investment amortization and long-term planning.
- cost-based profit policy - a policy that negates long-term benefits for contractors who modernize.

This IMIP program was implemented on the various major weapon system production contracts. The following chapter details the IMIP mechanics as implemented by the F-16 System Program Office.

CHAPTER 3

IMIP: AN HISTORIC PERSPECTIVE

THE AIR FORCE EXPERIENCE

IMIP's beginnings can be traced back to the late '70s with the first production contract for the F-16 multi-role fighter. What ensued was a program strategy which was unique, innovative, and more importantly successful. The strategy involved a partnership between General Dynamics (GD) and the Air Force to share the risk of "contracting for productivity." The Air Force called this program Technology Modernization or Tech Mod for short.

TECH MOD

The focus of this program was on productivity growth: capital investment and technology. The

goal was to reduce direct assembly line labor costs and supporting indirect costs at the prime contractor's (GD's) facility.

Defense industry (GD included) understood the relationship between capital investment and productivity growth; yet, there was tremendous reluctance to invest in a cost reduction program.

Why? Industry cited two primary reasons:

- **Maximizing return on invested capital.** Return on investment has long been a yardstick in measuring where a corporation spends its money. Corporations set standards for return in terms of percent of investment and time - called corporate "hurdle rates." For example, a typical corporate hurdle rate in 1980 would have been a 20% return with a maximum 3 year payback. Investment in technology and capital equipment requires large sums of capital up-front (short term) with productivity gains typically in the long term (See Chart 1). With emphasis on quick returns, investments in manufacturing technology and equipment could not compete with alternative investments. This was especially true in the late '70s and early '80s when interest rates were around 20%.

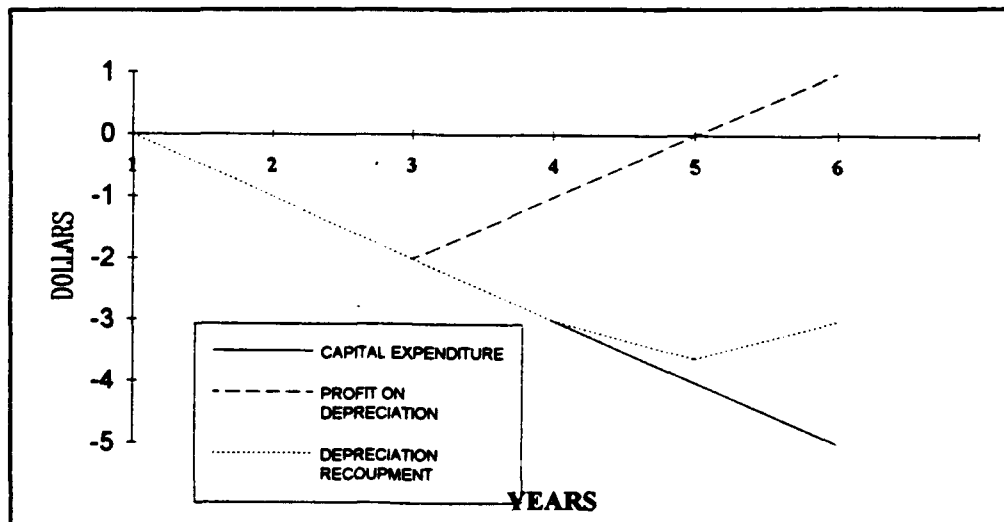


CHART 1: CAPITAL FACILITIES INVESTMENT RECOVERY (6:28)

- **DoD Contracting Practices.** Two practices in particular served to hinder cost reduction investments: annual year and cost-based contracting.

Since investment returns accrue over the long term, the viability of the investment requires a fairly long and stable production base. With the exception of multi-year cancellation protection, the government does not guarantee any production base.

Under DoD pricing policies, all cost reductions beyond the immediate contract would accrue to the Air Force. Under the Truth in Negotiation Act, contractors must report its most current and accurate costs in proposal submissions -- this includes cost avoidances due to productivity gains through capital investments. In addition, since profits are based on costs, any cost reductions would translate into a lower profit return in terms of actual dollars.

TECH MOD SOLUTIONS TO INVESTMENT BARRIERS

The appeal of Tech Mod was its ability to counter the two primary barriers to cost reduction investment initiatives. Specifically, the solutions were as follows:

- A multi-phased manufacturing technology development program (Chart 2) was initiated in partnership between the Air Force Wright Aeronautical Materials Laboratory, the F-16 System Program Office, and GD. The purpose of this program was to identify, develop, financially analyze, and implement on the factory floor enabling technologies that were shown to result in significant F-16 program savings. The government agreed to share up-front technology development investment (Phases I and II) with a guarantee

that the contractor would invest in the capital equipment to implement the technology (Phase III). This served two purposes:

- it minimized the contractor's up-front capital investment enhancing its return on investment rates
- it shared the inherent risks in manufacturing technology development process.
- The government agreed to help the contractor in meeting its return on investment hurdle rates by sharing the future cost reductions.
- The government agreed to termination protection for the contractor's investment in capital equipment.

PHASE I	PHASE II	PHASE III
CONDUCT TOP-DOWN FACTORY ANALYSIS	DESIGN AND VALIDATE: FACTORY DESIGN	IMPLEMENT MANUFACTURING TECHNOLOGIES
DESIGN CONCEPTUAL FACTORY	MANUFACTURING TECHNOLOGIES	ACQUIRE/INSTALL CAPITAL EQUIPMENT
ESTABLISH PRIORITIES	FINANCIAL PAYBACK CRITERIA	

CHART 2: A MULTI-PHASED DEVELOPMENT EFFORT

To the government acquisition world, IMIP was radical. It was the first time that industry and government formed a partnership to integrate an advanced manufacturing technology development program. The concept was straightforward:

- the government would provide the seed money to develop manufacturing technology
- the contractor would provide the capital to bring the productivity gains to fruition
- the government and contractor would share in the savings or cost avoidance on future production programs.

The success of the F-16 Tech Mod program was tremendous. The following data gives evidence of this success:

- Twenty-three enabling technologies were implemented on capital investments of over \$187 million
- Man-hour savings were estimated to exceed \$500 million through 1991
- Total airplane learning achieved an 86% slope beyond aircraft 400. No other aircraft program has been able to sustain such a performance over an extended period (6.6,25)

The program proved such a success that, in 1980, the government and GD extended the program to the F-16 subcontractor base. The objective of this subcontractor based program was much the same as the GD program: develop a partnership between the prime contractor (GD) and the F-16 sub-tier base to reduce the risk of technology development and capital investment -- all for the purpose of reducing weapon system costs. Chart 3 lists the results to date of this subcontractor program.

At the height of the IMIP, the Air Force had over 60 contractors involved. Combined resources committed included over \$530 million for the Air Force and over \$1.3 billion for industry with a total estimated cost savings exceeding \$4.5 billion. (14:338)

TOTAL PARTICIPATING SUBCONTRACTORS	64
TOTAL PROJECTS	250
PROJECTS IMPLEMENTED	94
TOTAL CURRENT SAVINGS	
F-16	\$ 41,000,000
OTHER DoD	\$362,000,000
COMMERCIAL	\$162,000,000
TOTAL PROJECTED SAVINGS	
F-16	\$ 81,000,000
OTHER DoD	\$804,000,000
COMMERCIAL	\$343,000,000
INVESTMENT	
AIR FORCE	\$ 87,200,000
SUBCONTRACTOR	\$520,000,000

CHART 3: F-16 SUBCONTRACTOR STATISTICS (7:1)

You could conclude from these results that IMIP supported DoD goals. However, in October, 1992, Mr Atwood, Deputy Secretary of Defense, with no stated rationale elected to terminate the IMIP program. The speculative reason is that the DoD simply does not want to participate in any industrial base program aimed at enhancing the productivity of individual defense contractors even though significant benefits could be derived for both parties.

CHAPTER 4

IMIP ANALYSIS

Many organizations have analyzed the effectiveness of the IMIP program. This chapter will review three such analyses and provide personal observations from my experience with the program.

OSD REVIEW

In 1982, Deputy Secretary of Defense Carlucci initiated a review of the Air Force's Tech Mod program for DoD-wide implementation. The test was monitored by a steering group composed of flag or equivalent rank officers for each of the military services, the Office of the Secretary of Defense, Defense Logistics Agency, Defense Contract Audit Agency, and the National Aeronautics and Space Administration. (7:1-2)

Mr Carlucci charged the steering group to review alternative contractual approaches to implementing IMIP, to develop financial analysis tools, and to address a multitude of technical issues.

RESULTS

In 1985, after a two and one half year test program, Rear Admiral Sansone, Chairman of the DoD Tri-Service Steering Group, wrote the following to the Deputy Under Secretary of Defense

(Acquisition Management), "...the IMIP test has been completed and the unanimous view is that the program is an astounding success." (4:1)

Notwithstanding this glowing appraisal, the Steering Group did raise several issues:

- implementation at the subcontractor level is very complex since savings and incentives could flow over many programs. The contractual arrangement would have to involve numerous program offices and prime contractors
- validating cost savings could prove to be costly and time consuming if it could be accurately done at all. Validation of cost savings would usually involve developing an automated cost tracking system that compares "before" and "after" cost of changed manufacturing processes. It becomes more difficult if indirect costs are involved
- IMIP should focus on the defense marketplace where price competition is not a factor. It was felt that price competition is adequate to motivate cost-reducing investments without any additional incentives (10:3-3,3-5)

DoD IG REVIEW

On 8 September 1989, the DoD IG issued an audit report entitled, "The DoD Industrial Modernization Incentives Program." The one year audit was to determine whether the program was effective in reducing system acquisition costs and improving the defense industrial base.(2:i)

Specific audit objectives included:

- whether DoD components have effectively implemented the program
- whether the basis for sharing industrial modernization savings with defense contractors was reasonable
- whether projected program savings were actually achieved (2:2)

RESULTS

Mr Steven A. Trodden, Assistant Inspector General for Auditing, wrote the following in his letter to the Under Secretary of Defense for Acquisition, "Overall, we could not verify the claimed projected reductions in weapon system costs for the Program, but the Program helped modernize a small portion of the Defense industrial base." (2:i)

The IG had two major findings:

- limited OSD management oversight hindered program effectiveness
- inadequate savings validation procedures hindered verification of program savings (2.7.13)

The OSD oversight finding was basically an administrative finding due to a lack of program data (such as savings achieved, projected savings, incentives paid, etc.). The second finding, however, was more substantial and parallels the OSD and later the Air Force's findings in 1985 and 1991, respectively.

AIR FORCE PROCESS ACTION TEAM REVIEW

In October 1990, Air Force Systems Command established an IMIP process action team (PAT). According to the Deputy Chief of Staff for Engineering and Technical Management, "Although IMIP had been successful, there was concern, both within the Air Force and industry, that IMIP had not achieved its full potential." (1:1) Therefore, the PAT was chartered to assess the status of IMIP and provide the most meaningful recommendations for change. (1:1)

The final report, which was approved in the summer of '91, identified several strengths and weaknesses of the program:

- **Strengths**

- IMIP clearly brought technology and capital investment to the defense industrial base
- IMIP created a culture in which government and industry sought better ways to do things (1:3-4)

- **Weaknesses**

- Process is too lengthy and complex
- Inadequate savings validation procedures
- Commitment and resources limited performance
- Low priority in the acquisition process (1:3-1)

PERSONAL OBSERVATIONS

IMIP was successful for three reasons:

- Air Force and industry leaders supported the innovative ideas that broke from traditional contracting paradigms and resisted the functional bureaucracies who did not like government supported programs interfering in private sector decisions
- productivity decline was a priority on the President's domestic agenda. Any creative solution that enhanced productivity on the factory floor was supported by the military leadership

and realized success in the budgetary process. Simultaneously, the Reagan build-up increased the number of systems in production. These two events, funding and business base, created an environment for capital investment and allowed IMIP to claim huge savings

- IMIP was able to influence both the prime and sub-tier base. Significant benefits could only be achieved if the second and third-tier contractors were allowed to enhance their productivity through this capital investment incentives program

IMIP was based on a win/win philosophy which was starkly different from the traditional adverse environment of contract negotiations. It also broke down functional barriers within industry that hindered change -- especially change on the factory floor. The concept of a total top-down factory analysis was, if not new, an under utilized planning tool for industry. Not only was management blind to their inefficiencies, few had plans for factory modernization as part of a strategic vision. Typically, the manufacturing engineering department was physically and organizationally separate from production operations. Production's focus was on meeting delivery dates with a product -- they had no time for factory analysis planning much less downtime to install, debug, and train for new manufacturing technology. IMIP forced the marriage between these two vital functions and created an atmosphere where the technologists and production managers could mutually support the others goals.

In the end, the very thing that sold the program -- savings -- quickened its demise. The government proved to be just as short-term minded as the industry it was trying to resuscitate.

The government's total focus, as evidenced by the IG and other findings, was on returns and payback periods. This unfortunate shortsightedness missed the value of IMIP. The government is not a profit generating entity; therefore, the focus should have been on industrial productivity, capacity and capability. The government should be more concerned with industry's ability to produce affordable, reliable weapon systems rather than on savings validation.

CHAPTER 5

LESSONS LEARNED

After a decade of focus on productivity growth and capital investment, programs such as IMIP and industry's experiences with implementation of production technology offer excellent lessons from which to create policies for the future. This chapter will reach conclusions to these lessons learned focusing on education, R&D, and investment deficiencies.

EDUCATION

A theme resonating throughout industry is that human resources are the critical link to extracting maximum benefit from manufacturing innovation. Story after story is told about how a capital investment will not be utilized at peak capacity until workers are trained on how to use it.

Ms Marcie Tyre, an assistant professor at MIT's Management of Technology Group, addresses this issue in her article entitled, "Managing Innovation on the Factory Floor":

Manufacturing managers often buy the most advanced equipment and systems but then fail to integrate them fully into production. Unsolved problems can persist for years, hindering quality improvement, product delivery, and factory efficiency....Trouble-shooting new technologies often requires expertise--say, in electronics, software, and systems integration--that is not available in the factory. (11:59,65)

In Japan, a different picture emerges. Their factories are staffed with the best and brightest manufacturing engineers. Their blue collar workers are graduates of technical schools and receive extensive on-going training throughout their careers. As a managing director of one Japanese company said, "if you are going to have flexible manufacturing, you have got to have flexible people." (13,8)

The IMIP program was deficient in the area of workforce education for a couple of reasons. First, the program originators and implementors were "transfixed" on the hardware solution. This was acceptable in that the hardware solution reaped huge productivity gains; however, a more flexible workforce could have optimized these gains. Take the example of where a new technology is moved from the lab to the factory floor. In many instances, the introduction of new equipment actually reduced productivity for that specific operation until the production workers were trained in its application. All too often, during the development and test phases the manufacturing engineers worked in a separate and isolated environment from the production management and workers. New technologies were tested and blessed without the benefit of the eventual operators' input. This lack of communication and teamwork hindered implementation creating additional cost. This additional cash outflow negatively impacted the cash flow analysis which in turn decreased the return on investment and increased the payback period.

Second, workforce education was viewed as a liability in an accounting sense with no offsetting measured benefit. Because of industry's and government's short-term perspective regarding capital investments, the traditional cost-benefit analysis could never justify spending (either

corporate or government money) on worker education without a quantifiable savings verification associated with a specific product or government contract. Our ability to quantify educational savings is elementary at best and neither party would have been willing to recognize savings cash flows from an otherwise subjective source.

RESEARCH AND DEVELOPMENT

Traditionally, our focus in the R&D area has been on product technology development. Very few resources are allotted to manufacturing R&D. A notable exception is the DoD's MANTECH program whose annual budgets vary between \$175-\$200M.^(14:337) As a result, as new technologies emerge such as composite materials, for example, the manufacturing capability to produce composite structures are limited.

Japan, on the other hand, views manufacturing technology R&D as co-equal with product R&D.

According to Dr Kelly, Special Assistant to the Director of DARPA:

...the Japanese view that manufacturing is a strategic factor which is as important in achieving competitive advantage as product design or marketing. They spend a tremendous amount of money in manufacturing technology and research.

In several companies, we received estimates that they spend about 40 percent of their internal research and development on manufacturing technology, as opposed to product improvement. ^(13:5)

IMIP, rightfully so, divorced itself from the R&D activities of manufacturing technology and focused strictly on the implementation of proven technology. This strategy was achievable because of healthy R&D programs such as MANTECH and independent commercial initiatives.

Without the R&D base, IMIP would not have been as successful because the likelihood of advanced technologies being available for immediate implementation would have been minimal. IMIP, therefore, would have been forced into a lengthy R&D phase costing up-front capital, delayed implementation, and unacceptable returns on investments. This separation of manufacturing technology R&D and implementation was key in IMIP's success because it allowed IMIP implementors to focus on factory designs and manufacturing technologies to optimize factory productivity.

The weak link in a MANTECH-IMIP strategy is the level of R&D funding provided to MANTECH and therefore the diversity of manufacturing research the government can sponsor. Absent government funded research on specific technologies through MANTECH, the defense industry must rely on the machine tool manufacturers for process technology. A less efficient approach would be for the defense industry itself to engage in its own independent or joint process technology R&D as an adjunct to their IR&D program. In order for this to occur, the government would have to allow for 100% cost recoupment for those manufacturing R&D projects that are or can be applied to defense products. Absent this avenue for cost recoupment, most defense industry contractors could not justify the up-front capital expenditure.

CAPITAL INVESTMENT

Capital equipment investment is where the "rubber meets the road." Unfortunately, there are a series of financial disincentives peculiar to the defense industry that hinder private investment in advanced manufacturing equipment. Chapter 3 talks to most of them. Mr Bernard L.

Schwartz, Chairman of the Board and Chief Executive Officer of The Loral Corporation, adds:

...changes should be made in the U.S. tax laws to actively encourage private investment in defense companies. The single most important change would be to foster the availability of low-cost capital by eliminating the capital gains tax or by deferring taxes on realized profits which are then reinvested in emerging high-tech companies. (15:8)

Mr Kelly, in his testimony to the Senate Subcommittee on Defense Industry and Technology, stated that the Japanese, "... incrementally and routinely improve their manufacturing facilities, and in doing this are facilitated by access to low-cost capital and by long-term market share focus."(13:5)

IMIP was specifically designed to address this area for the defense industry. Even though very successful in the environment of the Reagan build-up, the tools developed by IMIP will not necessarily work in the Clinton draw-down. IMIP was designed to work through traditional business economics. It assumed a stable production base and availability of new technology. It attacked the primary economic problems of the '80s -- high cost of capital and competitive returns on capital investments. The environment of the '90s and beyond offers a different challenge. Instead of high cost of capital being the problem, it is the lack of any substantive, stable production base that discourages capital investments. Without a production base, no incentive program based on traditional business economics will work. If programs like IMIP are to be successful in the future, new investment criteria must be developed.

CHAPTER 6

A NEW STRATEGY

IMIP was and still is a logical solution to a portion of the industrial base ills -- implementation of capital investment on the factory floor where a stable production base exists. Unfortunately, IMIP by itself is not enough to meet the new challenges of the '90s and beyond. What is missing is the synergy effect of integrating programs such as IMIP with educational and R&D initiatives. This chapter will define a strategic vision that is an interactive and integrated approach. This vision coordinates funding for manufacturing engineering education, manufacturing technology R&D, and capital investment incentive programs creating a synergy for maximum results.

EDUCATION

Funding for human resources is the key to a successful industrial base. Education should underlie everything we do. I offer the following recommendations as part of a joint government/industry initiative:

GOVERNMENT

- Elevate the prestige of a manufacturing career by offering special tuition assistance to our best and brightest students entering into a manufacturing engineering curriculum
- Offer special grants to universities to establish programs in the various manufacturing disciplines both at the undergraduate and graduate degree levels
- Identify the critical industry sectors for national security and actively participate in establishing "learning factories" for each sector to be operated by joint university and industry teaching teams
- Provide special funding for the broadening of student co-op programs where students go to work in industry and alternate periods in industry with periods in the universities

INDUSTRY

- Participate in funding the various scholarship and technical degree programs mentioned above
- Participate in "learning factories" by providing trained manufacturing engineering experts to supplement university teaching teams
- Establish extensive on and off the job training programs for employees to train in the operation of advanced technology machines and/or processes
- Create a teamwork environment within the factory allowing process operators, i.e., factory workers to work side by side with the manufacturing engineers to identify process inefficiencies and to work process improvements

RESEARCH AND DEVELOPMENT

GOVERNMENT

- Increase annual appropriations for the DARPA and MANTECH programs
- Support institutions such as the National Center for Manufacturing Science and expand DoD's role in them
- Offer tax incentives to industry for R&D investment in both product and manufacturing technology
- Modify the anti-trust laws to allow for lenient exemptions for consortium R&D activity in manufacturing technology
- Change the IR&D recovery rules to allow 100% cost recoupment on government contracts for independent research in manufacturing technology

INDUSTRY

- Increase independent R&D investment in manufacturing technology
- Consolidate resources and reduce risk by forming industry consortiums to conduct primary research in manufacturing technology requirements

CAPITAL INVESTMENT

GOVERNMENT

- Revive and modify the IMIP program to focus on criteria which addresses the problem of the 90's -- a declining business base

- Work with the financial industry to provide low-cost government-backed loans to industry for capital investments
- Change current tax laws to allow for a 100% investment tax credit for capital equipment investments
- Change the current government accounting rules to allow for shorter depreciation schedules

INDUSTRY

- Fence a substantial portion of investment budgets for capital expenditures in advanced manufacturing technology
- Refocus current return on investment criteria to long-term health of the corporation vice short-term returns

CONCLUSION

To live well, a nation must produce well -- no truer words were ever written when it comes to the future security of this nation. We have the resources, technically and financially, to ensure that no enemy physically threatens our shores. However, to ensure that those resources are employed effectively, the federal government and industry must work in partnership to establish the institutional and organizational means in education, research and development, and capital investment to remain a "manufacturing superpower."

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